Deal School
Curriculum

Science
Curriculum Guide
Kindergarten

Deal School

Deal, New Jersey

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Board of Education

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Course Title: Kindergarten Science

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Unit Title	Weather
Length of Unit	3 weeks to Introduce and then ongoing throughout the year
Summary/Overview	***How does weather forecasting help to keep people safe?*** In this unit of study, students develop an understanding of patterns and variations

	in local weather and the use of weather forecasting to prepare for and respond to severe weather. The crosscutting concepts of *patterns*; *cause and effect*; *interdependence of science, engineering, and technology*; and *the influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *asking questions*, *analyzing and interpreting data*, and *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
K-ESS2-1	**Use and share observations of local weather conditions to describe patterns over time.**
K-ESS3-2	**Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.**
K-2-ETS1-1	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
Focus Standards	
ESS2.D	**Weather and Climate** • Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS2-1)
ESS3.B	**Natural Hazards** • Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)

ETS1.A	Defining and Delimiting an Engineering Problem • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) • Before beginning to design a solution, it is important to clearly understand the problem.

Learning Objectives
(Students will be able to...)

- Determine from organizing data the different types of weather (ex: sunny, rainy, windy snowy, cool or warm days).
- Determine from organizing data patterns based on different time of days. (ex: cooler in the morning vs. warmer during the afternoon).
- Identify the relative number of days of different types of weather conditions in a month.
- Identify the change in the relative temperature over the course of a day.
- Interpret data to describe the differences in relative temperature over the course of a day (e.g., between early morning and the afternoon, between one day and another) are directly related to the time of day.
- Interpret data to describe types of weather within different months.(ex: a month may have more rainy days vs. more hot days).
- Formulate questions about severe weather such as hurricanes and snowstorms.
- Plan safety in regards to severe weather.
- Determine questions on weather based on personal observations.
- Observe patterns related to local severe weather (e.g., certain types of severe weather happen more in certain places).
- Collect Information on weather patterns (e.g., some events are more likely in certain regions).
- Articulate that severe weather warnings are used to communicate predictions about severe weather.

Understandings (Students will understand or know...)	Essential Questions
● **Scientists look for patterns and order when making observations about the world.** ● **Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.** ● **Weather is the combination of sunlight, wind, snow, or rain and temperature**	1. *What types of patterns can be observed in local weather conditions?* 2. *How does weather forecasting help us to prepare for and respond to severe weather?*

in a particular region at a particular time. ● **People measure these conditions to describe and record the weather and to notice patterns over time.** ● **Events have causes that generate observable patterns.** ● **People encounter questions about the natural world every day.** ● **Some kinds of severe weather are more likely than others in a given region.** ● **Weather scientists forecast severe weather so that communities can prepare for and respond to these events.** ● **People depend on various technologies in their lives; human life would be very different without technology.** ● **Before beginning to design a solution, it is important to clearly understand the problem.** ● **Asking questions, making observations, and gathering information are helpful in thinking about problems.** ● **A situation that people want to change or create can be approached as a problem to be solved through engineering.**	

Assessment Evidence	
Formative Assessments ● Observe and use patterns in the natural world as evidence and to describe phenomena. ● Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. ● Use and share observations of local weather conditions to describe patterns over time. ● Examples of qualitative observations could include descriptions of the weather, such as	**Summative Assessments** ● Projects ● Labs Reports ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

sunny, cloudy, rainy, and warm. ● Examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. ● Examples of patterns could include that it is usually cooler in the morning than in the afternoon. ● Observe patterns in events generated by cause-and-effect relationships. ● Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. ● Ask questions based on observations to find more information about the designed world. ● Ask questions to obtain information about the purpose of weather forecasting to prepare for and respond to severe weather. (Emphasis is on local forms of severe weather.) ● Define a simple problem that can be solved through the development of a new or improved object or tool. ● Ask questions, make observations, and gather information about a situation people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool.	

Learning Activities

What it looks like in the classroom…

In this unit of study, students are expected to develop an understanding of patterns and variations in local weather and the use of weather forecasting to prepare for and respond to severe weather. Throughout the unit, students will look for patterns and cause-and-effect relationships as they observe and record weather events. Students will have opportunities to ask scientific questions, analyze and interpret data, and communicate their findings to others.

In this unit of study, students learn that problem situations can be solved through engineering, and that in order to design a solution, we must first define the problem. As described in the narrative above, students define problems caused by severe weather events by asking specific questions, making observations, and gathering information that will help them understand the types of problems they might face when severe weather conditions exist in and around their homes, schools, and communities.

In this unit's progression of learning, students first develop an understanding that patterns in the natural world can be observed and documented, and that, like scientists, they can use these patterns as evidence to describe phenomena and make predictions. In order to observe patterns in weather, kindergartners will learn that weather is the combination of sunlight, wind, precipitation, and temperature in a particular region at a particular time. By observing and recording daily weather events—such as sunny, cloudy, rainy, and windy— students can analyze both qualitative and quantitative data. Recording and analyzing data over time will reveal recognizable weather patterns that can be used to make predictions. Examples of weather patterns may include:

- Snow and colder temperatures generally occur in the winter.
- Clouds may bring rain or snow.
- Rain occurs more often in the spring.
- Warmer/hotter temperatures occur in the summer.
- It is generally cooler in the morning and warmer in the afternoon.

At this grade level, it is developmentally appropriate to describe temperature in relative terms; therefore, vocabulary words such as hot, warm, cool, cold, and warmer/cooler should be used to describe temperature, rather than accurately measuring and describing temperature in degrees Celsius.

Students also learn that weather events have causes that generate observable patterns over time, and that these patterns help weather scientists predict severe weather. Kindergarteners need opportunities to learn about severe weather, especially those types that tend to occur in the local region in which they live. By using a variety of media and technology, such as computers, radio, and television, and by reading grade-appropriate texts about weather and weather events, students can learn about types of severe weather that are common to their region. In addition, they come to understand that people depend on technology to help us predict and solve problems, and without it, our lives would be very different.

In order to apply their learning, students need opportunities to ask questions about weather forecasting and how it can help us prepare for and respond to different types of severe weather. When kindergartners ask questions, make observations, gather weather information, and look for patterns of change in the weather, it prepares them to think about how to best prepare for and respond to local severe weather. As part of this unit of study, students are challenged to investigate how people prepare for and solve problems caused by severe weather. With adult guidance, students should define weather problems by asking questions, making

observations, and gathering information about severe weather situations. Some questions students might want to consider include the following:

- What kinds of severe weather events tend to occur in New Jersey (e.g., thunderstorms, hurricanes, flooding, snowstorms)?
- What do people do in response to these types of severe weather events?
- What kinds of tools can people use to solve problems caused by severe weather conditions (e.g., umbrellas, sandbags, salt, gravel, shovels, snow blowers)?

- What other solutions might people use for problems caused by severe weather (e.g., closing schools and businesses; sending out emergency workers to restore utilities; sending out early warnings; stockpiling food, water, and other supplies; having a portable generator)?
- What kinds of problems would we face if we had a lot of rain in a short period of time?
- What problems might we have if our community experienced flooding?
- What kinds of problems might occur if strong winds caused damage (e.g., knocked over trees, damaged power lines, damaged homes and businesses)?
- What kinds of precautions do people take during a hurricane? A tornado? A Nor'easter? Why?

Example Activities

Watching Weather: Students will make their own weather station consisting of actual and simplified versions of real weather equipment. The weather station will consist of a thermometer and a student-made weather vane. They will use that equipment to make observations about the local weather.

Weather Patterns: This lesson is the first in a two-part series on the weather. The study of the weather in these early years is important because it can help students understand that some events in nature have a repeating pattern. It also is important for students to study the earth repeatedly because they take years to acquire the knowledge that they need to complete the picture. The full picture requires the introduction of such concepts as temperature, the water cycle, and other related concepts. In the second activity, What's the Season, students identify the seasonal patterns in temperature and precipitation.

Weather Walks: Students learn about weather by taking walks during various weather conditions over the course of time. Walks take place during sunny, rainy, windy, or snowy conditions. The lesson is divided into four sections with activities assigned to each of the weather conditions being observed. Suggested activities include appropriate investigations to help students observe and describe weather phenomenon through first hand experiences.

Science- Weather: This is a free interactive learning activity designed for individual students and can easily be used as a whole class interactive whiteboard activity. This particular title explores weather in relationship to season and temperature. Students learn to use a thermometer as a tool for recording temperature and identify the four seasons through measurable changes in the thermometer readings.

About the Weather: This lesson is about using local weather to make observations, measure, collect, and record data to describe patterns over time. Students will count types of outdoor clothing worn by classmates and use the data to look for patterns in weather over months and seasons.

Weather interactive activity: http://www.e-learningforkids.org/science/lesson/weather/

Disappearing Water: http://sciencenetlinks.com/lessons/water-2-disappearing-water/

Many Faces of Weather:
http://www.lpi.usra.edu/education/explore/discoverEarth/activities/Activity5_Packet.pdf

Rain Cloud demonstration: http://onelittleproject.com/shaving-cream-rain-clouds/

Meteorologists - (youtube videos, rubric for weather report)

- WHOLE GROUP - Discuss how we find out what to wear everyday.
- What can we watch? What can we listen to?
- Introduce the term meteorologist. Watch a clip on weather forecast.
- Ask students what they think a meteorologist does and what they need.
- Read "How Can You Measure Rain and Wind?"
- Create a chart to compare - Instrument VS. What It Tells You
- Show children a large thermometer, water gauge and wind vane.
- Discuss the job of each tool.
- Independently - Begin weather tools book.

Windsocks

Day 1

Teacher reads "Spring, Summer, Fall, Winter" by Benjamin Linus.

Class creates anchor chart about the characteristics of each season. (describing words)

Students think of the reasons why they like each season.

Students will complete each sentence.

"I like fall because..."

"I like winter because..."

"I like spring because..."

"I like summer because..."

Day 2

Students will use their sentences from Day 1 to illustrate on each on their windsock.

Students will assemble windsock.

Class will go outside to fly their windsock.

Students will discuss reasons why their windsock did not fly and ways to change what they did. Students will discuss successes of why their windsock flew to help others.

Water Cycle

Whole Group - Create a word web of "A Rainy Day". Use describing words.

Discuss the water cycle (show illustration from "A Rainy Day") Explain how the water cycle continues in a circle.

Sing water cycle song. (Tune to She Will be Coming Around the Mountain)

"Water travels in a circle, yes it does.

Water travels in a circle, yes it does.

It go up as evaporation,

forms a cloud condensation,

and comes down as precipitation

Yes it does!"

Show students finger gestures.

Independently students will create water cycle bracelets.

Light blue bead - puddle

yellow bead - sun

clear bead - evaporation

white bead - cloud - condensation

dark blue bead - rain- precipitation

Students will sing song again using beads as visual.

Students will independently cut and paste to label the water cycle correctly using song and water cycle bracelet as a guide.

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

With adult support, students use trade books (read-alouds, big books) to learn about and discuss severe weather. Strategies, such as Think-Pair-Share, can be used to encourage students to think about information from books and to use that information to ask and answer questions about key details. With guidance, students use online media resources to view examples of severe weather. They can ask questions in order to understand how severe weather affects people and communities and to determine how communities prepare for and respond to severe weather.

- Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-ESS2-1) W.K.7
- With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2) RI.K.1
- Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2) SL.K.3
- Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1) RI.2.1
- With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1) W.2.6
- Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1) W.2.8

Mathematics

With adult support, students measure and record various types of weather (e.g., rainfall or snow amounts, relative temperature at different times of the day and over a period of time). They mathematically represent real-world information by organizing their data into simple weather charts and graphs. Kindergarteners attend to the meaning of various quantities using a variety of units of measure and use counting to analyze data and determine patterns in charts and graphs. By using media resources, students explore how weather scientists represent real-world weather data with picture representations, charts, and graphs. They can use this information to think about how weather scientists use tools to collect and record weather data in order to determine patterns of change. Students will attend to the meaning of various quantities used in simple weather charts and graphs, both from classroom observations and from media sources, by counting and comparing severe weather data with daily weather data (e.g., relative amounts of rainfall, snowfall). By analyzing data from weather graphs and charts, young students begin to understand how severe weather affects people and communities and that weather scientists play an important role in predicting severe weather conditions.

- Reason abstractly and quantitatively. (K-ESS2-1),(K-2-ETS1-1) MP.2
- Model with mathematics. (K-ESS2-1),(K-ESS3-2),(K-2-ETS1-1) MP.4
- Use appropriate tools strategically. (K-2-ETS1-1) MP.5
- Counting and Cardinality (K-ESS3-2) K.CC

- Know number names and the count sequence. (K-ESS2-1) K.CC.A
- Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1) K.MD.A.1
- Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1) K.MD.B.3
- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1) 2.MD.D.10

Accommodations and Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives and choices to differentiate and broaden the curriculum

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential Seating
- Allow extra time to complete assignments or assessments
- Modified Assessments

21 Century Life and Careers

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.

Career Awareness, Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4 Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.E.1 Use digital tools and online resources to explore a problem or issue.

8.1.2.B.1 Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Pacing Guide

https://docs.google.com/document/d/1tfwbC0DkMf1p_-hMWJVRhV-UntA7Cx9o1dlvNkSsg-s/edit?usp=sharing

Course Title: Kindergarten Science

Unit Title	Basic Needs of Living Things and Humans
Length of Unit	15 Weeks -Second half of Marking Period 1 and Marking Period 2
Summary/Overview	***How do plants and get the things that they need to live and grow?*** ***How can humans reduce their impact on the land, water, air, and other living things in the local environment?*** In this unit of study, students develop an understanding of what plants and animals need to survive and the relationship between their needs and where they live. Students compare and contrast what plants and animals need to survive and the relationship between the needs of living things and where they live. The crosscutting concepts of *patterns* and *systems and system models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *developing and using models*, *analyzing and interpreting data*, and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate understanding of the core ideas. Students develop an understanding of what humans need to survive and the relationship between their needs and where they live. The crosscutting concept of *cause and effect* is called out as the organizing concept for the disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *asking questions* and *defining problems,* and *in obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
K-LS1-1	**Use observations to describe patterns of what plants and animals (~~including humans~~) need to survive.**
K-ESS3-1	**Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.**

K-ESS3-3	**Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.**
K-2 ETS1-1	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
Focus Standards	
LS1.C	**Organization for Matter and Energy Flow in Organisms** • All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)
ESS3.A	**Natural Resources** • Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1)
ESS2.E:	**Biogeology** • Plants and animals can change their environment. (K-ESS2-2)
SS3.C	**Human Impacts on Earth Systems** • Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3-3)
ETS1.B	**Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary)* (K-ESS3-3)
ETS1.A	**Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

Course Title: Kindergarten Science

Learning Objectives
(Students will be able to…)

- With guidance, students will sort different types of animals.
- With guidance, students will sort animals based on the food they eat.
- With guidance, students will determine all animals need water to survive.
- Determine based on observation that all plants need water to grow.
- Determine based on observation that all plants need sunlight to grow.
- With guidance, determine the similarities and differences plants and animals need to survive.
- Identify that some animals eat only plants, some animals eat only other animals, and some animals eat both plants and animals.
- Identify through data plants need light and water to grow.
- Identify through data animals need light and water to live and grow.
- Identify through data animals get their food from plants, other animals, or both.
- Based on teacher model, identify and describe different parts of a plant or animal.
- Based on teacher model, identify and describe where plants and animals live.
- Based on teacher model, identify and describe plants and animals needs to survive.
- Based on teacher model, identify and describe how the needs of different animals and plants are met by various places they live.

- Describe how people affect the land, water, air, and/or other living things in the local environment in positive and negative ways.
- Create solutions that reduce the negative effects of humans on the local environment.
- Communicate information about solutions that reduce the negative effects of humans on the local environment.
- Communicate things that people do to live comfortably and how those things can cause changes to the land, water, air, and/or living things in the local environment.
- Articulate choices that people can make to reduce negative impacts and the effect those choices have on the local environment.
- Communicate the information about solutions with others in oral and/or written form (which include using models and/or drawings.

Understandings (Students will understand or know…)	Essential Questions
• **Scientists look for patterns and order when making observations about the world.** • **Patterns in the natural and human-designed world can be observed and used as evidence.** • **Plants need water and light to live and grow.** • **Systems in the natural and designed world have parts that work together.**	1. *What do plants need to live and grow?* 2. *What is the relationship between what plants need and where they live?* 3. *How can plants change their habitat?* 4. *How can humans reduce their impact on the land, water, air, and other living things in the local environment?*

• **Living things need water, air, and resources from the land, and they live in places that have the things they need.** • **Systems in the natural and designed world have parts that work together.** • **Plants can change their environments.** • **Things that people do to live comfortably can affect the world around them. People can make choices that reduce their impacts on the land, water, air, and other living things.** • **Events have causes that generate observable patterns.** • **Things that people do to live comfortably can affect the world around them.** • **People can make choices that reduce their impacts on the land, water, air, and other living things.** • **Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.** • **A situation that people want to change or create can be approached as a problem to be solved through engineering.** • **Asking questions, making observations, and gathering information are helpful in thinking about problems.** • **Before beginning to design a solution, it is important to clearly understand the problem.**	5. *How can you tell if something is alive?* 6. *What do living things need to survive?* 7. *Where do organisms live and why do they live there?*

Assessment Evidence	
Formative Assessments • Observe and use patterns in the natural world as evidence. • Use observations (firsthand or from media) to describe patterns in the natural world	**Summative Assessments** • Tests • Labs • Projects

in order to answer scientific questions. ● Use observations to describe patterns in what plants need to survive. Examples of patterns could include: ● Plants do not need to take in food. ● All plants require light. ● All living things need water. ● Use observations to describe patterns in what animals need to survive. Examples of patterns could include: ● Animals need to take in food, but plants do not. ● Different kinds of food are needed by different types of animals. ● All living things need water. ● Observe that systems in the natural and designed world have parts that work together. ● Use a model to represent relationships between the needs of different plants and the places they live in the natural world. (Plants, animals, and their surroundings make up a system.) ● Examples of relationships could include that grasses need sunlight, so they often grow in meadows. ● Examples of models include diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards. ● Use a model to represent the relationships between the needs of different animals and the places they live in the natural world. (Plants, animals, and their surroundings make up a system.) ● Examples of relationships could include that deer eat buds and leaves and therefore usually live in forested areas. ● Examples of models include diagrams, drawings, physical replica, dioramas, dramatizations, and storyboards. ● Observe that systems in the natural and designed world have parts that work together.	**Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

● Use a model to represent relationships between the needs of different plants and the places they live in the natural world. (Plants, animals, and their surroundings make up a system.) ● Examples of relationships could include that grasses need sunlight, so they often grow in meadows. ● Examples of models include diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards. ● Observe patterns in events generated due to cause-and-effect relationships. ● Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. ● Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. ● Ask questions based on observations to find more information about the natural and/or designed world. ● Define a simple problem that can be solved through the development of a new or improved object or tool. ● Ask questions, make observations, and gather information about a situation that people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool.	

Learning Activities

What it looks like in the classroom…

The unit should begin with observable phenomena. The purpose of presenting phenomena to students is to start them thinking and wondering about what they observe. After students have observed the event, they can work individually, with partners, or in a small group to develop questions about what they saw. The questions will lead them into investigational opportunities throughout the unit that will help them answer their questions.

The questions students share about this unit will be used to guide them in identifying patterns of what plants and animals need to survive. For example, a pattern may include the types of food that specific organisms eat or that animals consume food but plants do not. Furthermore, students' questions and investigations will also guide them in developing models that reflect their understanding of the inter-relationship between an organism and its environment.

- Prior to starting the unit, display pictures of living and non-living things. Direct students to sort the pictures into two groups: living and non-living. Ask students to explain how they decided which pictures represented living things and which represented non-living things.
- Watch the PBS video "Is It Alive?" Stop after each picture and ask students if it's alive or not. Ask them to explain how they can tell. (This activity will also provide an opportunity to pre-assess students' understandings and/or misconceptions. It will also provide an opportunity for students to think about what having life means.)
- Watch the TeacherTube video "Living or Non-Living?" (This activity provides similar experiences for students as the PBS video. The difference is that after each picture and question, the narrator provides the answer with reasoning.)

In this unit's progression of learning, students first learn that scientists look for patterns and order when making observations about the world and those patterns in the natural world can be observed and used as evidence. Students conduct firsthand and media-based observations of a variety living things and use their observations as evidence to support the concepts

- Plants do not need to take in food, but do need water and light to live and grow.
- All animals need food in order to live and grow, that they obtain their food from plants or from other animals, that different kinds of food are needed by different kinds of animals, and that all animals need water.

After determining what plants need to survive, kindergarteners learn that plants are systems, with parts, or structures, that work together, enabling plants to meet their needs in a variety of environments. The vast majority of plants have similar structures, such as roots, stems, and leaves, but the structures may look different depending on the type or variety of plant. Although there are many varieties of plants, their structures function in similar ways, allowing the plants to obtain the water and light they need to survive. In other words, each variety of plant has structures that are well-suited to the environment in which it lives. As students learn about different types of plants and the environments in which they live, they use models, such as diagrams, drawings, physical replicas, or dioramas, to represent the relationships between the needs of plants and the places they live in the natural world. For example, grasses need sunlight, so they often grow in meadows. Cacti, which live in places subject to drought, have thick, wide stems and modified leaves (spines) that keep water within the plant during long periods without rain.

After determining what animals need to survive, kindergarteners learn that animals are systems that have parts, or structures, that work together, enabling animals to meet their needs in a variety of environments. Many animals have similar structures, such as mouths or mouthparts, eyes, legs, wings, or fins, but the structures may look different, depending on the type or species of animal. Although there are many types of animals, their structures function in similar ways, allowing them to obtain the water and food they need to survive. In other words, each type of animal has structures that are well-suited to the environment in which they live. As students learn about different types of animals and the environments in which they live, they use models, such as diagrams, drawings, physical replicas, or dioramas, to represent the relationships between the needs of animals and the places they live in the natural world. For example, deer eat buds and leaves; therefore, they usually live in forested areas; pelicans eat fish, therefore they live near the shorelines of oceans or seas.

The final portion of the learning progression focuses on the understanding that plants and animals are system with parts, or structures, that work together. Students use what they have learned about plants and animals to make further observations to determine ways in which plants and animals change their environment to meet their needs. For example:

- Tree roots can break rocks and concrete in order to continue to grow, plants will expand their root systems in search of water that might be found deeper in the earth, and plants can be found growing around and through man-made structures in search of light.
- A Squirrel digs in the ground to hide food, and birds collect small twigs to build nests in trees. Students need opportunities to make observations, and then, with adult guidance, to use their observations as evidence to support a claim for how an animal can change its environment to meet its needs.

Students need opportunities make observations; then, with adult guidance, they can use their observations as evidence to support a claim about how living things can change its environment to meet its needs.

In this unit of study, students will develop an understanding of the impact that humans have on the land, water, air, and other living things in the local environment and engage in a portion of the engineering design process in order to communicate solutions that can reduce these impacts. To help students recognize the impact that humans have on the living and nonliving components of the local environment, they need opportunities to observe and think about the things that people do to live comfortably. Over a period of a few days, students can observe their families in their day-to-day lives, paying attention to what they eat, what they throw away, when and how they use water, how they warm or cool their home, what types of appliances and gadgets they use, how they maintain their home and yard, what resources are used to make the clothes they wear, how they travel from place to place, and how they communicate with others. During whole-group discussions, students can share their observations and then discuss the concept of comfortable lifestyle. This list could include:

- Plants and animals for food
- Trees, rocks, sand, and other materials for building homes and schools
- Local reserves of water for drinking, washing clothes, showering, washing dishes, watering lawns, and cooking
- Gas and oil for cars and buses
- Electricity to power the appliances in their homes
- Land for homes, schools, parks, parking lots, and landfills

Then the class can discuss how obtaining and using these types of resources affects the local environment. To help with these discussions, teachers can use books, multimedia resources, field trips, or even invite guest speakers to the classroom. As students participate in discussions, they should be encouraged to ask questions, share observations, and describe cause-and-effect relationships between human use of resources and human impact on the environment.

As students come to understand that things people do to live comfortably can affect the world around them, they are ready to engage in the engineering design process. The process should include the following steps:

- As a class or in groups, students participate in shared research to find examples of ways that people solve some of the problems created by humans' use of resources from the environment. For example, people in the community might choose to:
- Recycle plastic, glass, paper, and other materials in order to reduce the amount of trash in landfills;

Plant trees in areas where trees have been cut down for lumber to renew regional habitats for local wildlife; or

- Set up rainwater collection systems so that rainwater can be used to maintain landscaping instead of using water from local reserves.
- Groups of students then develop a simple sketch, drawing, diagram, or physical model to illustrate how the solution reduces the impact of humans on land, water, air and/or other living things in the local environment.
- Groups need the opportunity to communicate their solutions with the class in oral and/or written form, using their sketches, drawings, diagrams, or models to help explain how the solution reduces the human impact on the environment.

Example Activities

"Good Night" & Where Do Polar Bears Live? This is a Paired Text activity that uses the "Where Do Polar Bears Live" read aloud and the non-fiction text "Good Night" which addresses hibernation.

The Needs of Living Things This lesson plan has one level for Grades K-2 and another level for Grades 3-5. Students will learn about what plants and animals need to survive and how habitats support those needs. They will also learn about how organisms can change their environment.

Living Things and Their Needs: This is an excellent resource that provides a Teacher Guide, videos, reading resources, and student activity sheets. The objective of the lessons is for students to learn about living organisms and what they need to survive. These lessons can easily be taught as an interdisciplinary set of learning experiences.

How do living things Interact: This unit plan is about unit plan about living things and environmental interactions

5E Science Lesson Plan: This Prezi presentation describes lesson ideas that support students' understanding of living organisms. Lessons also provide an opportunity for students to identify patterns that help them determine similarities and differences between plants and animals.

Curious George: Paper Towel Plans: This video from Curious George shows students helping bean seeds sprout outside of soil by meeting their essential needs for moisture, temperature, air, and light. The children place the beans and a wet paper towel inside a zippered plastic bag and leave them undisturbed in a warm, well-lighted place. After two weeks, the students return and observe that the beans have sprouted and, like apple seeds, will one day grow to be fully developed plants.

From Seed to Fruit | Everyday Learning: Seed to Fruit takes children through the different stages of growth in the life of a cherry tomato plant. Planting a seed in a cup and watching it grow over time is a wonderful way to introduce the life cycle to young children. This resource is part of the KET Everyday Science for Preschoolers collection. This video is available in both English and Spanish audio, along with corresponding closed captions. *Apple and pumpkin season

Think Garden: The Importance of Water: This video from KET's Think Garden collection explores why plants need water to survive, and how they tell us they're thirsty. Learn about the signs plants give when they've had too much or too little water and the part water plays in the process of photosynthesis. See a quick, easy-to-understand animation explaining the water cycle and transpiration process. Also find out how to improve water quality with rain gardens and how to conserve water with rain barrels. This video is available in both English and Spanish audio, along with corresponding closed captions.

Think Garden: Plant Structure: This video from KET's Think Garden collection examines plant structure by taking a closer look at the root and shoots systems. Learn about roots, stems, leaves, flowers, seeds, and fruit through engaging illustrations and animations.

Humans on Earth: This is a 3.5 minute narrated video explaining the use of natural resources to supply the needs of humans, and solutions for preserving them.

The Clean Water Book: Choices for Resource Water Protection: This book is available from the New Jersey Department of Environmental Protection

Recycling Manual for New Jersey Schools: This manual will guide school personnel through a step-by-step process of setting up a recycling program in the school. It provides all the necessary tools for designing and implementing a viable and comprehensive program in private, public and parochial institutions.

Speakers Program: The New Jersey Department of Environmental Protection (DEP) fields requests for public speakers, classroom presentations and exhibitors regarding the various environmental topics, programs and services that are administered by the agency.

Practice the 5 R's – Poster

The USGS Water Science School: Welcome to the U.S. Geological Survey's (USGS) Water Science School. We offer information on many aspects of water, along with pictures, data, maps, and an interactive center where you can give opinions and test your water knowledge.

Demonstration of blubber for insulation

https://www.education.com/science-fair/article/fatty-insulators/

Growing Pumpkins

http://www.almanac.com/plant/pumpkins

Walking Water and Carnations

cut carnation food coloring

http://www.adabofgluewilldo.com/walking-water-science-activity-kids/

Water Filtration

http://pbskids.org/zoom/activities/sci/waterfilter.html

https://www.nasa.gov/pdf/146846main_Cleaning_Water_Educator.pdf

Recycled Seed Paper
https://www.youtube.com/watch?v=dQ6FhNxKv1w
https://www.youtube.com/watch?v=N3tbZguBzG8&t=4s

Recycling lessons
http://www.kindergarten-lessons.com/recycling_for_kids/

Is water forever? How much water do we have on earth?
https://www.howtosmile.org/resource/smile-000-000-004-646

Recycling Crayons
http://www.skiptomylou.org/making-crayons-using-molds-craft-camp/
http://naturalthrifty.com/recycled-crayons-tutorial.html

Water usage… Number of cups used in the Day vs. Refillable water bottle
Data collection

Engineering Design Challenge Keep the bunnies out of the Garden
http://www.ciese.org/curriculum/engineering/garden.html

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

With adult support, kindergarteners use trade books (read-alouds and big books) to learn about plants and animals. With prompting and support strategies, such as Think-Pair-Share, students can discuss what they have learned and read and answer questions using key details from text. As students learn about different types of plants, animals and the environments in which they live, they will use models, such as diagrams, drawings, physical replicas, or dioramas, to represent the relationships between the needs of living things and the places they live in the natural world. Using models in this way gives students an opportunity to use simple informative writing to provide additional detail that will enhance their visual displays.

With adult support, students participate in shared research in order to find examples of ways that humans reduce their impact on the land, water, air, and other living things in the local environment. With prompting and support, students will ask and answer questions about key details in a text. Students, with adult support and/or peer collaboration, can also use simple books and media resources to gather information and then use drawings, simple informative writing (or dictation), and visual displays to represent some of the ways that people lessen their impact on the environment. With support from adults, students will recall information from experiences or gather information provided from sources to answer a question. Students can clarify their ideas, thoughts, and feelings using simple informative writing.

- Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1) RI.2.1
- With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1) W.2.6
- Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1) W.2.8
- Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book. (K-ESS2-2) W.K.1
- Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS2-2, K-ESS2-2) W.K.2
- Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-LS1-1) W.K.7
- Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1) SL.K.5
- With prompting and support, ask and answer questions about key details in a text. (K-ESS2-2) R.K.1

Mathematics

With adult support, kindergarteners use simple measurements to describe various attributes of plants and animals. Kindergarteners can use simple, nonstandard units to measure the height of plants or the amount of water given to plants. For example, they might use Unifix cubes to measure height or count the number of scoops of water given to a plant on a daily or weekly basis. Students should work in groups to measure and record their data. They also measurements to describe various attributes of animals. Kindergarteners can use simple, nonstandard units to measure such attributes as height, length, or weight. They can also count numbers of appendages or other body parts. They might use Unifix cubes to measure height or length and wooden blocks to measure weight. Students should work in groups to measure and record their data.

With adult guidance and questioning, students can then learn to analyze their data. As students use data to compare the amount of growth that occurs in plants that get varying amounts of water or sunlight, they

are given the opportunity to reason abstractly and quantitatively. For example, students can measure and compare the height of a sunflower grown in the shade compared to the height of a sunflower grown in the sun, or they can count and compare the number of leaves on bean plants that receive different amounts of water daily. These investigations will give students evidence to support claims about the needs of plants. Students should also have opportunities to solve one-step addition/subtraction word problems based on their collected data.
With adult support, students will classify data by one attribute, sort data into categories, and graph the data. For example, students can keep track of the amount of materials recycled over a period of time. They can classify recycled trash as paper, plastic, or glass, then count and graph these data, using bar graphs or picture graphs. Student should have opportunities to analyze and compare the data and then use the data to solve word problems. As students work with their data, they are learning to reason abstractly and quantitatively, model by diagramming the situation mathematically, and use appropriate tools strategically.

- Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-LS1-1) K.MD.A.2
- Reason abstractly and quantitatively. (K-ESS3-1,K-2-ETS1-1) MP.2
- Model with mathematics. (K-ESS3-1,K-2-ETS1-1) MP.4
- Counting and Cardinality (K-ESS3-1) K.CC
- Use appropriate tools strategically. (K-2-ETS1-1) MP.5
- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1) 2.MD.D.10

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented

- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives and choices to differentiate and broaden the curriculum

English Language Learners

- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction

- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential Seating
- Allow extra time to complete assignments or assessments
- Modified Assessments

21 Century Life and Careers

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.

Career Awareness, Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration Of Technology

8.1.2.A.4 Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.E.1 Use digital tools and online resources to explore a problem or issue.

8.1.2.B.1 Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Pacing Guide

https://docs.google.com/document/d/1tfwbC0DkMf1p_-hMWJVRhV-UntA7Cx9o1dlvNkSsg-s/edit?usp=sharing

Unit Title	Effects of Sun
Length of Unit	Marking Period 3
Summary/Overview	*How can we use science to keep a playground cool in the summertime?* During this unit of study, students apply an understanding of the effects of the sun on the Earth's surface. The crosscutting concepts of *cause and effect* and *structure and function* are called out as organizing concepts for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency in *developing and using models*; *planning and carrying out investigations*; *analyzing and interpreting data*; and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
K-PS3-1	**Make observations to determine the effect of sunlight on Earth's surface**
K-PS3-2	**Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.**
K-2-ETS1-1	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the**

	development of a new or improved object or tool.
K-2-ETS1-2	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Focus Standards	
PS3.B	**Conservation of Energy and Energy Transfer** • Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2)
ETS1.A	**Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)
ETS1.B	**Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas
Learning Objectives (Students will be able to…)	
• With guidance, identify and describe the idea sunlight warms the Earth's surface. • With guidance, identify and describe the effect of sunlight on Earth's materials. • With guidance, identify and describe patterns of relative warmth of materials in sunlight vs. shade. (e.g. sand, soil, rock, water) • Describe the evidence that will result from the investigation including observations of the relative warmth of materials in the presence and absence of sunlight. • Based on the investigation plan, identify and describe the materials on Earth's surface to be investigated. • Based on the investigation plan, describe how the relative warmth of the materials will be observed and recorded. • Collect and record data to compare the warmth of the Earth's materials place in sunlight and the same Earth's materials placed in shade. • Collect and record data to identify patterns of relative warmth of materials in sunlight and in shade. • Collect and record data to describe that sunlight warms the Earth's surface. • Generate design solutions using given scientific information about sunlight's warming effect on the Earth's surface to collaboratively design and build a structure that reduces warming caused by the sun.	

- Describe the problem of sunlight on the earth's surface
- Design a solution to reduce the amount of sunlight on a human
- Describe that the structure is expected to reduce warming for a designated area by providing shade.
- Describe whether the structure meets the expectations in terms of cause (structure blocks sunlight) and effect (less warming of the surface).
- Use the given materials and tools when building their structure.

Understandings (Students will understand or know...)	Essential Questions
• **Events have causes that generate observable patterns.** • **Scientists use different ways to study the world.** • **Sunlight warms Earth's surface.** • **Events have causes that generate observable patterns.** • **The shape and stability of structures of natural and designed objects are related to their function(s).** • **Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.** • **Because there is always more than one possible solution to a problem, it is useful to compare and test designs.** • **Sunlight warms Earth's surface.**	1. *How does sunlight affect the playground?* 2. *Imagine that we have been asked to design a new playground. How would we keep the sand, soil, rocks, and water found on the playground cool during the summer?*

Assessment Evidence	
Formative Assessments	**Summative Assessments**
• Observe patterns in events generated by cause-and-effect relationships. • Make observations (firsthand or from media) to collect data that can be used to make	• Tests • Labs • Projects

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comparisons.

- Make observations to determine the effect of sunlight on Earth's surface. (Assessment of temperature is limited to relative measures such as warmer/cooler.)
  - Examples of Earth's surface could include:
    - Sand
    - Soil
    - Rocks
    - Water
- Observe patterns in events generated by cause-and-effect relationships.
- Describe how the shape and stability of structures are related to their function.
- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.
- Use tools and materials to design and build a structure (e.g., umbrellas, canopies, tents) that will reduce the warming effect of sunlight on an area.
- Develop a simple model based on evidence to represent a proposed object or tool.
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Alternative Assessments

- Oral Presentations
- Teacher Observations
- Making Models
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Learning Activities

What it looks like in the classroom…

In this unit of study, students investigate the effects of the sun on the surface of the Earth. Throughout the unit, students make observations in order to describe patterns of change. With adult support, they design and build a structure that will reduce the warming effect of sunlight, and then conduct tests to determine if the structure works as intended.

Scientists use different ways to study the world. In this unit's progression of learning, students work like scientists to investigate the warming effect of sunlight on the surface of the Earth. They will conduct simple investigations in order to make observations and collect data that can be used to make comparisons. Students should test a variety of materials that are found naturally on the surface of the Earth, including sand, soil, rocks, and water. Samples of each of these materials can be placed on two separate paper plates or shallow plastic containers; one container can be placed in direct sunlight, and the other can be placed out of direct sunlight. After a period of time, students should compare the relative temperature of each. Students should record their observations, then analyze and compare the data to determine if there is a pattern. They should draw the conclusion that the sun has the same warming effect on all the materials found on the surface of the Earth.

As students come to understand that the sun warms the surface of the Earth, they should engage in the engineering design process as follows:

- Students are challenged to design and build a structure that will reduce the warming effects of the sun.
- Students brainstorm a list of objects that reduce the warming effects of the sun (e.g., shade trees, umbrellas, large hats, canopies).
- As a class, students determine what the design should be able to do (criteria). For example:
- The structure must reduce the warming effects of the sun.

The structure should be built using materials provided by the teacher.

- The structure should be easy to carry and fit through the doorway of the classroom.
- Groups of students then use simple drawings or diagrams to design a structure, and use given tools and materials to build their design. Groups should be given a predetermined amount of time to draw and build their designs.
- Groups share their designs with the class, using their drawings or diagrams, and then test their designs outside. (Groups can place their structures in a sunny area, then compare the relative temperature of the ground under the structure and the ground in direct sunlight.).
- Students make and use observations to determine if the designs worked as intended, then compare the strengths and weaknesses of how each design performed.

While engaging in this process, students should use evidence from their observations to describe how their structures reduced the warming effect of sunlight.

Through this process, students learn that the shape and stability of structures of designed objects are related to their function. They will use tools and materials to design and build their structures. Because there is always more than one possible solution to a problem, students will test and compare their designs, then analyze data to determine if their structures work as intended.

Example Activities

Casting Shadows Across Literacy and Science: This lesson introduces shadows by taking students on a shadow walk. Ideally this should be done on a sunny day in the schoolyard or neighborhood, but it can be a simple walk around the classroom.

A Big Star: This reading passage that explains what the sun is and that it provides heat to the Earth. This activity comes with comprehension and critical thinking questions.

The Warmth of the Sun: This lesson helps students broaden their understanding of the sun, particularly its critical role in warming the land, air, and water around us.

The Sun Lesson Plan: This lesson plan is adaptable to several grade band levels. The adjustments are included in the lesson plan along with suggestions for extension activities.

Cooler in the Shadows: This lesson includes several activities where students observe, explore, and analyze shadows. Students will make inferences about the cause of shadows, The lesson is linked to

NASA's MESSENGER spacecraft in its voyage to and around Mercury. This lesson is designed to last 4 or more days. There are four different activities within the lesson. The teacher will need to gather some materials prior to beginning the lesson.

Shadow Smile! - Part 6 | Sid the Science Kid: In this song, Miss Susie teaches the class about shadows and the necessary shade they provide for people and animals in the heat! Learn how shadows are a result of an object getting in the way of the path of the sun and that the shadow it casts over the ground provides shade.

Lights and Shadows

https://drive.google.com/a/dealschool.org/file/d/0BycDHSPsSBF1T2NBcUdlMHVMYzQ/view?usp=sharing

Groundhog Project with groundhog tunnel

https://www.kidssoup.com/activity/groundhog-day-preschool-and-kindergarten-activities

Cooler in the Shadows

https://www.kidssoup.com/activity/groundhog-day-preschool-and-kindergarten-activities

Sunlight on Earth's Surface

https://www.wardsci.com/www.wardsci.com/images/kindergarten_temp_probe-_final.pdf

Making a cooler house - What kind of material will keep my house cool?

http://bggreensource.org/what-we-do/educational-and-outreach/pk-12/outdoor-play-and-learning/content-aligned-curriculum/energy-and-energy-transfer-lesson/

Making a shelter with shade

https://betterlesson.com/next_gen_science/browse/2053/ngss-k-ps3-2-use-tools-and-materials-to-design-and-build-a-structure-that-will-reduce-the-warming-effect-of-sunlight-on-an-area

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

With guidance and support from adults, students recall information from experiences and gather information from books (read-alouds, big books) and other resources about the warming effects of the sun. Strategies such as Think-Pair-Share can be used to encourage students to think about and use information from books to answer questions and share their thinking. Kindergartners can add drawings or other visual displays to descriptions to provide additional detail about the structures they built to reduce the warming effects of the sun. With guidance and support from adults, students produce and publish their descriptions and observations of the structures they designed and built.

- Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1),(K-PS3-2) W.K.7
- Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference. (K- PS3-1) K.MD.A.2
- Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1) RI.2.1
- With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1),(K-2-ETS1-3) W.2.6
- Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),(K-2-ETS1-3) W.2.8
- Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2) SL.2.5

Mathematics

Students make comparisons of objects using relative temperature [hotter, colder, warmer, cooler] and describe the objects as warmer or cooler. Students can classify the objects into categories (warmer/cooler), then count and compare the number of objects in each category. Data should be organized and compared so that students understand that placing objects in the sun generates an observable pattern of change (i.e., the objects get warmer). Kindergarteners attend to the meaning of various quantities using a variety of measurement tools, such as thermometers without scale markings, to determine if an object has gotten warmer when placed in the sun. They mathematically represent real-world information by organizing their data into simple graphs or charts or by diagramming the situation mathematically.

- Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference. (K-PS3-2) K.MD.A.2

- Reason abstractly and quantitatively. (K-2-ETS1-1),(K-2-ETS1-3) MP.2
- Model with mathematics. (K-2-ETS1-1),(K-2-ETS1-3) MP.4
- Use appropriate tools strategically. (K-2-ETS1-1),(K-2-ETS1-3) MP.5
- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1),(K-2-ETS1-3) 2.MD.D.10

Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives and choices to differentiate and broaden the curriculum

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential Seating
- Allow extra time to complete assignments or assessments
- Modified Assessments

21 Century Life and Careers

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. **CRP11.** Use technology to enhance productivity. **Career Awareness, Exploration and Preparation** 9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.
Integration of Technology
8.1.2.A.4 Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums). **8.1.2.E.1** Use digital tools and online resources to explore a problem or issue. **8.1.2.B.1** Illustrate and communicate original ideas and stories using multiple digital tools and resources.
Pacing Guide
https://docs.google.com/document/d/1tfwbC0DkMf1p_-hMWJVRhV-UntA7Cx9o1dlvNkSsg-s/edit?usp=sharing

Unit Title	Push and Pulls
Length of Unit	10 Weeks - 4th Marking Period

Summary/Overview	*What does science have to do with playing sports?* During this unit of study, students apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution. The crosscutting concept of *cause and effect* is called out as the organizing concept for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *analyzing and interpreting data*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
K-PS2-1	**Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.**
K-PS2-2	**Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.**
K-2-ETS1-3	**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Focus Standards	
PS2.A	**Forces and Motion** • Pushes and pulls can have different strengths and directions. (K-PS2-1), (K-PS2-2) • Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1), (K-PS2-2)
PS2.B	**Types of Interactions** • When objects touch or collide, they push on one another and can change motion. (K-PS2-1)
PS3.C	**Relationship Between Energy and Forces** • A bigger push or pull makes things speed up or slow down more quickly. *(secondary to K-PS2-1)*

ETS1.A	**Defining Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable
ETS1.A	**Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) • Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

Learning Objectives
(Students will be able to…)

- With guidance, collaboratively identify the effect caused by different strengths and directions of pushes and pulls on the motion of an object.
- With guidance, collaboratively identify the purpose of the investigation by gathering evidence to support or refute student ideas based on comparing the effects of different strengths of pushes and pulls on the motion of an object.
- With guidance, collaboratively develop an investigation plan to investigate the relationship between the strength and direction of pushes and pulls and the motion of an object.
- Identify how observations connect the purpose of investigation.
- Predict the effect of push and pull on the motion of an object based on prior experiences.
- Collaboratively describe the object whose motion was being investigated.
- Collaboratively describe what will be in contact with the object to cause the push or pull.
- Collaboratively describe relative strengths of the push and pull that will be applied to the object to start or stop its motion or change its speed.
- Collaboratively describe relative directions of the push or pull that will be applied to the object.
- Collaboratively describe how the motion of the object will be observed and recorded.
- Collaboratively describe how the push or pull will be applied to vary strength or direction.
- With guidance, collaboratively make observations to compare the effect on motion of the object caused by changes in the strength and direction of the pushes and pulls and record their data.
- Organize given information using graphical or visual displays (e.g., pictures, pictographs, drawings, written observations, tables, charts).
- Determine the relative speed or direction of the object before a push or pull is applied (i.e., qualitative measures and expressions of speed and direction; e.g., faster, slower, descriptions* of "which way").
- Induce relative speed or direction of the object after a push or pull is applied.
- Articulate the relative strength of a push or pull affects the speed or direction of an object (i.e., qualitative measures or expressions of strength; e.g., harder, softer).
- Describe relative changes in the speed or direction of the object caused by pushes or pulls from the design solution.
- Observe and describe relationship in the data, to determine whether the push or pull from the design solution causes the intended change in speed or direction of motion of the object.

Course Title: Kindergarten Science

Understandings (Students will understand or know...)	Essential Questions
- People use different ways to study the world. - Simple tests can be designed to gather evidence to support or refute student ideas about causes. - Pushes and pulls can have different strengths and directions. - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. - When objects touch or collide, they push on one another and can change motion. - A bigger push or pull makes things speed up or slow down more quickly. - Simple tests can be designed to gather evidence to support or refute student ideas about causes. - Pushes and pulls can have different strengths and directions. - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. - A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. - Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	1. *Why do scientists like to play soccer?* 2. *How can you design a simple way to change the speed or direction of an object using a push or pull from another object?*

Assessment Evidence	
Formative Assessments With guidance, design simple tests to	**Summative Assessments** Tests

gather evidence to support or refute ideas about cause-and-effect relationships. ● With guidance, plan and conduct an investigation in collaboration with peers. ● With guidance, collaboratively plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. Some examples of pushes and pulls on the motion of an object could include: ● A string attached to an object being pulled. ● A person pushing an object. ● A person stopping a rolling ball. ● Two objects colliding and pushing on each other. ● With guidance, design simple tests to gather evidence to support or refute ideas about cause-and-effect relationships. ● Analyze data from tests of an object or tool to determine if it works as intended. ● Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. ● Analyze data to determine whether a design solution works as intended to change the speed or direction of an object with a push or a pull. ● Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. ● Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.	● Labs ● Projects **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

Learning Activities

<u>What it looks like in the classroom…</u>

In this unit of study, students plan and carry out investigations in order to understand the effects of different strengths and different directions of pushes and pulls on the motion of an object. Students will also engage in a portion of the *engineering design process* to determine whether a design solution works as intended to change the speed or direction of an object.

Scientists often design simple tests in order to gather evidence that can be used to understand cause-and-effect relationships. In this unit's progression of learning, kindergarteners need adult guidance to collaboratively plan and conduct simple investigations to discover and compare the effects of pushes and pulls on the motion of an object. Students will need opportunities to push and pull a variety of objects, such as balls, toy cars, pull toys, cans, tops, and boxes. Students should push/pull these objects first with varying strengths, and then in a variety of directions. They should also explore the effects of pushing objects into one another, as well as into walls and other stationary objects. Students should record their observations using pictures and words, and should participate in class discussions on the effects of varying the strength or direction of a push or pull on an object.

As students engage in these types of simple force and motion investigations, they will learn that:

- Pushes and pulls can have different strengths and directions.
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.
- When objects touch or collide, the object's motion can be changed.
- The force of the push or pull will make things speed up or slow down more quickly.

To enhance students' experiences, teachers can schedule time for students to investigate these force and motion concepts using playground equipment, such as swings, seesaws, and slides. Teachers can also use trade books and multimedia resources to enrich students' understanding. As students participate in discussions, they should be encouraged to ask questions, share observations, and describe cause-and-effect relationships between forces (pushes and pulls) and the motion of objects.

As students come to understand the force and motion concepts outlined above, they should engage in the *engineering design process* as follows.

- Students are challenged to design a simple way to change the speed or direction of an object using a push or pull from another object.
- As a class, students determine what the design should be able to do (criteria). For example:
- An object should move a second object a certain distance;
- An object should move a second object so that the second object follows a particular path;
- An object should change the direction of the motion of a second object; and/or
- An object should knock down other specified objects.
- Students determine the objects that will move/be moved (balls, ramps, blocks, poker chips) and the types of structures (ramps or barriers) and materials (rubber bands, paper tubes, cardboard, foam, wooden blocks) that can be used to meet this challenge.
- Groups of students then develop a simple drawing or diagram and use given materials to build their design. Groups should be given a predetermined amount of time to draw and build their designs.
- Groups share their designs with the class, using their drawings or diagrams, and then test their designs.

- Students make and use observations to determine which of the designs worked as intended, based on the criteria determined by the class.

While engaging in this process, students should use evidence from their observations to describe how forces (pushes and pulls) cause changes in the speed or direction of an object.

In this unit of study, students learn that problem situations can be solved through engineering, and that because there is always more than one possible solution to a problem, it is useful to compare and test designs. Students will use what they have learned about the effect of pushes and pulls of varying strength and direction on the motion of an object to determine whether a design solution works as intended. This process is outlined in greater detail in the previous section.

Example Activities

Push Pull-Changing Direction: Students investigate the interactions between colliding objects using pushes and pulls. Students play a game of kickball and observe how the ball is pushed, pulled, started, stopped, or collided with other objects and how it changed position and speed. As a group, students will then brainstorm about other objects being pushed, pulled or colliding and then choose one of those objects to investigate.

- Marble Roll: This is an assessment probe from the book Uncovering Student Ideas in Primary Science Vol. 1 that is used to elicit children's descriptions of motion. The probe is designed to reveal how students describe the path of a moving object as it leaves a winding track.

Roller Coaster: There are two parts to this lesson from the book More Picture Perfect Science Lessons. In the first part learners explore ways to change the speed and direction of a rolling object by building roller coasters out of pipe insulation after reading the book, Roller Coaster by Marla Frazee. In the second part students read I Fall Down by Vicki Cobb and then investigate the idea that gravity affects all objects equally by conducting dropping races with everyday items.

Ramps 2: Ramp Builder: This is a multi-day lesson plan that has students design, build, and test their own ramps. Students are introduced to a variety of materials and explore putting them together. Students engage in an inquiry-based learning experience to reinforce math, science, and technology. They create plans for ramps by evaluating a variety of materials provided to them.

Engineering Motion: This article provides insight on an a first grade derby car engineering activity. First graders build derby cars while enhancing their communication skills.

Catch Me If You Can!: This resource is an introductory kindergarten STEM unit that focused on building a trap to catch a gingerbread man.

Physical Education Meets Physical Science: In an effort to incorporate science into an early childhood physical education program, a physical education teacher worked with kindergarten teachers, a science teacher, and a science curriculum coordinator.

Invent a Backscratcher from Everyday Materials: Being able to recognize a problem and design a potential solution is the first step in the development of new and useful products. In this activity, students create devices to get "that pesky itch in the center of your back.

Push Pull-Changing Direction: Students will investigate the interactions between colliding objects using pushes and pulls.

Trap a gingerbread man http://static.nsta.org/files/sc1304_65.pdf

Marble Roller Coaster DIY https://www.youtube.com/watch?v=h1oWaryiiFg

Turn, Turn, Turn… Changing Direction
https://betterlesson.com/lesson/635812/turn-turn-turn-a-simple-assessment

Intro to force and motion
https://betterlesson.com/lesson/638992/introduction-to-force-and-motion

Which is faster
https://betterlesson.com/lesson/635339/which-one-is-faster-an-introductory-investigation-of-speed

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

In order to integrate English Language Arts into this unit, students need the opportunity to participate in shared research that will enhance their understanding of the effect of forces (pushes and pulls) on objects. This could include exploring simple books and other media or digital resources. With prompting and support, students should ask and answer questions about key details in texts in order to seek help, get information, or clarify something that they do not understand. With support from adults, students will also recall information from experiences to answer questions and clarify their thinking. With support and/or collaboration, they can use digital tools to produce and publish simple informative writing or to document their observations of the simple force and motion systems they design and build.

- With prompting and support, ask and answer questions about key details in a text. (K-PS2-2) RI.K.1
- Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS2-1) W.K.7
- Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-PS2-2) SL.K.3

Mathematics

During this unit of study, students will make connections to Mathematics in a number of ways. Kindergartners can use simple nonstandard units to measure the distances that two different objects travel when pushed or pulled or the distances that an object travels when varying the strength of a push or a pull. If using two objects, students can compare them using a measurable attribute, such as weight, to see which object has "more of" or "less of" the attribute, and describe the effect that increased weight has on the distance that an object travels. As students conduct multiple trials with the two objects (or with a single object, varying the strength of the push or pull), they can document the distance traveled in a simple graph. Then they can analyze the data in order to describe the cause-and-effect relationship between forces and motion of objects. As students collect and analyze data, they are learning to reason abstractly and quantitatively and use appropriate tools strategically.

- Reason abstractly and quantitatively. (K-PS2-1), (K-2-ETS1-1),(K-2-ETS1-3) MP.2
- Model with mathematics. (K-2-ETS1-1), (K-2-ETS1-3) MP.4
- Use appropriate tools strategically. (K-2-ETS1-1), (K-2-ETS1-3) MP.5
- Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-PS2-1) K.MD.A.1
- Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS2-1) K.MD.A.2

Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented

- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives and choices to differentiate and broaden the curriculum

English Language Learners

- Pair visual prompts with verbal presentations.

- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
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- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
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- Preferential Seating
- Allow extra time to complete assignments or assessments
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21 Century Life and Careers

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

Career Awareness, Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4 Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.E.1 Use digital tools and online resources to explore a problem or issue.

8.1.2.B.1 Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Course Title: Kindergarten Science

Pacing Guide
https://docs.google.com/document/d/1tfwbC0DkMf1p_-hMWJVRhV-UntA7Cx9o1dlvNkSsg-s/edit?usp=sharing

Annual Pacing Guide

Grade Level: Kindergarten

Subject: Science

September	October	November	December	January
eather	Weather Basic Needs of Living Things and Humans	Weather Basic Needs of Living Things and Humans	Weather Basic Needs of Living Things and Humans	Weather Basic Needs of Living Things and Humans

February	March	April	May	June
eather fects of Sun	Weather Effects of Sun	Weather Effects of Sun	Weather Push and Pulls	Weather Push and Pulls

Deal School Curriculum

Science
Curriculum Guide
Grade 1

Deal School

Deal, New Jersey

2018

Board of Education

Administration

Donato Saponaro, Jr.
Superintendent of Schools

Principal

Curriculum Writing Committee

Administration

Donato Saponaro, Jr.

Consultant/Curriculum Development

Science Education Consulting LLC

Jena Valdiviezo

Teacher

Ms. Moskov

Developed and Written

March 2017 – May 2017

Revised

December 2018

Unit Title	Using the patterns of the sun, moon, and stars to make predictions of future observations?
Length of Unit	Marking Period 1 and ongoing throughout the year
Summary/Overview	***Can we predict how the sky will change over time?*** In this unit of study, students observe, describe, and predict some patterns in the movement of objects in the sky. The crosscutting concept of *patterns* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out*

	investigations and *analyzing and interpreting data*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
1-PS4-2	**Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.**
1-ESS1-1	**Use observations of the sun, moon, and stars to describe patterns that can be predicted.**
1-ESS1-2	**Make observations at different times of year to relate the amount of daylight to the time of year.**
Focus Standards	
PS4.B	**Electromagnetic Radiation** ● Objects can be seen if light is available to illuminate them or if they give off their own light.
ESS1.A	**The Universe and its Stars** ● Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)
ESS1.B	**Earth and the Solar System** ● Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)
Learning Objectives (Students will be able to...)	

- Articulate a statement that when an object in the dark is lit (e.g., turning on a light in the dark space or from light the object itself gives off), it can be seen.
- Observe and make observations of the appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects in a space with no light.
- Observe and make observations of the appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects in a space with light.
- Observe and make observations of the appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects that give off light in a space with no other light.
- Support through evidence presence of light in a space causes objects to be able to be seen in that space.
- Organize data from given observations that objects (i.e., sun, moon, stars) visible in the sky during the day.
- Organize data from given observations that objects (i.e., sun, moon, stars) visible in the sky during the night.
- Organize data from given observations that the position of the sun changes in the sky at various times during the day.
- Organize data from given observations the position of the moon in the sky at various times during the day or night.
- Identify and describe patterns in the sky the stars are not seen in the sky during the day, but they are seen in the sky during the night.
- Identify and describe patterns of the sun is at different positions in the sky at different times of the day, appearing to rise in one part of the sky in the morning and appearing to set in another part of the sky in the evening.
- Identify and describe patterns of the moon that can be seen during the day and at night, but the sun can only be seen during the day.
- Identify and describe patterns of the moon is at different positions in the sky at different times of the day or night, appearing to rise in one part of the sky and appearing to set in another part of the sky.
- Identify patterns of the motions of objects in the sky to provide evidence that future appearances of those objects can be predicted (e.g., if the moon is observed to rise in one part of the sky, a prediction can be made that the moon will move across the sky and appear to set in a different portion of the sky; if the sun is observed to rise in one part of the sky, a prediction can be made about approximately where the sun will be at different times of day).
- Use patterns related to the appearance of objects in the sky to provide evidence that future appearances of those objects can be predicted (e.g., when the sun sets and can no longer be seen, a prediction can be made that the sun will rise again in the morning; a prediction can be made that stars will only be seen at night).
- Identify and describe the relationship between the amount of daylight and the time of year.
- Observations and describe (firsthand or from media) of relative length of the day (sunrise to sunset) throughout the year.
- Determine the pattern between the amount of daylight and the time of year (i.e., relative lightness and darkness at different relative times of the day and throughout the year).
- Determined (e.g., whether it will be light or dark when waking in the morning, at breakfast, when

having dinner, or going to bed at night).

- Determine when observations will be made and how they will be recorded, both within a day and across the year.
- Collaboratively make and record observations about the relative length of the day in different seasons to make relative comparisons between the amount of daylight at different times of the year (e.g., summer, winter, fall, spring).

Understandings (Students will understand or know...)	Essential Questions
• **Science assumes that natural events happen today as they happened in the past.** • **Many events are repeated.** • **Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.** • **Patterns in the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.**	1. *What patterns of change can be predicted when observing the sun, moon, and stars?* 2. *What is the relationship between the amount of daylight and the time of year*

● **Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.** ● **Seasonal patterns of sunrise and sunset can be observed, described, and predicted.**	

Assessment Evidence	
Formative Assessments ● Observe and use patterns in the natural world as evidence and to describe phenomena. ● Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. ● Use observations of the sun, moon, and stars to describe patterns that can be predicted. Examples of patterns could include: ● The sun and moon appear to rise in one part of the sky, move across the sky, and set. ● Stars other than our sun are visible at night but not during the day. ● Observe and use patterns in the natural world as evidence and to describe phenomena. ● Make observations (firsthand or from media) to collect data that can be used to make comparisons. ● Make observations at different times of the year to relate the amount of daylight to the time of year.	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

Learning Activities

<u>What it looks like in the classroom…</u>

In this unit of study, students observe, describe, and predict some patterns of the movement of objects in the sky. Throughout the unit students look for patterns as they plan and carry out investigations and analyze and interpret data.

In this unit's progression of learning, students develop the understanding that natural events happen today as they happened in the past, and that many events are repeated. In addition, they observe and use patterns in the natural world as evidence and to describe phenomena. First graders ask questions and use observations of the sun, moon, and stars to describe apparent patterns of change in each. These patterns are then used to answer questions and make predictions. Some examples of patterns include:

- The sun and moon appear to rise in one part of the sky, move across the sky, and set.
- The shape of the moon appears to change over a period of time in a predictable pattern.
- Stars, other than our sun, are visible at night but not during the day.

After students observe and document these types of patterns over a period of time, they need opportunities to describe the patterns and to make predictions about the changes that occur in the objects in the sky. It is important that they use observed patterns as evidence to support predictions they might make about the sun, moon, and stars.

In this unit, students also learn that seasonal patterns of sunrise and sunset can be observed, described, and predicted. They relate the amount of daylight to the time of year by making observations at different times of the year. Over time, they collect and use data in order to identify the relationship between the amount of sunlight and the season. Grade 1 students are expected to make relative comparisons of the amount of daylight from one season to the next, and assessment should be limited to relative amounts of daylight, not quantifying the hours or time of daylight.

Example Activities

The Dynamic Trio: In this lesson, students will learn about the stars, planets, and moons found in our solar system and how they relate to one another. The video segment enhances the learning. After a non-fiction read aloud, students work in groups to create models of the Solar System.

Our Super Star: This is a three part lesson where students use observations, activities, and videos to learn basic facts about the Sun. Students also model the mechanics of day and night and use solar energy to make a tasty treat. One of the videos is a time-lapse video of a sunrise and a sunset.

Keep a Moon Journal: The National Wildlife Federation's "Keep a Moon Journal" page allows students to get acquainted with the phases of the moon by keeping a moon journal to record their nightly observations for one month. The page has links to diagrams, a student printable, and activities connecting the journal to other content. The page is set up as a "family activity" and could be used as nightly homework for students then discussed weekly in class.

Patterns of Daylight: This is a mini-unit that can be taught directly after Space Part 1 or independently. The author chose to teach the Space Part 1 unit (also available on Better Lesson! at http://betterlesson.com/lesson/613469/introduction-and-pre-assessment) during January, and follows up at the end of the year in a recap in May. This lesson uses prior student knowledge and a video simulation.

Observing the Sun: This lesson is an activity where students create a sun tracker and monitor the sun's position over the course of a day. Examples of student journals and connections within a larger unit are provided.

Science lesson on Space Patterns in the Sky https://betterlesson.com/user/472042/68207/160576/kathryn-yablonski/curriculum

Space Systems: patterns and cycles
http://ngss.nsta.org/DisplayStandard.aspx?view=topic&id=6
NSTA Science Lessons: First Grade Standards
http://ngss.nsta.org/AccessStandardsByTopic.aspx

Assembly - Portable Planetarium

http://starlab.com/digital-starlab/digital-starlab-curriculum/

Interactive Notebook for 1st Graders
http://firstgradecentersandmore.blogspot.com/2016/01/interactive-science-notebook.html

Resources

Next Generation Science Standards https://www.nextgenscience.org
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161

Connecting with English Language Arts/literacy and Mathematics

English Language Arts/Literacy

In this unit of study, students need opportunities to participate in shared research and writing projects about patterns of change in the sky. For example, students can use online resources or books to research the patterns of change that are visible over time when we observe the objects in the sky. With guidance from adults, students could create books that describe and illustrate the different patterns of change observed in objects in the sky. They could also describe and illustrate the relative amount of daylight in relation to the season using a sequenced set of journal entries or in a sequence-of-events foldable.

- Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-ESS1-1),(1-ESS1-2) W.1.7
- With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-ESS1-1),(1-ESS1-2) W.1.8

Mathematic

Students need opportunities to represent and interpret data and to use addition and subtraction. The following examples from NGSS Appendix L could provide guidance for instruction and should be done with teacher support:

Science example 1: There were 16 hours of daylight yesterday. On December 21, there were 8 hours of daylight. How many more hours of daylight were there yesterday than on December 21?

Science example 2: Based on the data collected and posted on the bulletin board so far, which day has been the longest of the year so far? Which day has been the shortest?

- Reason abstractly and quantitatively. *(1-ESS1-2)* MP.2
- Model with mathematics. *(1-ESS1-2)* MP.4
- Use appropriate tools strategically. *(1-ESS1-2)* MP.5
- Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations to represent the problem. *(1-ESS1-2)* 1.OA.A.1
- Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. *(1-ESS1-2)* 1.MD.C.4

Accommodations and Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented

- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners

- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- preferential seating
- organize and offer flexible small group learning activities
- modify assessments

21st Century Life and Careers

CAREER READY PRACTICES

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them

CRP11. Use technology to enhance productivity.

CAREER AWARENESS, EXPLORATION, AND PREPARATION

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4
Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.E.1
Use digital tools and online resources to explore a problem or issue.

8.1.2.B.1
Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Pacing Guide

https://docs.google.com/document/d/1UvXwMPr7ZInl1TtUmZyFTS5uT4d3YczxYBqgTZCKK5s/edit?usp=sharing

Unit Title	Sending messages over a distance using light or sound
Length of Unit	Marking Period 2
Summary/Overview	***How can you prove that you can only see something when someone shines a light on it or if the object gives off its own light?*** ***How would we communicate over a distance without the use of any of the devices that people currently use?*** In this unit of study, students develop an understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. The idea that light travels from place to place can be understood by students at this level by placing objects made with different materials in the path of a beam of light and determining the effect of the different materials. Students continue to develop their understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. Students apply their knowledge of light and sound to engage in engineering design to solve a simple problem involving communication with light and sound. The crosscutting concept of *cause and effect* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations*, *constructing explanations*, and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
1-PS4-1	**Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.**
1-PS4-3	**Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.**
1-PS4-4	**Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.**
K-2-ETS1-1	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**

K-2-ETS1-2	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Focus Standards	
PS4.A	**Wave Properties** ● Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)
PS4.C	**Information Technologies and Instrumentation** ● People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)
PS4.C	**Information Technologies and Instrumentation** ● People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)
ETS1.A	**Defining and Delimiting Engineering Problems** ● A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) ● Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) ● Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)
ETS1.B	**Developing Possible Solutions** ● Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)
Learning Objectives (Students will be able to...)	
● Make observations of objects in the light and the dark ● Identify and describe with evidence to answer questions about the relationship between vibrating materials and sound. ● Observe that sounds can cause materials to vibrate ● Observe that vibrating materials can cause sounds. ● Explain with evidence relationship between vibrating materials and sound. ● Determine how the materials will be made to vibrate to make sound ● Determine how resulting sounds will be observed and described. ● Determine what sounds will be used to make materials vibrate.	

- Determine how it will be determined that a material is vibrating.
- Collaboratively collect and record observations about:sounds causing materials to vibrate and vibrating materials causing sounds.
- Answer a question about what happens when objects made of different materials (that allow light to pass through them in different ways) are placed in the path of a beam of light.
- Design and conduct an investigation to gather evidence to support or refute student ideas about putting objects made of different materials in the path of a beam of light.
- Observe the effect of placing objects made of different materials in a beam of light.
- Describe the what happens when light passed through material that allows all, some or no light through.
- Articulate what light source produces light
- collaboratively collect and record observations about what happens when objects made of materials that allow light to pass through them in different ways are placed in the path of a beam of light, according to the developed investigation plan
- Describe a given problem involving people communicating over long distances
- With guidance, students design and build a device that uses light or sound to solve the given problem of people communicating over long distances.
- Describe how communicating over long distances helps people.

Understandings (Students will understand or know...)	Essential Questions
• **Objects can be seen if light is available to illuminate them or if they give off their own light.** • **Simple tests can be designed to gather evidence to support or refute student ideas about causes.** • **Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach.** • **Mirrors can be used to redirect a light beam.** • **Sound can make matter vibrate, and vibrating matter can make sound.** • **Simple tests can be designed to gather evidence to support or refute student ideas about causes.** • **The shape and stability of structures of natural and designed objects are related to their function(s).**	1. *How can you prove that you can only see something when someone shines a light on it or if the object gives off its own light?* 2. *What happens to a beam of light when you put different kinds of things in front of it?* 3. *How would you design an experiment to prove your thinking?* 4. How do instruments (band) make sound? 5. *How can light or sound be used to communicate over a distance?*

People depend on various technologies in their lives; human life would be very different without technology. **People also use a variety of devices to communicate (send and receive information) over long distances.** **A situation that people want to change or create can be approached as a problem to be solved through engineering.** **Asking questions, making observations, and gathering information are helpful in thinking about problems.** **Before beginning to design a solution, it is important to clearly understand the problem.** **Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.**	

Assessment Evidence	
Formative Assessments ● Design simple tests to gather evidence to support or refute ideas about cause and effect relationships. ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. ● Make observations (e.g., in a completely dark room, using a pinhole box, using video of a cave explorer with a flashlight) to construct an evidence-based account that objects can be seen only when illuminated (from an external light source or by an object giving off its own light). ● Design simple tests to gather evidence to support or refute ideas about cause and effect relationships. ● Plan and conduct investigations collaboratively to produce data to serve as the	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Models ● Teacher Conference ● Observations

basis for evidence to answer a question. ● Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. Materials can be: ● Transparent (clear plastic, glass) ● Translucent (wax paper, thin cloth) ● Opaque (cardboard, construction paper) ● Reflective (a mirror, a shiny metal spoon) ● Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. ● Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. ● Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.	

Learning Activities

What is looks like in the Classroom…

In this unit of study, students plan and conduct investigations and make observations as they explore sound and light energy. Students describe the relationships between sound and vibrating materials and the availability of light and the ability to see objects. They also investigate the effect on a beam of light when objects made of different materials are placed in its path. Throughout the unit, students will use their observations and data as evidence to determine cause-and-effect relationships in the natural world.

Students begin this unit by observing objects with and without available light. They need opportunities to observe a variety of objects in both illuminated and non-illuminated settings. For example, observations could be made in a completely dark room, or students can use a pinhole box to observe objects. Students can also watch videos of cave explorers deep in the earth, using light from a single flashlight. With experiences such as these, they will come to understand that objects can be seen only when illuminated, either from an external light source or by when they give off their own light.

Next, students plan and conduct simple investigations to determine what happens to a beam of light when objects made of various materials are placed in its path. Students need the opportunity to explore the interaction of light with a variety of materials, and they should record what they observe with each one. When selecting materials to use, teachers should choose some that allow all light to pass through (transparent), some that allow only a portion of the light to pass through (translucent), some that do not allow any light to pass through (opaque), and some that redirect the beam of light (reflective). Examples could include clear plastic, glass, wax paper, thin cloth, cardboard, construction paper, shiny metal spoons, and mirrors.

As students observe the interaction between light and various materials, they should notice that when some or all of the light is blocked, a shadow is created beyond the object. If only a portion of light is blocked (translucent materials), a dim shadow will form, and some light will pass through the object. If all the light is blocked (opaque materials), students will see only see a dark shadow beyond the object. They will also observe that shiny materials reflect light, redirecting the beam of light in a different direction. Students should use their observations as evidence to support their explanations of how light interacts with various objects.

After investigating light energy, students continue to plan and conduct investigations to develop an understanding of some basic properties of sound. Students can use a variety of objects and materials to observe that vibrating materials can make sound and that sound can make materials vibrate. Students need multiple opportunities to experiment with a variety of objects that will make sound. Some opportunities could include:

- Gently tapping various sizes of tuning forks on a hard surface.
- Plucking string or rubber bands stretched across an open box.
- Cutting and stretching a balloon over an open can to make a drum that can be tapped.
- Holding the end of a ruler on the edge of a table, leaving the opposite end of the ruler hanging over the edge, and then plucking the hanging end of the ruler.
- Touching a vibrating tuning fork to the surface of water in a bowl.
- Placing dry rice grains on a drum's surface and then touching the drum with a vibrating tuning fork or placing the drum near the speaker of a portable sound system.
- Holding a piece of paper near the speaker of a portable sound system.

As students conduct these simple investigations, they will notice that when objects vibrate (tuning forks that have been tapped and string, rubber bands, and rulers that have been plucked), sound is created. They will also notice that sound will cause objects to vibrate (sound from a speaker causes rice grains to vibrate on the surface of a drum, the vibrating tuning fork causes ripples on the surface of water, and sound from the speaker also causes paper to move). Students should use these types of observations as evidence when explaining the cause and effect relationship between sound and vibrating materials

Example Activities

Investigating Sound: This is #4 of a nine lesson unit about sound. Students will be investigating sound stations to provide evidence that sound makes vibrations and that those vibrations make sound

What Makes Sound?: This is Lesson #3 in a unit of nine lessons about sound. Students will learn about how we hear sounds. They will also plan and conduct investigations of sound to prove that sounds have vibrations and vibrations make sound.

Sound Vibrations: This multi-activity lesson allows students to explore how various materials vibrate to make sound. Videos are provided that can be shown to students to enforce the content or used by the teacher to see how to make sound.

Telephones: This lesson is an activity where students make a model "landline" and investigate how sound travels.

What's All the Noise About?: This is a mini-unit that is part of the NSTA Publication " Science for the Next Generation". It is a 5 E model unit with each activity ranging in time needed from 30-90 minutes. In the Explore section, students observe a thunder drum and wine glass.

Waves: Light and Sound:This is an 11 lesson unit that addresses all of the Waves: Light and Sound Performance Expectations. It includes a parent letter, 11 lessons, 5 assessments and multiple, explicit connections to other content areas.

NSTA Science Lessons: First Grade Standards: http://ngss.nsta.org/AccessStandardsByTopic.aspx

Waves: Light and Sound Unit
http://www.alvordschools.org/cms/lib8/CA01900929/Centricity/Domain/2616/1st%20Grade%20Teachers%20Guide%20Complete.pdf
Telephone Building https://betterlesson.com/lesson/638060/telephones
Sound Vibrations https://nj.pbslearningmedia.org/resource/phy03.sci.phys.howmove.lp_sound/sound-vibrations/#.WMqjLVc01SU
Building a communication device https://betterlesson.com/lesson/638721/assessing-light-knowledge
Music - Assessing the Unseen http://static.nsta.org/files/sc1605_54.pdf
Fireflies and light http://static.nsta.org/files/sc1601_52.pdf
Light-Up Playdoh http://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p073/electricity-electronics/squishy-circuits-project-1

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161

Connecting with English Language Arts/literacy and Mathematics

English Language Arts/Literacy

To integrate the CCSS for English Language Arts into this unit, students need opportunities to read informational texts in order to gather information about light and sound. With adult guidance, they identify the main topic and retell key details from texts and ask and answer questions about key details.

Students should also participate in shared research and writing projects. They can gather information from a variety of preselected, grade-level appropriate texts and resources, and use that information to answer questions about light and sound. In pairs or small groups, students can use pictures and words to create simple books about vibration (sound) and illumination (light). The students' writing should include facts about the topic and have a sense of closure. Throughout the unit of study, students need multiple opportunities to share their experiences with light and sound in collaborative conversations with adults and peers, in small and large group settings.

- Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. (1-PS4-2) W.1.2
- Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1),(1-PS4-2),(1-PS4-3) W.1.7
- With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3) W.1.8
- Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. (1-PS4-1),(1-PS4-2),(1-PS4-3) SL.1.1

Mathematic

N/A

Accommodations and Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- preferential seating
- organize and offer flexible small group learning activities

- modify assessments

21st Century Life and Careers

CAREER READY PRACTICES

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them

CRP11. Use technology to enhance productivity.

CAREER AWARENESS, EXPLORATION, AND PREPARATION

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4
Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.E.1
Use digital tools and online resources to explore a problem or issue.

8.1.2.B.1
Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Pacing Guide

https://docs.google.com/document/d/1UvXwMPr7ZInl1TtUmZyFTS5uT4d3YczxYBqgTZCKK5s/edit?usp=sharing

Unit Title	Sunlight and Organisms
Length of Unit	Marking Period 3
Summary/Overview	How can we solve problems related to organisms and sunlight? In this unit of study, students develop an understanding of how plants and animals use their parts to help them survive, grow, and meet their needs. Students also need opportunities to develop possible solutions. As students develop possible solutions, one challenge will be to keep them from immediately implementing the first solution they think of and to instead think through the problem carefully before acting. Having students sketch their ideas or make a physical model is a good way to engage them in shaping their ideas to meet the requirements of the problem. The crosscutting concept of structure and function is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in constructing explanations, designing solutions, and in developing and using models. Students are expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
1-LS1-1	**Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs**
K-2-ETS1-2	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Focus Standards	
LS1.A	**Structure and Function**

	• All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)
LS1.B	**Growth and Development of Organisms** • Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)
LS1.D:	**Information Processing** • Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)
ETS1.B	**Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)

Learning Objectives
(Students will be able to...)

- With guidance use given scientific information about plants and/or animals to design the solution about how external structures are used to help the plant and/or animal grow and/or survive.
- With guidance use given scientific information about plants and/or animals to design the solution about how animals use external structures to capture and convey different kinds of information they need.
- With guidance use given scientific information about plants and/or animals to design the solution about how plants and/or animals respond to information they receive from the environment.
- Students design a device (using student-suggested materials) that provides a solution to the given human problem by mimicking how plants and/or animals use external structures to survive, grow, and/or meet their needs.
- Describe a device mimic plant and/or animal external parts, and/or animal information-processing.

Understandings (Students will understand or know...)	Essential Questions
• **Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.** • **The shape and stability of structures of natural and designed objects are related to**	1. *How can humans mimic how plants and animals use their external parts to help them survive and grow?* 2. *Why is sunlight essential for plants and animals*

their function(s). ● **All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.** ● **Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.** ● **Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.**	

Assessment Evidence	
Formative Assessments ● Observe and describe how the shape and stability of structures of natural and designed objects are related to their functions. ● Use materials to design a device that solves a specific problem or [design] a solution to a specific problem. ● Use materials to design a solution to a human problem that mimics how plants and/or animals use their external parts to help them survive, grow, and meet their needs: Examples of human problems that can be solved by mimicking plant or animal solutions could include: ● Designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales. ● Stabilizing structures by mimicking animal tails and roots on plants.	**Summative Assessments** ● Labs/Reports ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Models ● Teacher Conference ● Observations

● Keeping out intruders by mimicking thorns on branches and animal quills. ● Detecting intruders by mimicking eyes and ears. ● Develop a simple model based on evidence to represent a proposed object or tool. ● Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	

Learning Activities

What is looks like in the classroom…

In this unit of study, students investigate how plants and animals use their external structures to help them survive, grow, and meet their needs. Then students are challenged to apply their learning to design a solution to a human problem that mimics how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
In order to recognize ways in which animals and plants use their external structures, students need opportunities to observe and describe how the shape and stability of organisms' structures are related to their functions. Students can make direct observations and use media resources to find relevant examples for both plants and animals. They should observe that different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. In addition, animals have body parts that capture and convey different kinds of information from the environment, enabling them to respond to these inputs in ways that aid in survival. Plants, like animals, have different parts (roots, stems, leaves, flowers, fruits) that each serve specific functions in survival and growth, and plants also respond to external inputs. For each structure that students observe, they should describe how the shape and stability of that structure is related to its function.

The next step in this unit is to engage in engineering design. Students need opportunities to use materials to design a device that solves a specific human problem. Designs should mimic how plants and/or animals use their external parts to help them survive and grow. The engineering design process students engage in should include the following steps:

- As a class or in small groups, students participate in shared research to find examples of human-made products that have been designed and built by applying knowledge of the natural world. For each example, students identify the human problem(s) that the product solves and how that solution was designed using an understanding of the natural world.
- Students brainstorm possible human problems that can be solved by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Examples could include:
- Designing clothing or equipment to protect bicyclists that mimics turtle shells, acorn shells, and animal scales.

- Stabilizing structures that mimic animal tails and plant roots.
- Keeping out intruders by mimicking thorns on branches and animal quills.
- Detecting intruders by mimicking eyes and ears.
  - In small groups, students use sketches, drawings, or physical models to convey a design that solves a problem by mimicking one or more external structures of plants and/or animals.
  - Use materials to create the design solution.
  - Share the design solution with others in the class.

Example Activities

Eat Like a Bird! January: This lesson and activity is one of several lessons about birds. In this lesson, students learn that bird beaks come in many different sizes and shape. Each beak has a specific shape and function to help the bird to get and eat food.

Why So Yummy: In this lesson students will investigate how fruits help some plants survive. The background information is important to the overall goals of this lesson. It states, "fruit-bearing plants can be distinguished from other plants, because they contain a reproductive structure that develops into an edible fruit. This reproductive structure is the shelter that protects the seeds until they are mature. This is important, because seeds are not distributed to the earth for germination until they are ripe." The teacher will need to purchase some fruits ahead of time for this lesson. Identifying a variety of fruits and especially fruits children might have less experience with will enhance the experience.

The Emperor Penguin's Egg: Students read a book about Emperor penguins and learn about how parental behavior helps their offspring to survive. Then students use what they have learned to model how Emperor penguins care for the eggs of their young.

Investigating Pill Bug Structures: This 5-E lesson plan encourages students to observe pill bug behavior during a checkpoint lab and associate the behaviors with pill bug sense receptors. After observing the pill bugs, students design investigations to answer the questions.

How Do Animals Move?: This 5E lesson addresses animal structures and how these structures function to help the animal survive. The Big Idea: RUN! JUMP! SLITHER! Let's move like animals and learn how to survive in nature!

Ultimate Animal Moms - Baby Animals: This is one minute and twenty five second video clip depicts baby animals and their parents. It emphasizes the fact that offspring need to learn a vast amount from their parents. They learn how to communicate, play, ...

Penguin Parent Patrol: This two minute and forty eight second video describes Emperor Penguin parents and the obstacles they overcome to help their offspring survive. The obstacles include: starvation, freezing weather, and predators.

Bee-ing an Engineer with Wisconsin Fast Plants: This resource is an excerpt of lessons from the University of Wisconsin-Madison's Investigating Plants with Wisconsin Fast Plants Program. Students will explore Fast Plants' flowers and learn how flowers and their internal structures are related to…

Animal Horns: This is a short two minute video about the variety of horns that animals have and their importance for protection and breeding rights. The video explains that animals go head-to-head and when the stronger male wins, they are able to pass their genes.

Why So Yummy: In this lesson students will investigate how fruits help some plants survive. The background information is important to the overall goals of this lesson. It states, "fruit-bearing plants can be distinguished from other plants, because they contain ...

Eat Like a Bird! January: This lesson and activity is one of several lessons about birds. In this lesson, students learn that bird beaks come in many different sizes and shape. Each beak has a specific shape and function to help the bird to get and eat food. ...

How Animals Meet Their Needs: This is a link to an interactive game students can use as a whole group or on personal devices. Students click on a projector button and an animal appears on the screen.

Where in the Wild?: Using the book titled Where in the Wild? Camouflages Creatures Concealed and Revealed by Davide Schwartz and Yeal Schy students develop an understanding of how particular features help animals survive. This lesson focuses on the use of camouflage.

Leaf It To Me: Students participate in a leaf scavenger hunt and create a leaf collection. Through the lesson students identify characteristics such as leaf size, thickness and texture and explore how these characteristics help plants survive in their environment.

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students participate in shared research and writing projects. Engaging in engineering design provides a perfect opportunity for students to conduct shared research and complete writing projects. Students can use text and media resources to gather information about how the shape and stability of external structures of organisms are related to their functions. In addition, students can conduct simple research to find examples of how humans solve problems using an understanding of the natural world. Examples of writing projects could include creating a book that includes examples of how humans mimic the characteristics of organisms to design solutions to human problems. Students can also use drawings or other visual displays to accompany their design solutions. Students will need support from teachers to conduct shared research and complete writing projects.

- Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions). (1-LS1-1)
- Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2) SL.2.5

Mathematics

N/A

Accommodations and Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- preferential seating
- organize and offer flexible small group learning activities
- modify assessments

21st Century Life and Careers

CAREER READY PRACTICES

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them

CRP11. Use technology to enhance productivity.

CAREER AWARENESS, EXPLORATION, AND PREPARATION

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

CAREER AND TECHNICAL EDUCATION **9.3.12.AG-ANI.6** Classify, evaluate and select animals based on anatomical and physiological characteristics.
Integration of Technology
8.1.2.A.4 Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums). 8.1.2.E.1 Use digital tools and online resources to explore a problem or issue. 8.1.2.B.1 Illustrate and communicate original ideas and stories using multiple digital tools and resources.
Pacing Guide
https://docs.google.com/document/d/1UvXwMPr7ZInl1TtUmZyFTS5uT4d3YczxYBqgTZCKK5s/edit?usp=sharing

Unit Title	Relating patterns of sunlight throughout the year as well as to relationships between parents and offspring
Length of Unit	Marking Period 4
Summary/Overview	In this unit of study, students develop an understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs, as well as how the behaviors of parents and offspring help offspring survive. The understanding that young plants and animals are like, but not exactly the same as, their parents is developed. The crosscutting concept of *patterns* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *obtaining, evaluating, and communicating information* and *constructing explanations*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 1-LS3-1 and 1-LS1-2.

Desired Outcomes	
Standards	
1-LS3-1	**Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.**
1-LS1-2	**Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.**
Focus Standards	
LS3.A	**Inheritance of Traits** • Many characteristics of organisms are inherited from their parents. (3-LS3-1)
LS1.B	**Growth and Development of Organisms** • Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)
Learning Objectives (Students will be able to…)	
● Use grade-appropriate books and other reliable media to obtain the following scientific information about the idea that both plants and animals can have offspring.	

- Use grade-appropriate books and other reliable media to obtain the following scientific information about behaviors of animal parents that help offspring survive (e.g., keeping offspring safe from predators by circling the young, feeding offspring).
- Use grade-appropriate books and other reliable media to obtain the following scientific information about behaviors of animal parents that help offspring survive (e.g., keeping offspring safe from predators by circling the young, feeding offspring).
- Use grade-appropriate books and other reliable media to obtain the following scientific information about behaviors of animal offspring that help the offspring survive (e.g., crying, chirping, nuzzling for food).
- Evaluate information to determine and describe the patterns of what animal parents and offspring do to help offspring survive (e.g., when a baby cries, the mother feeds it; when danger is present, parents protect offspring; some young animals become silent to avoid predators).
- articulate a statement that relates a given phenomenon to a scientific idea, including the idea that young plants and animals are like, but not exactly like, their parents (not to include animals that undergo complete metamorphoses, such as insects or frogs).
- Determine the key differences between different types of plants and animals (e.g., features that distinguish dogs versus those that distinguish fish, oak trees vs. bean plants).
- Articulate that young plants and animals of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity).
- Determine from observations that adult plants and animals (i.e., parents) of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity).
- Determine from observations and data that patterns of similarities and differences in features between parents and offspring.
- Connect the evidence of observed patterns in features to support the evidence-based account by describing chains of reasoning that include: young plants and animals are very similar to their parents or that young plants and animals are not exactly the same as their parents.
- Describe the similarities and differences in features are evidence that young plants and animals are very much, but not exactly, like their parents.
- Describe that the similarities and differences in features are evidence that although individuals of the same type of animal or plant are recognizable as similar, they can also vary in many ways.

Understandings (Students will understand or know...)	**Essential Questions**
• **Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.** • **Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.** • **Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents.** • **Scientists look for patterns and order when making observations about the world.** • **Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.**	1. *How are young plants and animals alike and different from their parents?* 2. *What types (patterns) of behavior can be observed among parents that help offspring survive?*

• **Adult plants and animals can have young.** • **In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring survive.**	

Assessment Evidence	
Formative Assessments • Observe and use patterns in the natural world as evidence and to describe phenomena. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. • Examples of patterns could include features plants or animals share. • Examples of observations could include that leaves from the same kind of plant are the same shape but can differ in size and that a particular breed of puppy looks like its parents but is not exactly the same. • Observe and use patterns in the natural world as evidence and to describe phenomena. • Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. • Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. Examples of patterns of behaviors could include: • The signals that offspring make, such as crying, cheeping, and other vocalizations. • The responses of the parents, such as feeding, comforting, and protecting the offspring.	**Summative Assessments** • Labs/Reports • Projects • Tests **Alternative Assessments** • Oral Presentations • Models • Teacher Conference • Observations

Learning Activities

What it looks like in the classroom...

In this unit of study, students observe organisms in order to recognize that many types of young plants and animals are like, but not exactly the same as, their parents. Students also observe how organisms use their external parts to help them survive, grow, and meet their needs, and how the behaviors of parents and offspring help offspring survive. Throughout the unit, students will look for patterns; obtain, evaluate, and communicate information; and construct explanations.
People look for patterns in the natural world and use these patterns as evidence to describe phenomena. Students begin this unit by observing and comparing external features of organisms, looking for patterns in what they observe. They will need opportunities to observe a variety of plants and animals in order to look for similarities and differences in their features. For

example, when comparing the shape, size, color, or number of leaves on plants, students begin to notice that plants of the same kind have leaves that are the same shape and color, but the leaves of one plant may differ from another in size or number. When comparing body coverings; number, size, and type of external features (legs, tail, eyes, mouth parts); body size, body coloring, or eye color of animals, students learn that animals of the same kind have the same type of body covering and the same number and types of external features, but the size of the body, the size of external features, body color, and/or eye color of individuals might differ. Making observations like these helps students recognize that young plants and animals look very much, but not exactly, like their parents, and that even though individuals of the same kind of plant or animal are recognizable as similar, they can also vary in many ways.
In addition to observing and documenting similarities and differences in the external features of organisms, students also need opportunities to make direct observations, read texts, or use multimedia resources to determine patterns in the behaviors of parents and offspring that help offspring survive. While both plants and animals can have young, it is the parents of young animals who might engage in behaviors that help their young survive. Some examples of these patterns of behaviors could include the signals that offspring make, such as crying, cheeping, and other vocalizations, and the responses of parents, such as feeding, comforting, and protecting their young.

Example Activities

Chip Off the Old Block: In this lesson students compare adult plants with young plants and then match pictures of adult animals with their young. They then are asked to identify specific physical traits of plants and animals that can be used to identify them. Note: The Parent/Offspring photo collection on page three incorrectly states the offspring of a horse is a pony.

Eat Like a Bird! January: This lesson and activity is one of several lessons about birds. In this lesson, students learn that bird beaks come in many different sizes and shape. Each beak has a specific shape and function to help the bird to get and eat food.

Why So Yummy? In this lesson students will investigate how fruits help some plants survive. The background information is important to the overall goals of this lesson. It states, "fruit-bearing plants can be distinguished from other plants, because they contain a reproductive structure that develops into an edible fruit. This reproductive structure is the shelter that protects the seeds until they are mature. This is important, because seeds are not distributed to the earth for germination until they are ripe." The teacher will need to purchase some fruits ahead of time for this lesson. Identifying a variety of fruits and especially fruits children might have less experience with will enhance the experience.

Family Tree - Genealogy Study

Animal Traits http://www.harmonydc.org/Curriculum/pdf/1sample.pdf

Create an Animal based on characteristics and habit

http://creativeeducator.tech4learning.com/2014/lessons/create-a-creature

http://switchzoo.com

Design your own superspecies

LIFE-SCIENCE-Project-Based-Learning-PBL.docx - Snow Elementary

NSTA Science Lessons: First Grade Standards

http://ngss.nsta.org/AccessStandardsByTopic.aspx

Resources

National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

To integrate English Language Arts into this unit, students need opportunities to read informational texts to gather information about traits and behaviors of organisms. With adult guidance, they identify the main topic, retell key details from texts, and ask and answer questions about key details. Students should also participate in shared research and writing projects. They can gather information from a variety of preselected, grade-level-appropriate texts and resources and use that information to answer questions about traits and behaviors of organisms. In pairs or small groups, students can use pictures and words to create simple books that describe features that parents and offspring share or behaviors that parents and offspring exhibit that help offspring survive.

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1) RI.3.1
- Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-1) RI.3.2
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1) RI.3.3
- Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS1-1) W.1.7
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-1) SL.3.4
- Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS3-1) W.3.2

Mathematics

To integrate mathematics into this unit, students reason abstractly and quantitatively and use appropriate tools strategically as they collect and organize data, and use it to solve problems. For example, when students gather information about the shape, size, color, and number of leaves on plants, they can:

- Use grade-level-appropriate tools and strategies to measure, compare, and order leaves by length.
- Organize data (e.g., number of leaves) into simple graphs or tables, and then use strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to make comparisons.
- Use drawings and equations as they solve problems (e.g., more or less, total amount, how many in each).
- Reason abstractly and quantitatively. (3-LS3-1) MP.2
- Model with mathematics. (3-LS3-1) MP.4
- Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS3-1) 3.MD.B.4

Accommodations and Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per

IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
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21st Century Life and Careers

CAREER READY PRACTICES

CRP2. Apply appropriate academic and technical skills.

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CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them

CRP11. Use technology to enhance productivity.

CAREER AWARENESS, EXPLORATION, AND PREPARATION

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

CAREER AND TECHNICAL EDUCATION

9.3.12.AG-ANI.6 Classify, evaluate and select animals based on anatomical and physiological characteristics.

Integration of Technology

8.1.2.A.4
Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.E.1
Use digital tools and online resources to explore a problem or issue.

8.1.2.B.1
Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Pacing Guide

https://docs.google.com/document/d/1UvXwMPr7ZInl1TtUmZyFTS5uT4d3YczxYBqgTZCKK5s/edit?usp=sharing

Annual Pacing Guide
Grade Level:
Subject:

September	October	November	December	January
ing the patterns of the n, moon, and stars to ke predictions of future servations.	Using the patterns of the sun, moon, and stars to make predictions of future observations.	Using the patterns of the sun, moon, and stars to make predictions of future observations. Sending messages over a distance using light or sound	Using the patterns of the sun, moon, and stars to make predictions of future observations. Sending messages over a distance using light or sound	Using the patterns of th sun, moon, and stars to make predictions of futu observations. Sending messages over distance using light or sound

February	March	April	May	June
ing the patterns of the n, moon, and stars to ke predictions of future servations. nlight and Organisms	Using the patterns of the sun, moon, and stars to make predictions of future observations. Sunlight and Organisms	Using the patterns of the sun, moon, and stars to make predictions of future observations. Relating patterns of	Using the patterns of the sun, moon, and stars to make predictions of future observations. Relating patterns of sunlight throughout the	Using the patterns of th sun, moon, and stars to make predictions of futu observations. Relating patterns of

		sunlight throughout the year as well as to relationships between parents and offspring	year as well as to relationships between parents and offspring	sunlight throughout the year as well as to relationships between parents and offspring

Deal School Curriculum

Science Curriculum Guide Grade 2

Course Title: 2nd Grade Science

Deal School

Deal, New Jersey

2018

Administration

Administration

Donato Saponaro, Jr.

Superintendent of Schools
Principal

Curriculum Writing

Committee Administration

Donato Saponaro, Jr.

Consultant/Curriculum Development
Next Generation Science Education
Consulting LLC
Jena Valdiviezo

Teacher(s)

Mrs. Illiano

Developed and

Written

March 2017 –

May 2017

Revised

December 2018

Unit Title	Relationship in Habitats
Length of Unit	Marking Period 1
Summary/Overview	***Why do we see different living things in different habitats?*** In this unit of study, students develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students also compare the diversity of life in different habitats. The crosscutting concepts of *cause and effect* and *structure and function* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *developing and using models*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
2-LS4-1	**Make observations of plants and animals to compare the diversity of life in different habitats.**
2-LS2-1	**Plan and conduct an investigation to determine if plants need sunlight and water to grow.**
2-LS2-2	**Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.**
K-2-ETS1-1)	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool**
Focus Standards	

LS4.D	Biodiversity and Humans ● There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)
LS2.A	Interdependent Relationships in Ecosystems ● Plants depend on water and light to grow. (2-LS2-1) ● Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)
ETS1.B	Developing Possible Solutions ● Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary to 2-LS2-2)*
ETS1.A	Defining and Delimiting Engineering Problems ● A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) ● Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) ● Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

Learning Objectives
(Students will be able to…)

- Describe the diversity of living organisms.
- Describe the biological needs of plants including reproductive and growth of plants.
- Describe how the diversity of habitats affects the organisms that live in
- Model the concept of bio diversity through multiple means of representation, such as a 3D model, drawing, or written expression.
- Students identify and describe diversity of life in different habitats
- Comparison and contrast plant and animal life.
- Based on observations of habitats students will be able to describe land habitats (e.g., playground, garden, forest, parking lot) and water habitats (e.g., pond, stream, lake).
- Describe based on observations (firsthand or from media) different types of living things in each habitat (e.g., trees, grasses, bushes, flowering plants, lizards, squirrels, ants, fish, clams).
- Describe different types of living things that can be found in different habitats.
- Provide evidence of patterns of plant and animal diversity across habitats (i.e. cold habitat animal need fur)
- Collect, record, and organize data on different types of plants and animals in the habitats.
- Answer a question about whether plants need sunlight and water to grow.

- Investigate plant growth with both light and water.
- Determine whether plants need light and water to grow.
- Describe how plants will be kept with/without light in both the light/dark test and the water/no water test.
- Observe and record plant growth (e.g., observations of plant height, number and size of leaves, thickness of the stem, number of branches).
- Collaboratively collect and record data on plant growth: (i.e providing both light and water or withholding light but providing water).
- Develop a simple model that mimics the function of an animal in seed dispersal or pollination of plants (e.g., hair that snares seeds, squirrel cheek pouches that transport seeds, bees have fuzzy bodies to which pollen sticks, hummingbirds have bills that transport pollen)
- Students identify the relevant components of their model, including those components that mimic the natural structure of an animal that helps it disperse seeds (or that mimic the natural structure of an animal that helps it pollinate plants).
- Describe how pollen or seeds move in environment.

Understandings (Students will understand or know...)	Essential Questions
People look for patterns and order when making observations about the world. **There are many different kinds of living things in any area, and they exist in different places on land and in water.** **Events have causes that generate observable patterns.** **Plants depend on water and light to grow.** **The shape and stability of structures of natural and designed objects are related to their function.** **Plants depend on animals for pollination or to move their seeds around.** **Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.**	1. *How does the diversity of plants and animals compare among different habitats?* 2. *What do plants need to live and grow?* 3. *Why do some plants rely on animals for reproduction?*

Assessment Evidence

Formative Assessments	Summative Assessments
• Look for patterns and order when making observations about the world. • Make observations (firsthand or from media) to collect data that can be used to make comparisons. • Make observations of plants and animals to compare the diversity of life in different habitats. • Observe patterns in events generated by cause-and-effect relationships. • Plan and conduct an investigation collaboratively to produce data to serve as a basis for evidence to answer a question. • Plan and conduct an investigation to determine whether plants need sunlight and water to grow. • Describe how the shape and stability of structures are related to their function. • Develop a simple model based on evidence to represent a proposed object or tool. • Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. • Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem	• Labs • Projects • Tests **Alternative Assessments** • Oral Presentations • Teacher Observations • Making Models

Learning Activities
What it looks like in the classroom… In this unit of study, students explore and compare the diversity of life in different habitats. They develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students learn about cause-and-effect relationships and how an organism's structures are related to the function that each structure performs. Developing and using models plays an important role in students' understanding of structure/function relationships. To begin this unit's progression of learning, students observe a variety of plants and animals from a

variety of habitats in order to compare the diversity of life. Using firsthand observations and media resources, students explore and collect data about different habitats that exist in the world and how plants and animals have structures that help them survive in their habitats. Students need many opportunities to observe many different kinds of living things, whether they live on land, in water, or both. As students learn about the diversity of life, they begin to look for patterns and order in the natural world. As scientists, students will begin to notice patterns in the structures that enable organisms to support their existence in specific habitats. For example, webbed feet enable survival in wetlands; gills enable survival in rivers, lakes, and oceans; and blubber enables survival in polar regions.

The learning progresses as students' focus changes from diversity to commonalities among plants—what plants need in order to grow. Students need opportunities to observe that plants depend on water and light to grow. As they begin to understand that changes in the amount of water and light can affect the growth of plants, they begin to understand that all cause-and-effect relationships generate observable patterns. For example, some plants require very little water to survive, most plants will not grow without sunlight, and most plants need an adequate amount of water to thrive. Students might also observe patterns such as the effects of too much or too little water on a plant and too much or too little light on a plant. In order for students to develop these understandings, they should plan and conduct investigations and collect data, which should be used as evidence to support the idea that all events have causes that generate observable patterns.

Finally, students investigate the roles that animals play in plant reproduction. Students learn that many types of plants depend on animals for pollination and/or for the dispersal of seeds. As students begin to explore the interdependent relationships among plants and animals, they learn that the shape and stability of the structures of organisms are related to their function. For example,

- As bees collect nectar, portions of their body are designed to collect and then carry pollen from plant to plant.
- Some seeds are designed to stick to animal fur so that animals can carry them from place to place.
- Animals eat fruits containing seeds, which are then dispersed through animal's' body waste.

Second graders will need multiple opportunities to develop an understanding of the important relationship between structure and function, because they are expected to use engineering design to plan and develop simple models that mimic the function of an animal in dispersing seeds or pollinating plants. Students can use sketches, drawings or physical models to illustrate how the shape of the model helps it function as needed, and they should use evidence to support their design choices. Some common examples of models could include the following:

- Using Velcro "seeds" and furry material to model how seeds with hooks adhere to animal fur.
- Using pipe cleaners to gather and distribute "pollen" in a way similar to bees pollinate flowers.

In this unit of study, students learn that designs can be conveyed through sketches, drawings, or physical models, and that these representations are useful in communicating ideas for a problem's solutions to other people. As described in the narrative above, students develop simple sketches, drawings, or models that mimic the function of an animal in dispersing seeds or pollinating plants in order to illustrate how the shape of an object helps it function as needed to solve a given problem.

Example Activities

Do Plants Need Sunlight? Students will explore the importance sunlight for a plant's survival by conducting an investigation. Each group of students will cover parts of plants' leaves with black construction paper and make observations of the plant's leaves over several days. This lesson serves to model the process of investigation. The investigation will take 7 days to complete. Then students can remove the black paper, place the plants back in the sunlight, and view the leaves in a second investigation.

Who Needs What? Students identify the physical needs of animals. Through classroom discussion, students speculate on the needs of plants. With teacher guidance, students then design an experiment that can take place in the classroom to test whether or not plants need light and water in order to grow. Students conduct the associated activity in which sunflower seeds are planted in plastic cups, and once germinated, are exposed to different conditions. In the classroom setting, students test for the effects of light versus darkness, and watered versus non-watered conditions. During exposure of the plants to these different conditions, students measure growth of the seedlings every few days using non-standard measurement. After a few weeks, students compare the growth of plants exposed to the different conditions, and make pictorial bar graphs that demonstrate these comparisons.

I Scream, You Scream, We All Scream for Vanilla Ice Cream! In this lesson students design a vanilla plant pollinator. This is an end-of-the-unit task, taking about 3 days to complete. The students will view an amazing video that tells about the problems with pollinating vanilla by hand. The students pretend to be employees of Ben and Jerry's ice cream company and help to plan and design a pollinator for the vanilla plant so that the great vanilla flavored ice cream can continue to be produced. (This is the first of several lessons created by Jeri Faber on plant pollination at: betterlessons.com/)

Building and Testing Our Vanilla Plant Pollinator: In previous lessons designed by Jeri Faber, students have learned about how animals help pollinate flowers. The students have also planned and designed their own vanilla plant pollinator. In this lesson, students use the engineering design process to build and test the plant pollinator they planned the day before in class.

Two Scoops Are Better Than One: This lesson is the second day of an end of the unit task to address the Performance Expectation: Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. This end of unit task is expected to take 3-4 days to complete. In the previous lesson (http://betterlesson.com/lesson/628130/i-scream-you-scream-we-all-scream-for-vanilla-ice-cream), the students were challenged to brainstorm their version of a vanilla flower pollinator. For this lesson, students work with a partner to choose and develop their engineering plans by drawing a diagram for a vanilla plant pollinator. They also create a list of materials needed for the task.

Improving Our Vanilla Bean Pollinators: This lesson is part of a series of lessons created by Jeri Faber on using the engineering design process to solve a problem. In the Ice Scream, You Scream We All Scream for Vanilla Ice Cream, the students were challenged to design a vanilla flower plant pollinator. For day 2, Two Scoops Are Better Than One, students worked with a partner to determine which design to build for their vanilla plant pollinator. For day 3, Building and Testing Our Vanilla Pollinators, the students constructed and tested the effectiveness of their pollinators based on the design plans. In this lesson, students improve their plant pollinator models and retest the pollinator's effectiveness.

The Bug Chicks-Mission: Pollination (Episode 5): The Bug Chicks' five minute video provides a fun, animated way of learning about the fascinating world of pollination and insects. In this video, the students observe interesting museums and habitats to look at lesser known insect pollinators. The student challenge at the end leads students into their environment to look for other pollinators and encourages them to bring their observations back to the classroom to discus

World of the weird and wacky - This video, presented in the form of a game show, introduces students to the unusual leaves of some plants and how they help the plant survive. It is a nice introduction to a study of plant structures and functions or as a discussion starter for further research about how plants meet their needs in a variety of environments. It can also be used as an extension activity, after a plant unit of study, to see if students can apply their knowledge to unusual plants and environments and in a different context.
http://www.science4us.com/SCO/act_756/index.aspx?aid=756&cid=P-0

David Williams Rainforest Song With Lyrics https://www.youtube.com/watch?v=BQ3ToUoW1ak

Trip to the Rainforest https://www.youtube.com/watch?v=9rEBbF6wnSw

Magic School Bus Rainforest https://www.youtube.com/watch?v=me7LIuLEraI

Wonders of the Rainforest https://betterlesson.com/lesson/630106/the-wonders-of-the-rain-forest

Biodiversity http://pbskids.org/dragonflytv/show/biodiversity.html

The Bug Chicks' five minute video provides a fun, animated way of learning about the fascinating world of pollination and insects. In this video, the students observe interesting museums and habitats to look at lesser known insect pollinators. The student challenge at the end leads students into their environment to look for other pollinators and encourages them to bring their observations back to the classroom to discuss
https://pollinatorlive.pwnet.org/teacher/bug_chicks.php?movie_file=BugChicks5.flv

Bee-ing and Engineer -This resource is an excerpt of lessons from the University of Wisconsin-Madison's Investigating Plants with Wisconsin Fast Plants Program. Students will explore Fast Plants' flowers and learn how flowers and their internal structures are related to their functions (in pollination and reproduction). Students will also explore how bees have structures that are associated with pollination functions, using "bee sticks" to pollinate their flowers and observing bee and flower structures with guides.
http://resources.fastplants.org/ngss/bee-inganengineer.pdf

Sock Seeds
The video demonstrates a simple investigation students may participate in to gain a better understanding of the external features of plants that help them thrive and survive in different kinds of places.
https://nj.pbslearningmedia.org/resource/tdc02.sci.life.stru.sockseeds/sock-seeds/#.WML2dzsrJPY

Better Lesson Links for Unit 1

- https://betterlesson.com/lesson/628130/i-scream-you-scream-we-all-scream-for-vanilla-ice-cream https://betterlesson.com/lesson/629477/building-and-testing-our-vanilla-plant-pollinator
- https://betterlesson.com/lesson/629527/two-scoops-are-better-than-one
- https://betterlesson.com/lesson/632218/improving-our-vanilla-plant-pollinators
- https://betterlesson.com/lesson/634057/creating-animals-that-disperse-seeds
- https://www.youtube.com/watch?v=BQ3ToUoW1ak

Do Plants Need Sunlight?
http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/sunlight.html

Who Needs What?
https://www.teachengineering.org/lessons/view/duk_sunflower_mary_less

Resources

Next Generation Science Standards https://www.nextgenscience.org
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lessons https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161
Science 4 Us - www.science4us.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts/Literacy

English Language Arts can be leveraged in this unit in a number of ways. Students can participate in shared research using trade books and online resources to learn about the diversity of life in different habitats or to discover ways in which animals help pollinate plants or distribute seeds. Students can record their findings in science journals or use the research to write and illustrate their own books. Students can also learn to take notes in their journals order to help them recall information from experiences or gather information from provided sources. They can add drawings or other visual displays to their work, when appropriate, to clarify ideas, thoughts, and feelings.

- Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS2-1) W.2.7
- Recall information from experiences or gather information from provided sources to answer a question. (2-LS2-1),(K-2-ETS1-1) W.2.8
- Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-LS2-2) SL.2.5

- With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1) W.2.6
- Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1) RI.2.1

Mathematic

Throughout this unit of study, students need opportunities to represent and interpret categorical data by drawing picture graphs and/or bar graphs (with a single-unit scale) to represent a data set with up to four categories. This will lead to opportunities to solve simple put-together, take-apart, and compare problems using information presented in these types of graphs. For example, students could create bar graphs that show the number of seedlings that sprout with and without watering or that document plant growth. They could also create a picture graph showing the number of plant species, vertebrate animal species, and invertebrate animal species observed during a field trip or in a nature photograph. As students analyze the data in these types of graphs, they can use the data to answer simple put-together, take apart, and compare problems. This unit also presents opportunities for students to model with mathematics. They can diagram situations mathematically or solve a one-step addition or subtraction word problems. Data collected in bar graphs and picture graphs can easily be used for this purpose.

- Reason abstractly and quantitatively. (2-LS2-1),(K-2-ETS1-1) MP.2
- Model with mathematics. (2-LS2-1),(2-LS2-2),(K-2-ETS1-1) MP.4
- Use appropriate tools strategically. (2-LS2-1),(K-2-ETS1-1) MP.5
- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-LS2-2) 2.MD.D.10

Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modify assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Career and Technical Education

9.3.12.AG-NR.4 Demonstrate responsible management procedures and techniques to protect or maintain natural resources.

Integration of Technology

8.1.2.A.4

Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.B.1

Illustrate and communicate original ideas and stories using multiple digital tools and resource.

8.1.2.E.1

Use digital tools and online resources to explore a problem or issue.

https://docs.google.com/document/d/1PnnQ_4M5_m2ZYsZuPTkVIqBOHCCDeAVYLohC3BpZWJw/edit?usp=sharing

Course Title: 2nd Grade Science

Unit Title	Properties of Matter and Changes in Matter
Length of Unit	Marking Period 2
Summary/Overview	***How do the properties of materials determine their use?*** ***How can objects change?*** ***Are all changes reversible?*** In this unit of study, students demonstrate an understanding of observable properties of materials through analysis and classification of different materials. Students continue to develop an understanding of observable properties of materials through analysis and classification of different materials. The crosscutting concepts of *cause and effect* and *energy and matter* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *constructing explanations*, *designing solutions*, and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
2-PS1-1	**Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.**
2-PS1-2	**Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.**
2-PS1-3	**Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.**
2-PS1-4	**Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.**

K-2-ETS1-3	**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Focus Standards	
PS1.A	Structure and Properties of Matter ● Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1) ● Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) ● A great variety of objects can be built up from a small set of pieces. (2-PS1-3)
PS1.A	Structure and Properties of Matter ● Different properties are suited to different purposes. (2-PS1-3) ● A great variety of objects can be built up from a small set of pieces. (2-PS1-3)
PS1.B	Chemical Reactions ● Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)
ETS1.C	Optimizing the Design Solution ● Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)
Learning Objectives (Students will be able to…)	
● Identify phases of matter ● Identify matter as a solid, liquid, or gas. ● Predict the outcome of a phase change. Will an ice cube melt? ● Distinguish between melting, freezing, and evaporating. ● Identify and describe different kinds of matter have different properties, and sometimes the same kind of matter has different properties depending on temperature. ● Describe and classify different kinds of materials by their observable properties. ● Describe and classify materials (e.g., different kinds of metals, rocks, wood, soil, powders). ● Observe materials at different temperatures, and how those temperatures will be determined (e.g., using ice to cool and a lamp to warm) and measured (e.g., qualitatively or quantitatively). ● Collect and record data on the properties of the materials. ● Organize materials by their properties using graphical displays (e.g., pictures, charts, grade-appropriate graphs),	

- Describe relationships between materials and their properties (e.g., metal is strong, paper is absorbent, rocks are hard, sandpaper is rough).
- Identify and describe relationships between properties of materials and some potential uses purpose (e.g., hardness is good for breaking objects or supporting objects; roughness is good for keeping objects in place; flexibility is good to keep a materials from breaking, but not good for keeping materials rigidly in place).
- Give examples of a material's intended use (e.g., ability to absorb for cleaning up spills, strength for building material, hardness for breaking a nut).
- Articulate a statement that an object made of a small set of pieces can be disassembled and made into a new object.
- Describe the characteristics (e.g., size, shape, arrangement of parts) of the original object.
- Articulate that an object can be broken into parts and reassembled in a new way.
- Articulate that the original object has its own unique properties that differ from the new object
- Compared to the original object, the new object or objects can have different characteristics, even though they were made of the same set of pieces (lego house turns into lego car).
- Describe that changes caused by heating or cooling can be reversed and some cannot (baking a cake cannot get back the original ingredients vs. ice cube to water can go back to ice cube).

- Determine that materials change after heating (e.g., ice becomes water, an egg becomes solid, solid chocolate becomes liquid).
- Describe that a change in the material after heating is reversible (e.g., water becomes ice again, a cooked egg remains a solid, liquid chocolate becomes solid but can be a different shape).
- Describe that a change in the material after cooling (e.g., when frozen, water becomes ice, a plant leaf dies).
- Describe that a change in the material after cooling is reversible (e.g., ice becomes water again, a plant leaf does not return to normal).
- Describe that a changes caused by heating or cooling can be reversed by cooling or heating (e.g., ice that is heated can melt into water, but the water can be cooled and can freeze back into ice [and vice versa]).
- Describe that some changes caused by heating or cooling cannot be reversed by cooling or heating (e.g., a raw egg that is cooked by heating cannot be turned back into a raw egg by cooling the cooked egg, cookie dough that is baked does not return to its uncooked form when cooled, charcoal that is formed by heating wood does not return to its original form when cooled).

Understandings (Students will understand or know...)	Essential Questions
• **Patterns in the natural and human-designed world can be observed.** • **Different kinds of matter exist and many of them can be either solid or liquid,**	1. *How can we sort objects into groups that have similar patterns?* 2. *Can some materials be a solid or a liquid?* 3. What should the three little pigs have used to build their houses?

depending on temperature. ● **Matter can be described and classified by its observable properties.** ● **Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.** ● **Simple tests can be designed to gather evidence to support or refute student ideas about causes.** ● **Different properties are suited to different purposes.** ● **Because there is always more than one possible solution to a problem, it is useful to compare and test designs.** ● **Objects may break into smaller pieces and be put together into larger pieces or change shapes.** ● **Different properties are suited to different purposes.** ● **A great variety of objects can be built up from a small set of pieces.** ● **People search for cause-and-effect relationships to explain natural events.** ● **Events have causes that generate observable patterns.** ● **Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.**	4. *In what ways can an object made of a small set of pieces be disassembled and made into a new object?* 5. *Can all changes caused by heating or cooling be reversed?*

Assessment Evidence	
Formative Assessments ● Observe patterns in the natural and human-designed world. ● Plan and conduct an investigation collaboratively to produce data to serve as the	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments**

basis for evidence to answer a question. ● Plan and conduct an investigation to describe and classify different kinds of material by their observable properties. ● Observations could include color, texture, hardness, and flexibility. ● Patterns could include the similar properties that different materials share. ● Design simple tests to gather evidence to support or refute student ideas about causes. ● Analyze data from tests of an object or tool to determine if it works as intended. ● Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. (Assessment of quantitative measurements is limited to length.) Examples of properties could include: ● Strength ● Flexibility ● Hardness ● Texture ● Absorbency ● Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of each. ● Break objects into smaller pieces and put them together into larger pieces or change shapes. ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. ● Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. ● Observe patterns in events generated due to cause-and-effect relationships. ● Construct an argument with evidence to support a claim. ● Construct an argument with evidence	● Oral Presentations ● Teacher Observations ● Making Models

that some changes caused by heating or cooling can be reversed, and some cannot.
● Examples of reversible changes could include materials such as water and butter at different temperatures.
● Examples of irreversible changes could include
  ● Cooking an egg
  ● Freezing a plant leaf
  ● Heating paper	

Learning Activities

What is looks like in the classroom...

In this unit of study, students look for patterns and cause-and-effect relationships as they describe and classify materials using physical properties. In addition, students collaboratively plan and carry out investigations and analyze and interpret data in order to determine which materials are best suited for an intended purpose.

In the natural world, different types of matter exist, and all matter can be described and classified according to physical properties. To begin this unit's progression of learning, students plan and conduct investigations to describe different kinds of material using observable properties. They will collect data during these investigations; analyze the data to find patterns, such as similar properties that different materials share; and use the data to classify materials. Materials can be classified by color, texture, hardness, flexibility, or state of matter. For example, students can explore hardness of rocks by shaking them in containers to see how easily they break apart. They can explore viscosity by pouring a set amount of various liquids, such as glue, oil, and water from one container to another to observe the relative speed that each flows. Students can also heat or cool a variety of materials, such as butter, chocolate, or pieces of crayon, in order to determine whether or not these materials can be either solid or liquid depending on temperature.

Because every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world, it is important that students understand that different properties are suited to different purposes. After investigating and classifying a variety of materials based on their physical properties, students will engage in the engineering design process. Students can work collaboratively, with adult guidance, to test different materials to determine which have properties that are best suited for an intended purpose. For example, this project could be launched using the children's story, *The Three Little Pigs*. After reading the story, students would:

- Investigate the physical properties of straw, sticks, and bricks in order to determine what properties make bricks the material best suited for building a house.
- Work together to brainstorm a list of possible structures that could be built with different materials. For example, students could build bridges or simple roller coasters for marbles.
- Select one structure from the list and determine the intended purpose of that structure.
- Select two or three different materials that could be used to build the structure.
- Investigate the physical properties of the materials, including shape, strength, flexibility, hardness,

texture, or absorbency.

- Collect and analyze data to determine whether or not the given materials have properties that are suited for the intended purpose of the selected structure.
- In groups, use one of the materials to build the structure. (Teachers should have different groups use different materials.)
- Test and compare how each structure performs. Because there is always more than one possible solution to a problem, it is useful to compare the strengths and weaknesses of each structure and each material used.

Integration of engineering

In this unit, students investigate the physical properties of a variety of materials, and then build a structure with materials that are best suited for the structure's intended purpose. This process is outlined in greater detail in the previous section.

In the continuation of this unit of study, students investigate cause-and-effect relationships between matter and energy as they analyze and classify materials that undergo change. Throughout the unit, students will construct explanations and engage in argument from evidence as they investigate the ways in which matter can change and determine whether or not a change is reversible. Students engaged in the engineering design process in order to understand that different properties are suited to different purposes. Students use this understanding as they construct evidence-based accounts of how an object made of small pieces can be disassembled and made into new objects. In order to do this, they need multiple opportunities to take apart and reassemble objects that are made of small pieces. For example, using blocks, building bricks, and other small objects such as Legos, small groups of students can build an object, and then a second group of students can take the object apart and build another object using those same small blocks or bricks. As students construct and deconstruct objects, then reconstruct the pieces into new objects, they should document the process in their science journals, explaining how they went about reconstructing the pieces into a new object.

After students have worked through and documented this process, ask them, "Are the changes you made to each of the original objects reversible? Can we disassemble the new objects and use the pieces to reconstruct the original object? After class discussion, ask students, "Are all changes reversible?" This should lead to opportunities for students to observe changes caused by heating or cooling. With close supervision and guidance by teachers, students can investigate such changes as heating or cooling butter, chocolate chips, or pieces of crayon, freezing water, and melting ice. They can observe an egg before and after cooking or a small piece of paper or cardboard before and after burning. As they attempt to reverse changes, they will also notice that all events have causes that generate patterns of change that can be observed and predicted. Through these types of experiences, students will recognize that some changes caused by heating or cooling can be reversed and some cannot, and they can use evidence from their investigations to support their thinking.

Example Activities

Exploring Reversible Changes of State and Exploring Irreversible Changes of State: These two lessons work together to explore reversible and irreversible changes of state through guided investigations. The PDF is a set of activities focusing on materials followed by some optional post-activity lessons.

Discovering Science: classifying and categorizing (matter, grades 2-3): This resource is a day, or longer, lab activity aimed for second and third grade students. The lesson starts with a guided discussion and an activity identifying and classifying materials, then it guides students through a series of observations of mixing and changing different materials of different states and observing the resulting effects. Overall, the lesson targets the states of matter, and forces and motion. Some of the ideas (i.e., gas and energy) are aimed at the third grader and beyond. Please note that the link above goes to a larger set of activities and you need to click on the link Discovering science: Classifying and categorizing matter grades 2-3.

Materials and Their Properties, lessons Comparing the Properties of Different Materials (pp. 22); and Exploring Thermal Insulators and Conductors (pp. 23): Students participate in an open-ended sort using various materials. Based on their self-selected categories, students explain their reasoning. Next, through a fair test trial, students use new information to decide, using evidence, which material is best suited for maintaining cold the longest.

The Properties of Materials and their Everyday Uses: This wonderful set of lessons engage students in testing materials to understand their properties and discuss appropriate uses for the materials based on those properties. For example, one activity has the students examining the materials that a number of balls are made out of (plastic, rubber, aluminum, etc.) and describing the properties of the materials (light, stretchy, rigid). Next, the students test balls made of those materials for bouncing height and record their data. The students discuss which materials are best for bouncing and why. The teacher could choose to do all of the activities and have a robust alignment with the three dimensions of the NGSS PS1-2, an engineering physical science Performance Expectation.

Matter song a music video by untamed Science: This is an engaging music video that defines and gives examples of matter. The video is fun, colorful and explores many different kinds of matter as part of the music video sequence. Young students will love the song and the interactive dance sequences.

Science Games For Kids: Properties of Materials: This resource is an interactive simulation designed to have students test various materials for different properties including flexibility, strength, waterproof, and transparency. The simulation includes a workshop where students can select different materials to see if the selected property matches the intended use.

STEM in a BOX - Shakin' Up the Classroom: K-3 EarthScienceSTEMintheboxprint.docx: In this engaging lesson, the students examine and describe materials and their properties in order to assemble these materials into a strong building that could withstand the earth shaking. The physical science core ideas in the Performance Expectation are met through a larger earth science/earthquake unit that is part of the unit level resource.

Thousands of tiny pieces can create something big: In this resource which is based on enactment in a second grade classroom and includes videos and examples of student work, the teacher introduces students to Watt's tower, a tower made of many pieces of junk in the neighborhood. Students make their own objects out of many pieces or materials that the teacher provides and the students think about and discuss whether they could use the same set of materials to make something different.

Take it apart, put it together: This is a wonderfully supported and creative lesson that involves students taking apart an old appliance and making a new object using the appliance parts. The teacher guides students using a variety of teacher prompts and individual journaling to track their idea development, questions, changing plans, and evidence-based explanations.

Exploring Reversible Changes of State and Exploring Irreversible Changes of State

These two lessons work together to explore reversible and irreversible changes of state through guided investigations. The PDF is a set of activities focusing on materials followed by some optional post-activity lessons. Two of these post activity lessons deal with reversible and irreversible changes to materials. The first lesson involves teachers showing students phenomena and then asking the students to generate questions about their observations of the phenomena. The second lesson involves students engaging in investigating, explaining and asking questions about two irreversible changes and using observations to identify what about the changes make them irreversible.

The Magic School Bus Bakes in a Cake lesson and video, "Ready Set Dough" !: This is a lesson plan that accompanies the reading or watching of The Magic School Bus Bakes a Cake, or Ready Set Dough. The lesson is a short activity with guided questions that accompany making pretzel dough. In the book and video, which are not included in the resource, The Magic School Bus shrinks down to molecule size to observe and discuss chemical and physical changes while baking. The resource contains a link to purchase the book. The video can be found at https://www.youtube.com/watch?v=dTw-ok3KkuU.

The Science of Macaroni Salad (and 2. Dig Deeper): This three minute video is great for teachers who need a short and deeper understanding of what is entailed in the Performance Expectations for Properties of Matter and what is involved when a physical and chemical change occurs. It would be over the heads of younger children, but perfect for elementary teachers who can either view the video themselves and translate the most pertinent ideas in it, or watch the video with the students and narrate in kid language. If the teacher watched the video first, they would be ensured that they had the understanding necessary for tough questions.

Slo Mo Guys: YouTube Videos https://www.youtube.com/user/theslowmoguys/videos

Matter song a music video by untamed Science https://www.youtube.com/watch?v=jQ5VbjWetUE

Classifying Matter This resource is a day, or longer, lab activity aimed for second and third grade students. The lesson starts with a guided discussion and an activity identifying and classifying materials, then it guides students through a series of observations of mixing and changing different materials of different states and observing the resulting effects. Overall, the lesson targets the states of matter, and forces and motion. Some of the ideas (i.e., gas and energy) are aimed at the third grader and beyond. Please

note that the link above goes to a larger set of activities and you need to click on the link Discovering science: Classifying and categorizing matter grades 2-3.
http://nstacommunities.org/blog/2013/08/02/discovering-science-classifying-and-categorizing-matter-grades-2-3/

Observable Properties of Matter
http://www.cpalms.org/Public/PreviewResourceLesson/Preview/46090

Identifying Your Soil This activity involves students collecting, feeling, and describing different types of soil from a known location based on properties. The students are guided to learn that soil can have different properties depending on the different materials that it is made up of (sand, silt, clay and organic materials).
https://www.dropbox.com/s/f7fyrd43hgo5tqg/Identifying%20Your%20Soil.pdf?dl=0

Physical Science For Children All About Properties https://www.youtube.com/watch?v=8ta4HygRCpk

Properties of Materials - in SlideShare https://www.slideshare.net/emiesrpe16/materials-and-their-properties-presentation

Discovering Science: classifying and categorizing (matter, grades 2-3)
http://nstacommunities.org/blog/2013/08/02/discovering-science-classifying-and-categorizing-matter-grades-2-3/

The Properties of Materials and their Everyday Uses

http://www.primaryresources.co.uk/science/pdfs/rsc_tc_nc1.pdf

Science Games For Kids: Properties of Materials
http://www.sciencekids.co.nz/gamesactivities/materialproperties.html

A House for Chase the Dog http://static.nsta.org/files/sc1605_76.pdf

The Science of Lunch:
https://www.youtube.com/watch?annotation_id=annotation_1464105769&feature=iv&src_vid=zD7W5O0BH7g&v=dN2VDcmuTl4

Engineering Encounters: Sailing Into the Digital Era http://static.nsta.org/files/sc1503_66.pdf

Thousands of tiny pieces can create something big
https://betterlesson.com/lesson/636230/thousands-of-tiny-pieces-can-create-something-big

Many parts to make an object In this resource, students work in collaborative groups to use materials to design a shelter for an army man in the desert. The "real-world" scenario and collaborative group structure is engaging for second grade students. The lesson structure is easy to read and implement. It is grade-level appropriate to meet the PE for PSI.
https://betterlesson.com/next_gen_science/browse/2087/ngss-2-ps1-3-make-observations-to-construct-an-evidence-based-account-of-how-an-object-made-of-a-small-set-of-pieces-can-be-disa

Melting and Freezing
http://sciencenetlinks.com/lessons/water-3-melting-and-freezing/

The Magic School Bus Bakes in a Cake lesson and video, "Ready Set Dough" !
https://www.scholastic.com/teachers/lesson-plans/teaching-content/magic-school-bus-baked-cake/

The Science of Macaroni Salad (and 2. Dig Deeper) - good video for teacher understanding of mixtures
https://www.youtube.com/watch?v=Vt7lN4QPU0k#digdeeper

Matter and Heat/ Irreversible Changes
https://betterlesson.com/lesson/639234/matter-and-heat-irreversible-changes

Exploring Reversible Changes of State and Exploring Irreversible Changes of State
http://www.tqg.org.uk/downloads/learning/tqg_en_bk2_kt_materials.pdf#page=26%20%20

Resources

Next Generation Science Standards **https://www.nextgenscience.org**
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lessons https://betterlesson.com
TBAISD **https://tbamoodle.tbaisd.org/course/view.php?id=161**

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

The CCSS for English Language Arts can be incorporated in this unit in a number of ways. Students can participate in shared research, using trade books and online resources, to learn about the properties of matter. As students explore different types of materials, they can record their observations in science journals, and then use their notes to generate questions that can be used for formative or summative assessment. Students can add drawings or other visual displays to their work, when appropriate, to help clarify their thinking. To teach students how to describe how reasons support specific points an author makes in a text, teachers can model the comprehension skill of main idea and details using informational text about matter. Technology can be integrated into this unit of study using free software programs (e.g., Animoto) that students can use to produce and publish their writing in science.

Students need opportunities to read texts that give information about matter and the changes that can happen to matter. With adult support, students can identify the main idea and details in informational text in order to answer questions about matter. With teacher support and modeling, students can ask and answer who, what, where, when, why, and how questions to demonstrate their understanding of key details in informational text.

As students investigate reversible and irreversible changes to matter, they should record observations in science journals, using drawings or other visual displays, when appropriate, to help clarify their thinking. To further support their learning, students can conduct shared research using trade books and online resources in order to learn more about physical changes to matter.

After reading informational texts and conducting investigations, students should be able to write opinion pieces in which they state an opinion, supply evidence to support their opinion, use linking words to connect opinion to evidence (reasons), and provide a concluding statement. For example, students can be presented with an example of matter that has been changed in some way, then asked to write an opinion piece in which they state whether or not they think the change is reversible or irreversible, and supply evidence to support their thinking. Evidence can include information recalled from experiences or information gathered from informational texts or other resources. Some possible changes that can be used are: tearing paper, bending a spoon, baking a cake, hammering a nail into a piece of wood, getting grass stains on a pair of jeans and cutting your hair.

- Describe how reasons support specific points the author makes in a text. (2-PS1-2)(2-PS1-4) RI.2.8
- With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-3) W.2.6
- Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1),(2-PS1-2) (2-PS1-3) W.2.7
- Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1),(2-PS1-2),(2-PS1-3),(K-2-ETS1-3) W.2.8
- Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (2-PS1-4) RI.2.1
- Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4) RI.2.3
- Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to

connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4) W.2.1

Mathematics

Throughout this unit of study, students have opportunities to model with mathematics and reason abstractly and quantitatively. During investigations, students can collect and organize data using picture graphs and/or bar graphs (with a single-unit scale). This can lead to opportunities to analyze data and solve simple put together, take-apart, and compare problems using information presented in these types of graphs. Some examples of ways to sort and classify materials in order to create graphs include: classifying materials as solids, liquids, or gases, classifying materials by color, shape, texture, or hardness, classifying materials based on what they are made of (e.g., wood, metal, paper, plastic and classifying materials based on potential uses.

- With any graph that students create, they should be expected to analyze the data and answer questions that require them to solve problems
- Reason abstractly and quantitatively. (2-PS1-2), (K-2-ETS1-3) **MP.2**
- Model with mathematics. (2-PS1-1),(2-PS1-2, (K-2-ETS1-3)) **MP.4**
- Use appropriate tools strategically. (2-PS1-2), (K-2-ETS1-3) **MP.5**
- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-PS1-1),(2-PS1-2), (K-2-ETS1-3) **2.MD.D.10**

Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating

- Modify assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4
Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.B.1
Illustrate and communicate original ideas and stories using multiple digital tools and resources.

8.1.2.E.1
Use digital tools and online resources to explore a problem or issue.

Pacing Guide

https://docs.google.com/document/d/1PnnQ_4M5_m2ZYsZuPTkVIqBOHCCDeAVYLohC3BpZWJw/edit?usp=sharing

Unit Title	The Earth's Land and Water
Length of Unit	Marking Period 3
Summary/Overview	***Where do we find water?*** In this unit of study, students use information and models to identify and represent the shapes and kinds of land and bodies of water in an area and where water is found on Earth. The crosscutting concept of *patterns* is called out as an organizing concept for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *developing and using models* and *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
2-ESS2-2	**Develop a model to represent the shapes and kinds of land and bodies of water in an area.**
2-ESS2-3	**Obtain information to identify where water is found on Earth and that it can be solid or liquid.**
Focus Standards	
ESS2.C	The Roles of Water in Earth's Surface Processes ● Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)
ESS2.B	Plate Tectonics and Large-Scale System Interactions

	● Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

Learning Objectives
(Students will be able to…)

- Use models to differentiate between different types of land.
- Use models to differentiate between bodies of water.
- Recognize land masses and bodies of water through a map. (Where is the Pacific Ocean).
- Represent types of land and water through visual representation such as models and drawings.
- Develop a model (i.e., a map) that identifies the relevant components that represent both land and bodies of water in an area.
- Identify and describe by using a model relationships between components using a representation of the specific shapes and kinds of land (e.g., playground, park, hill) and specific bodies of water (e.g., creek, ocean, lake, river) within a given area.
- Use the model to describe the patterns of water and land in a given area (e.g., an area may have many small bodies of water; an area may have many different kinds of land that come in different shapes).
- Describe that because they can map the shapes and kinds of land and water in any area, maps can be used to represent many different types of areas.
- Use books and other reliable media as sources for scientific information to answer scientific questions about: Where water is found on Earth, including in oceans, rivers, lakes, and ponds.?
- Identify that water can be found on Earth as liquid water or solid ice (e.g., a frozen pond, liquid pond, frozen lake).
- Determine where water is found on earth, and what form it is in (frozen at the poles or underground).

Understandings (Students will understand or know…)	Essential Questions
● **Patterns in the natural world can be observed.** ● **Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.** ● **Patterns in the natural world can be observed.** ● **Maps show where things are located. One can map the shapes and kinds of land and water in any area.**	1. *How can we identify where water is found on Earth and if it is solid or liquid?* 2. *In what ways can you represent the shapes and kinds of land and bodies of water in an area?*

Assessment Evidence

Formative Assessments	Summative Assessments
● Observe patterns in the natural world. ● Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons) and other media that will be useful in answering a scientific question. ● Obtain information to identify where water is found on Earth and to communicate that it can be a solid or liquid. ● Observe patterns in the natural world. ● Develop a model to represent patterns in the natural world. ● Develop a model to represent the shapes and kinds of land and bodies of water in an area.	● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

Learning Activities

What it looks like in a classroom...

Students look for patterns as they identify where water is found on Earth and explore the shapes and kinds of land and bodies of water found in an area. Students also develop models to identify and represent the shapes and kinds of land and bodies of water in an area.

To begin this unit's progression of learning, students identify where water is found on Earth and whether it is solid or liquid. Using texts, maps, globes, and other resources (including appropriate online resources), students will observe that water is found in liquid form in oceans, rivers, lakes, and ponds. They also discover that water exists as a solid in the Earth's snowcaps and glaciers.

After students identify where water is found on the Earth, they take a closer look at bodies of water and landforms that can be found in the natural world. Using firsthand observations and media resources, students should look for patterns among the types of landforms and bodies of water. For example, students should notice that mountains are much taller and more rugged than hills, lakes are an enclosed body of water surrounded by land, and streams flow across land and generally end at a larger body of water, such as a lake or the ocean.

Students should also have opportunities to use maps to determine where landforms and bodies of water are located. As students become more familiar with the types and shapes of landforms and bodies of water, they develop models to represent the landforms and bodies of water found in an area. For example, students can draw/create a map of the area of the state in which they live, showing various landforms (e.g., hills, coastlines, and islands) and bodies of water (e.g., rivers, lakes, ponds, and the ocean). Teachers should keep in mind that assessment does not include quantitative scaling of models (an accurate proportional relationship with the real world).

Example Activities

Creating a Landform Yakit: In this lesson, students take information learned about landforms and make a short, creative and entertaining presentation using an App called *Yakit* to tell their classmates about their research. This lesson is the 4th of 10 in a uni…

Planning a Landform Model: This is lesson 8 in a series of lessons that cover landforms and bodies of water. In this lesson, students will design and create a model of their own island that includes several types of landforms and bodies of water.

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Earth is the Water Planet Video https://www.youtube.com/watch?v=8NwS86wtmlM

Planning a Landform Model https://betterlesson.com/lesson/635822/planning-a-landform-model

Creating a Landform Yakit https://betterlesson.com/lesson/637732/creating-a-landform-yakit

Resources

Next Generation Science Standards **https://www.nextgenscience.org**
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lessons https://betterlesson.com
TBAISD **https://tbamoodle.tbaisd.org/course/view.php?id=161**

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students gather information about the types of landforms and bodies of water from experiences or from text and digital resources. They can use this information to answer questions such as, “Where can water be found as solid ice or snow year round?” Students should also have the opportunity to use their research to publish a writing piece, with guidance and support from adults or collaboratively with peers, based on their findings about various landforms and bodies of water. Diagrams, drawings, photographs, audio or video recordings, poems, dioramas, models, or other visual displays can accompany students' writing to help recount experiences or clarify thoughts and ideas.

- With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS2-3) W.2.6
- Recall information from experiences or gather information from provided sources to answer a question. (2-ESS2-3) W.2.8
- Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2) SL.2.5

Mathematics

As students collect data about the size of landforms and bodies of water, these numbers can be used to answer questions, make comparisons, or solve problems. For example; If students know that a mountain is 996 feet in height, a lake is 550 feet deep, a river is 687 miles long, and a forest began growing about 200 years ago, have students show each number in three ways using base-ten blocks, number words, and expanded form.A stream was 17 inches deep before a rainstorm and 33 inches deep after a rainstorm. How much deeper did it get during the rainstorm?

As students engage in these types of mathematical connections, they are also modeling with mathematics and reasoning abstractly and quantitatively. When modeling with mathematics, students diagram situations mathematically (using equations, for example) and/or solve addition or subtraction word problems. When students reason abstractly and quantitatively, they manipulate symbols (numbers and other math symbols) abstractly and attend to the meaning of those symbols while doing so.

- Reason abstractly and quantitatively. (2-ESS2-2) MP.2
- Model with mathematics. (2-ESS2-2) MP.4
- Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2) 2.NBT.A.3
- Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. (2-ESS2-1) 2.MD.B.5

Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modify assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4

Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.B.1

Illustrate and communicate original ideas and stories using multiple digital tools and resources.

8.1.2.E.1

Use digital tools and online resources to explore a problem or issue.

Course Title: 2nd Grade Science

Pacing Guide
https://docs.google.com/document/d/1PnnQ_4M5_m2ZYsZuPTkVIqBOHCCDeAVYLohC3BpZWJw/edit?usp=sharing

Unit Title	Changes to Earth's Land
Length of Unit	Marking Period 4
Summary/Overview	***In what ways do humans slow or prevent wind or water from changing the shape of the land?*** In this unit of study, students apply their understanding of the idea that wind and water can change the shape of land to compare design solutions to slow or prevent such change. The crosscutting concepts of *stability and change*; *structure and function*; and *the influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *asking questions and defining problems*, *developing and using models*, and *constructing explanations and designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
2-ESS1-1	**Use information from several sources to provide evidence that Earth events can occur quickly or slowly.**
2-ESS2-1	**Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land**
K-2-ETS1-1	**Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
K-2-ETS1-2	**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Focus Standards	

ESS1.C	The History of Planet Earth ● Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)
ESS2.A	Earth Materials and Systems ● Wind and water can change the shape of the land. (2-ESS2-1)
ETS1.A	Defining and Delimiting Engineering Problems ● A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) ● Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) ● Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)
ETS1.B	Developing Possible Solutions ● Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)

Learning Objectives
(Students will be able to…)

- Describe the process that changing land undergoes.
- Explain how wind can affect the shape of a land.
- Explain how water can affect the shape of a land
- Predict changes to land based on wind and water patterns.
- Articulate a statement that Earth events can occur very quickly or very slowly.

- Articulate that some Earth events occur quickly (e.g., the occurrence of flood, severe storm, volcanic eruption, earthquake, landslides, erosion of soil).
- Determine that some results of Earth events that occur very slowly (e.g., erosion of rocks, weathering of rocks).
- Model relative amount of time it takes for the given Earth events to occur (e.g., slowly, quickly, hours, days, years).
- Model relative amount of time it takes for the given Earth events to occur (e.g., slowly, quickly, hours, days, years).
- Articulate that some Earth events occur quickly (e.g., the occurrence of flood, severe storm, volcanic eruption, earthquake, landslides, erosion of soil).

Course Title: 2nd Grade Science

Understandings (Students will understand or know...)	**Essential Questions**
● Some events happen very quickly; others occur very slowly over a time period much longer than one can observe. ● Things may change slowly or rapidly. ● Things may change slowly or rapidly. ● Developing and using technology has impacts on the natural world. ● Scientists study the natural and material world. ● The shape and stability of structures of natural and designed objects are related to their function(s). ● Wind and water can change the shape of the land. ● Because there is always more than one possible solution to a problem, it is useful to compare and test designs. ● A situation that people want to change or create can be approached as a problem to be solved through engineering. ● Asking questions, making observations, and gathering information are helpful in thinking about problems. ● Before beginning to design a solution, it is important to clearly understand the problem. ● Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people	1. *What evidence can we find to prove that Earth events can occur quickly or slowly?* 2. *In what ways do humans slow or prevent wind or water from changing the shape of the land?*

Assessment Evidence	
Formative Assessments	**Summative Assessments** ● Labs

● Make observations from several sources to construct an evidence-based account for natural phenomena. ● Use information from several sources to provide evidence that Earth events can occur quickly or slowly. Some examples of these events include: ● Volcanic explosions ● Earthquakes ● Erosion of rocks. ● Compare multiple solutions to a problem. ● Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Examples of solutions could include: ● Different designs of dikes and windbreaks to hold back wind and water ● Different designs for using shrubs, grass, and trees to hold back the land. ● Ask questions based on observations to find more information about the natural and/or designed world. ● Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. ● Define a simple problem that can be solved through the development of a new or improved object or tool. ● Develop a simple model based on evidence to represent a proposed object or tool. ● Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

Learning Activities

What it looks like in the classroom…

In this unit of study, students learn that a situation that people want to change or create can be approached as a problem to be solved through engineering. Before beginning to design a solution, it is important to clearly understand the problem, and asking questions, making observations and gathering information are helpful in thinking about and clarifying problems. Students learn that designs can be conveyed through sketches, drawings, or physical models, and that these representations are useful in communicating ideas for a problem's solutions to other people. As outlined in the narrative above, students will develop simple sketches or drawings showing how humans have helped minimize the effects of a chosen Earth event.

Students use evidence from several sources to develop an understanding that Earth events can occur quickly or slowly. Because some events happen too quickly too observe, and others too slowly, we often rely on models and simulations to help us understand how changes to the surface of the Earth are caused by a number of different Earth events. For example,

- Volcanic eruptions are Earth events that happen very quickly. As volcanic eruptions occur, ash and lava are quickly emitted from the volcano. The flow of lava from the volcano causes immediate changes to the landscape as it flows and cools.
- Flooding can happen quickly during events such as hurricanes and tsunamis. Flooding can cause rapid changes to the surface of the Earth.
- Rainfall is an event that recurs often over long periods of time and will gradually lead to the weathering and erosion of rocks and soil.

In order to gather information to use as evidence, students need to make observations. They can easily look for evidence of changes caused by rain, flooding, or drought. However, actually observing Earth events as they happen is often not possible; therefore, students will need opportunities to observe different types of Earth events using models, simulations, video, and other media and online sources. At this grade level, quantitative measurements of timescales are not important. Students do need to see the kinds of changes that Earth events cause, and whether the changes are rapid or slow.

Engaging in engineering design helps students understand that a situation that people want to change or create can be approached as a problem to be solved through engineering. Asking questions, making observations, and gathering information are helpful in clearly understanding the problem. Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. In this unit of study, students need the opportunity to engage in the engineering design process in order to generate and compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Students are not expected to come up with original solutions, although original solutions are always welcome. The emphasis is on asking questions, making observations, and gathering information in order to compare multiple solutions designed to slow or prevent wind or water from changing the land. This process should include the following steps:

- As a class, with teacher guidance, students brainstorm a list of natural Earth events, such as a volcanoes, earthquakes, tsunamis, or floods. The class selects one Earth event to research in order to gather more information.
- As a class or in small groups, with guidance, students conduct research on the selected Earth event using books and other reliable sources. They gather information about the problems that are caused by the selected event, and gather information on the ways in which humans have minimized the effects of the chosen earth event. For example,
  - Different designs of dikes or dams to hold back water,

- Different designs of windbreaks to hold back wind, or
- Different designs for using plants (shrubs, grass, and/or trees) to hold back the land.
- Next, students look for examples in their community of ways that humans have minimized the effect of natural Earth events. This can be accomplished through a nature walk or short hike around the schoolyard, during a field trip, or students can make observations around their own neighborhoods. If available, students can carry digital cameras (or other technology that allows them to take pictures) in order to document any examples they find.
- Groups select one solution they have found through research and develop a simple sketch, drawing, or physical model to illustrate how it minimizes the effects of the selected Earth event.
- Groups should prepare a presentation using their sketches, drawings, or models, and present them to the class

Example Activities

How Can Water Change the Shape of the Land?

In this lesson plan children investigate water erosion. Students make a sand tower and observe the erosion as they drop water on it. Students observe, illustrate, and record notes about the process. Short videos and a read aloud also further support understanding of the Performance Expectation.

How Can Wind Change the Shape of the Land?

This lesson builds on another lesson created by Jeri Faber in which students discovered how water changes the earth. For this lesson, students take part in a teacher-led investigation to show how wind changes the land. The children use straws to blow on a small mound or hill of sand. As each child takes a turn, the other students record their detailed observations that will later be used to draw conclusions. Students also watch a short video on wind erosion and discuss the new learning with partners.

Finding Erosion at Our School

In this lesson, students walk around the school grounds, neighborhood, or another area of their community to locate evidence of erosion. Various problems caused by erosion are discussed and a solution is developed for one of the problems. This lesson is one in a series on erosion by Jeri Faber. A follow-up lesson is available where students compare their erosion design solutions.

Do Rocks Last Forever?
http://www.conservation.ca.gov/cgs/information/kids_geozone/Pages/do_rocks_last_forever.aspx

How Do Glaciers Change the Shape of the Land? https://betterlesson.com/lesson/634147/there-is-a-glacier-melting-in-the-classroom

Finding Erosion at Our School https://betterlesson.com/lesson/640745/finding-erosion-at-our-school

Let's Compare Erosion Design Solutions https://betterlesson.com/lesson/635874/let-s-compare-erosion-design-solutions

Break Down of Erosion http://www.geography4kids.com/files/land_erosion.html

Sand Dune Erosion in a Box: This is an erosion lesson featuring sand dunes and what happens to them in the wind….

Impact of Erosion Pictures: These are pictures from the International Erosion Control Association that show the impact of erosion. Some of the pictures are captioned with the cause of the erosion, while others only credit the photographer.

BrainPOP Weathering Video: This is a Brain POP video on weathering.

Soil Erosion Simulation: This is a simulation that shows the effect of rainfall on soil.…

Break Down of Erosion: This webpage provides a single page summary of erosion that could be used for teachers and students to gain background information. It includes a time lapsed video of coastal erosion in Alaska.

How Can Wind Change the Shape of the Land?: This lesson builds on another lesson created by Jeri Faber in which students discovered how water changes the earth. For this lesson, students take part in a teacher-led investigation to show how wind changes the land.

Resources

Next Generation Science Standards **https://www.nextgenscience.org**
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lessons https://betterlesson.com
TBAISD **https://tbamoodle.tbaisd.org/course/view.php?id=161**

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students participate in shared research to gather information about Earth events from texts and other media and digital resources. They will use this information to answer questions and describe key ideas and details about ways in which the land can change and what causes these changes. Students should also have opportunities to compose a writing piece, either independently or collaboratively with peers, using digital tools to produce and publish their writing. Students should describe connections between Earth events and the changes they cause, and they should include photographs, videos, poems, dioramas, models, drawings, or other visual displays of their work, when appropriate, to clarify ideas, thoughts, and feelings.

- Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (2-ESS1-1), (K-2-ETS1-1) RI.2.1
- Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1) RI.2.3
- With guidance and support from adults, use a variety of digital tools to produce and publish

writing, including in collaboration with peers. (2-ESS1-1), (K-2-ETS1-1) W.2.6
- Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1) W.2.7
- Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1), (K-2-ETS1-1) W.2.8
- Recount or describe key ideas or details from a text read aloud or information presented orally or through other media. (2-ESS1-1) SL.2.2
- Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2) SL.2.5
- Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1) RI.2.9

Mathematics

Students have multiple opportunities to reason abstractly and quantitatively as they gather information from media sources. Students can organize data into picture graphs or bar graphs in order to make comparisons. For example, students can graph rainfall amounts. Students can use the data to solve simple addition and subtraction problems using information from the graphs to determine the amount of change that has occurred to local landforms. For example, a gulley was 17 inches deep before a rainstorm and 32 inches deep after a rainstorm. How much deeper is it after the rainstorm? Students must also have an understanding of place value as they encounter the varying timescales on which Earth events can occur. For example, students understand that a period of thousands of years is much longer than a period of hundreds of years, which in turn is much longer than a period of tens of years. In addition, teachers should give students opportunities to work with large numbers as they describe length, height, size, and distance when learning about Earth events and the changes they cause. For example, students might write about a canyon that is 550 feet deep, a river that is 687 miles long, or a forest that began growing about 200 years ago.
- Reason abstractly and quantitatively. (2-ESS1-1), (2-ESS2-1), (K-2-ETS1-1) MP.2
- Model with mathematics. (2-ESS1-1), (2-ESS2-1) MP.4
- Use appropriate tools strategically. (2-ESS2-1, (K-2-ETS1-1) MP.5
- Understand place value. (2-ESS1-1) 2.NBT.A
- Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. (2-ESS2-1) 2.MD.B.5
- Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1) 2.MD.D.10

Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, *All Students/Case Studies for vignettes and explanations of the modifications.)*

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners
- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modify assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

Integration of Technology

8.1.2.A.4

Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games museums).

8.1.2.B.1

Illustrate and communicate original ideas and stories using multiple digital tools and resources.

Course Title: 2nd Grade Science

8.1.2.E.1 Use digital tools and online resources to explore a problem or issue.
Pacing Guide
https://docs.google.com/document/d/1PnnQ_4M5_m2ZYsZuPTkVIqBOHCCDeAVYLohC3BpZWJw/edit?usp=sharing

Annual Pacing Guide

Grade Level:

Subject:

September	October	November	December	January
lationship in Habitats	Relationship in Habitats -Properties of Matter and Changes in Matter	-Properties of Matter and Changes in Matter	Properties of Matter and Changes in Matter	The Earth's Land and Water

February	March	April	May	June
e Earth's Land and ater	The Earth's Land and Water	Changes to Earth's Land	Changes to Earth's Land	Changes to Earth's Land

Deal School
Curriculum

Science
Curriculum Guide
Grade 3

Course Title: 3rd Grade Science

Deal School

Deal, New Jersey

2018

Board of Education

Administration

Administration

Donato Saponaro, Jr.

Superintendent of Schools
Principal

Curriculum Writing

Committee Administration

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Next Generation Science Education
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Teacher(s)

Mrs. Casale

Developed and

Written

March 2017 – May

2017

Revised

December 2018

Unit Title	Force and Motion
Length of Unit	Marking Period 1
Summary/Overview	***How do equal and unequal forces on an object affect the object?*** ***How can we use our understandings about magnets be used to solve problems?*** In this unit of study, students are able to determine the effects of balanced and unbalanced forces on the motion of an object. In continuation the students determine the effects of balanced and unbalanced forces on the motion of an object and the cause-and-effect relationships of electrical or magnetic interactions to define a simple design problem that can be solved with magnets. The crosscutting concept of *cause and effect*, and the *interdependence of science, engineering, and technology, and the influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *asking questions and defining problems*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
3-PS2-1	**Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.**
3-PS2-2	**Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.**
3-PS2-3	**Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.**
3-PS2-4	**Define a simple design problem that can be solved by applying scientific ideas about magnets.**

3-5-ETS1-1	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**
Focus Standards	
PS2.A	Forces and Motion ● Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1) ● The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)
PS2.B	Types of Interactions ● Objects in contact exert forces on each other. (3-PS2-1)
PS2.B	Types of Interactions ● Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)
ETS1.A	Defining and Delimiting Engineering Problems ● Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)
Learning Objectives (Students will be able to…)	
● Identify and describe the effects of different forces on an object's motion (e.g., starting, stopping, or changing direction). ● Collaboratively develop an investigation plan and describe the data to be collected, including: The	

change in motion of an object at rest after being pushed,

- Describe different strengths and directions of balanced forces (forces that sum to zero) are applied to the object (tug of war).
- Individually describe how the evidence to be collected will be relevant to determining the effects of balanced and unbalanced forces on an object's motion.
- Describe how the motion of the object will be observed and recorded, including defining the following features: the object whose motion will be investigated, the objects in contact that exert forces on each other.
- Plan an investigation changing one variable at a time (e.g., control strength and vary the direction, or control direction and vary the strength).
- Individually describe how their investigation plan will allow them to address the purpose of the investigation.
- Collaboratively collect and record data according to the investigation plan they developed, including data from observations and/or measurements.
- Define that an object at rest and the identification of the forces acting on the object.
- Define object in motion and the identification of the forces acting on the object.
- Provide evidence that includes ideas that patterns of motion can be used to predict future motion of an object.
- Identify and describe the motion of the object as it repeats a pattern over time (e.g., a pendulum swinging, a ball moving on a curved track, a magnet repelling another magnet).
- Describe how the data will serve as evidence of a pattern in the motion of an object and how that pattern can be used to predict future motion.
- Observe and measure the motion of the object
- Ask questions that arise from observations of two objects not in contact with each other interacting through electric or magnetic forces, the answers to which would clarify the cause-and- effect relationships between: The sizes of the forces on the two interacting objects due to the distance between the two objects and the relative orientation of two magnets and whether the force between the magnets is attractive or repulsive.
- Describe presence of a magnet and the force the magnet exerts on other objects.
- Articulate that electrically charged objects have an electric force.
- Articulate that the size of the force depends on the properties of objects, distance between the objects, and orientation of magnetic objects relative to one another.

Understandings **(Students will understand or know...)**	**Essential Questions**
● **Science investigations use a variety of methods, tools, and techniques.** ● **Cause-and-effect relationships are routinely identified.** ● **Objects in contact exert forces on each**	1. *How do scientists play soccer?* 2. *Can we use patterns that we observed to predict the future?* 3. *What are the relationships between electrical and magnetic forces?*

other. ● **Each force that acts on a particular object has both strength and a direction.** ● **An object at rest typically has multiple forces acting on it, but they add to zero net force on the object.** ● **Forces that do not sum to zero can cause changes in the object's speed or direction of motion.** ● **Science findings are based on recognizing patterns.** ● **Patterns of change can be used to make predictions.** ● **The patterns of an object's motion in various situations can be observed and measured.** ● **When past motion exhibits a regular pattern, future motion can be predicted from it.** ● **Cause-and-effect relationships are routinely identified, tested, and used to explain change.** ● **Electric and magnetic forces between a pair of objects do not require that the objects be in contact.** ● **The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.** ● **Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.** ● **People's needs and wants change over time, as do their demands for new and improved technologies.** ● **Electric and magnetic forces between a pair of objects do not require that the objects be in contact.** ● **The sizes of the forces in each situation depend on the properties of the objects and**	4. *How can we use our understandings about magnets be used to solve problems?*

their distances apart. ● **For forces between two magnets, the size of the force depends on their orientation relative to each other.** ● **Possible solutions to a problem are limited by available materials and resources (constraints).** ● **The success of a designed solution is determined by considering the desired features of a solution (criteria).** ● **Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.**	

Assessment Evidence	
Formative Assessments ● Identify cause-and-effect relationships. ● Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence. ● Use fair tests in which variables are controlled and the number of trials considered. ● Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. ● Make predictions using patterns of change. ● Make observations and/or measurements to produce data to serve as the basis of evidence for an explanation of a phenomenon. ● Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. *Examples of motion with a predictable pattern could include:*	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

- *A child swinging in a swing.* - *A ball rolling back and forth in a bowl.* - *Two children on a seesaw.* - Identify and test cause-and-effect relationships in order to explain change. - Ask questions that can be investigated based on patterns such as cause-and-effect relationships. - Ask questions to determine cause-and-effect relationships in electric or magnetic interactions between two objects not in contact with each other. - Magnetic forces could include: - The force between two permanent magnets; - The force between an electromagnet and steel paper clips; - The force exerted by one magnet versus the force exerted by two magnets. - Cause-and-effect relationships could include: - How the distance between objects affects the strength of the force - How the orientation of magnets affects the direction of the magnetic force. - Define a simple problem that can be solved through the development of a new or improved object or tool. - Define a simple design problem that can be solved by applying scientific ideas about magnets (e.g., constructing a latch to keep a door shut or creating a device to keep two moving objects from touching each other). - Define a simple design problem that can be solved through the development of an object, tool, process, or system, and include several criteria for success and constraints on material, time, or cost. - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	

Learning Activities

What it looks like in the classroom…

In this unit of study, students look for cause-and-effect relationships as they investigate the effects of balanced and unbalanced forces on the motion of an object. They learn that objects in contact exert forces on each other, and these forces have both strength and direction. When forces are balanced, there is no change in the motion or the position of an object. In other words, an object at rest typically has multiple forces acting on it, but the forces balance out to equal a zero net force on the object. For example, if two children stand with their hands together and push against each other, the pushing force each exerts balances to a net zero effect if neither child moves. Pushing a box from both sides also demonstrates a balanced force if the forces do not produce any change in motion or position of the box.

When forces are unbalanced, however, there is a change in the motion and/or position of the object the forces are acting on. If the same two children from the example above were pushing against each other, and one child moves his/her hands, arms, or feet forward while the other child moves backward, this would demonstrate an unbalanced force. The first child is pushing with greater force than the second.

Through planning and conducting investigations, students will come to understand that forces that result in changes in an object's speed or direction of motion are unbalanced. Students can observe everyday examples on the playground, with seesaws and swings and by kicking and throwing soccer balls. As they conduct investigations and make observations, students should identify the cause-and-effect relationships at work and identify the objects that are exerting forces on one another. They should also use qualitative descriptions when identifying the relative strength (greater than, less than, equal) and direction of the forces, even if an object is at rest.

Investigating the effects of forces on objects will also give students opportunities to observe that patterns exist everywhere. Patterns are found in shapes, structures, natural environments, and recurring events. Scientists and engineers analyze patterns to make predictions, develop questions, and create solutions. As students have opportunities to observe forces interacting with objects, they will ask questions and analyze and interpret data in order to identify patterns of change in the motion of objects and to make predictions about an object's future motion. When students are on the playground, they can observe multiple patterns of change in the back-and-forth motion of a child swinging on a swing or in the up-and-down motion of a seesaw. In the classroom, students can observe a variety of objects, such as marbles rolling back and forth in bowls or tops spinning across the floor.

Throughout this unit, as students plan and carry out investigations, it is extremely important that they routinely identify cause-and-effect relationships and look for patterns of change as objects interact. As students interact with objects, such as when they push a door closed, bounce a ball, or roll a ball down a ramp, they may ask, "What caused the changes that I observed? How can I change the way in which the object moved?" Students need to have many experiences in order to deepen their understanding of the cause-and-effect relationships between balanced and unbalanced forces on the motion of an object, and they should be guided to plan and conduct fair tests, testing only one variable at a time.

After investigating electrical and magnetic forces, students will engage in a portion of the engineering design process in order to define a simple design problem that can be solved by applying scientific ideas about magnets. This process should include the following steps:

- As a class, create a list of the properties of magnets. (See content descriptions above)
- Brainstorm a list of everyday objects that use magnets, and discuss the function of the magnet(s) in

each object. For example, electric can openers have a strong magnet that attaches a can to the device as it cuts through (opens) the top of the can.

- In small groups or pairs, students discuss possible everyday problems that might be solved using magnets. For example, they could construct a latch to keep a door shut.
- As a class, determine possible criteria that might be used to determine how successful the devices might be, and discuss possible constraints (on materials, time, or cost) that might affect each group's design solution.
- Small groups or pairs should have the opportunity to create a presentation (poster, PowerPoint, drawings, or actual physical model, if time permits) to share both the design problem and solution with the class.

In this unit, students are not expected to build and test their design solutions or to optimize their designs; however, they can compare different proposals for solutions on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. The overall goal is for students to understand that engaging in engineering design will help them understand that scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process, and that as people's needs and wants change over time, so do their demands for new and improved technologies.

Engineering design is an important part of this unit of study. Students are expected to define a simple design problem that can be solved by applying scientific ideas and determine possible success criteria and constraints on time, materials, and cost. They should also compare different proposals for solutions based on how well the proposed solutions meet the criteria for success or how well each takes the constraints into account

Examples Activities
Puffing Forces: Students will predict and observe what happens when a force is applied to an object, and compare the relative effects of a force of the same strength on objects of different weights by using a straw to gently puff air at a ping pong ball then a golf ball and measuring the distance the ball travels with a ruler. Students will repeat this procedure using a harder puff. This lesson was adapted from the Utah Education Network http://www.uen.org/Lessonplan/preview?LPid=14858

Robo Arm: This fun activity is one of five in a series of space based engineering challenges developed by NASA and Design Squad where students are engaged in implementing the Engineering Design process to build a robotic arm that can lift a cup off a table using cardboard strips, brass fasteners, paper clips, straw, string, tape and a cup. The activity includes an instructor's guide, questioning techniques, discussion questions, extension activity, a rubric, and 3 short video clips that enhance the purpose of the activity and its relevance to NASA.

Investigating the Magnetic Force Field: Calculating the Magnetic Pull of a Magnet by Varying Distances: Students will investigate the magnetic pull of a bar magnet at varying distances with the use of paper clips. http://serc.carleton.edu/sp/mnstep/activities/26850.html

Static Cling: In this lesson, students will engage in two hands-on investigations to observe the phenomena that occurs when an electrically charged comb interacts cereal and styrofoam pellets. Through these observations, students will begin to establish the cause and effect relationships between two objects not in contact with one another.
https://www.teachengineering.org/activities/view/cub_electricity_lesson01_activity1

Charge it - In this lesson, students will perform a series of experiments to further their understanding of

static electricity and specifically, the cause and effect relationships of electrostatic interactions between objects not in contact with each other.
https://www.teachengineering.org/activities/view/cub_electricity_lesson02_activity1

Designing Bridges - (STEM Challenge)
https://www.scholastic.com/teachers/blog-posts/alycia-zimmerman/building-teamwork-and-bridges-stem-icebreaker/

Race Cars Gravity Racers
http://www.carolina.com/stem-inquiry-kits/carolina-stem-challenge-physical-science-balloon-race-cars-kit/750040.pr#

Gravity Design Challenge: This activity is one in a series of Mission: Solar System design challenges developed by PBS's Design Squad, NASA and the National Science Foundation. Students design, build, and improve a model that mimics gravity-assisted space travel. The design solution enables a steel ball (spacecraft) to roll past a magnet (force exerted by a planet), which will alter its direction in order to hit a designated target (e.g., Mars).
http://www-tc.pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_FullGuide.pdf

Force and Motion
In this lesson, students will collaboratively conduct an investigation to test how the strength of a force and the mass of an object affects motion. https://betterlesson.com/lesson/632779/force-and-motion-investigation

Air Resistance Cars
In this activity, students use the SCAMPER brainstorming tool to design a car that can overcome air resistance.
http://static.nsta.org/files/sc1501_34.pdf

Collision Zone
Students make predictions, then investigate what will happen when balls of various sizes, weights, and material compositions collide with one another. Trials provide evidence of the effects of balanced and unbalanced forces on the motion of objects. Patterns in motion emerge as students progress through the investigation that students then use to predict future motion.
http://www.uen.org/Lessonplan/preview?LPid=10038

How to go faster down a slide?
"How Can You Go Faster Down a Slide? is one of four mysteries that comprise a "Mystery Science" unit on forces and their interactions. Students are posed the driving question: How can you go fastest down a slide? Students then investigate friction as an oppositional force, its relationship to different material properties, and its effect on the downward motion of objects.
https://mysteryscience.com/forces/mystery-3/balance-of-forces-friction/44?r=892467#slide-id-731

Resources

Next Generation Science Standards https://www.nextgenscience.org
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161
Teach engineering www.teachengineering.org

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

In order to integrate the CCSS for ELA into this unit, students need opportunities to read content-specific texts to deepen their understanding of force and motion. As they read, teachers should pose questions such as, "What interactions can you identify between the objects in the text?" and "What patterns of motion are described in the text?" Students should be encouraged to answer questions and cite evidence from the text to support their thinking.

To further support the integration of the ELA standards, students can also conduct short research projects about simple force-and-motion systems and the interactions that occur among forces and objects within the systems. For example, students could be asked to conduct a short study by bouncing a ball 10 times and identifying the patterns they observe. Next students could predict, based on the patterns they saw, what would happen if they bounced the ball 10 more times. Students then could draw a model of the force and motion system, identifying the structures and forces that interact within the system. This would also give students the opportunity to develop note-taking skills and use multiple sources to collect information about force and motion.

Students should be given opportunities to conduct short research projects that build knowledge about electric and magnetic forces. They should be given multiple opportunities to recall and gather information from their investigations as well as from print and digital sources. Students should use that information to answer questions, describe cause-and-effect relationships, make comparisons, and explain interactions between objects when electrical or magnetic forces are involved.

Teachers should provide a variety of texts for students to explore in order to develop students' note-taking skills. As students take notes, they should use graphic organizers, such as Venn diagrams and T-charts, to sort supporting evidence into provided categories. For example, as students read a variety of texts about forces, they can take notes and then sort the evidence they collect into categories, such as electrical and magnetic forces.

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. RI.3.1 (3-PS2-1), (3-PS2-3)
- Conduct short research projects that build knowledge about a topic. W.3.7 (3-PS2-1),(3-PS2-2)
- Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. W.3.8 (3-PS2-1),(3-PS2-2)1
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps

in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-PS2-3) RI.3.3

- Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence). (3-PS2-3) RI.3.8
- Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3) SL.3.3

Mathematics

In order to integrate the Common Core State Standards for Mathematics, students can use measurement tools in a variety of ways to conduct investigations. Students could find the mass of an object in order to understand that the heavier something is, the greater the force needed to cause a change in its motion. Students could use rulers or tape measures to measure the distance an object moves. Student can then record and analyze their data to determine patterns of change and explain cause-and-effect relationships, while reasoning abstractly and quantitatively.

Students should use measurement tools in a variety of ways as they conduct investigations. They could find the mass of an object in order to understand that the more mass an object has, the greater the force needed to attract, repel, or move it. Students then reason mathematically as they analyze their data to determine patterns of change that can be used to support explanations of cause-and-effect relationships. Students might also use algebraic reasoning during investigations. For example, when measuring magnetic strength by increasing the number of magnets, students can use multiplication to make predictions about possible outcomes. So, if a paper clip moves toward a single magnet when it is 2 centimeters away, then students might predict that the paper clip will move toward a double magnet when it is 4 centimeters away. Or, if the paper clip moved towards a set of four magnets at a distance of 8 centimeters, then students might predict that the paper clip will move toward a single magnet when it is 2 centimeters away.

- Reason abstractly and quantitatively. MP.2 (3-PS2-1)
- Use appropriate tools strategically. MP.5 (3-PS2-1)
- Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. 3.MD.A.2 (3-PS2-1)

Accommodations/Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented

- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives, and choices

English Language Learners

- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.

- Assign a picture or movement to vocabulary words

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modified assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic success

Integration of Technology

8.1.5.D.2 Analyze the resource citations in online materials for proper use.
8.1.5.A.1 Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.

Pacing Guide

https://docs.google.com/document/d/1cZvypqfLeNLNwcjI1X4cvwpdGqf9Li9vmQ1uAd9AHQo/edit?usp=sharing

Course Title: 3rd Grade Science

Unit Title	Organisms and their Environment
Length of Unit	Marking Period 2
Summary/Overview	***Why don't we see alligators in the arctic?*** ***What do fossils tell us about the organisms and the environments in which they lived?*** In this unit of study, students develop an understanding of the idea that when the environment changes, some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. The crosscutting concepts of *cause and effect* and the *interdependence of science, engineering, and technology* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *engaging in argument from evidence*. Students are also expected to use this practice to demonstrate understanding of the core ideas. This unit is based on 3-LS2-1 and 3-LS4-3. In this unit of study, students develop an understanding of the types of organisms that lived long ago and also about the nature of their environments. Students develop an understanding of the idea that when the environment changes, some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. The crosscutting concepts of *systems and system models*; *scale, proportion, and quantity*; and *the influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *asking questions and defining problems*, *analyzing and interpreting data*, and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 3-LS4-1, 3-LS4-4, and 3-5-ETS1-1.

Desired Outcomes

Standards	
3-LS2-1	**Construct an argument that some animals form groups that help members survive.**
3-LS4-1	**Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.**
3-LS4-3	**Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.**
3-LS4-4	**Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.**
3-5-ETS1-1	**Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**
Focus Standards	
LS2.D: Social Interactions and Group Behavior	● Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size . (3-LS2-1)
LS4.C: Adaptation	● For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)
LS4.A: Evidence of Common Ancestry and Diversity	● Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (3-LS4-1) ● Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)
LS4.D: Biodiversity and	● Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)

Humans	
LS2.C: Ecosystem Dynamics, Functioning, and Resilience	● When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.*(secondary to 3-LS4-4)*
ETS1.A: Defining and Delimiting Engineering Problems	● Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

Learning Objectives
(Students will be able to…)

- Make a claim to be supported about a phenomenon in their claim, students include the idea that some animals form groups and that being a member of that group helps each member survive.
- Identifying types of animals that form or live in groups of varying sizes
- pared to animal alone
- Describe that animals in groups have more success defending themselves than those same animals acting alone.
- Articulate that animals make faster or better adjustments to harmful changes in their ecosystem than would those same animals acting alone.
- Construct an argument that being part of a group can have the effect of animals being more successful in obtaining food, defending themselves, and coping with change supports the claim that being a member of a group helps animals survive.
- Construct an argument that an animal losing its group status can have the effect of the animal obtaining less food, not being able to defend itself, and not being able to cope with change supports the claim that being a member of a group helps animals survive.
- Use graphical displays (e.g., table, chart, graph) to organize the given data, including data about: Fossils of animals (e.g., information on type, size, type of land on which it was found), Fossils of plants (e.g., information on type, size, type of land on which it was found) and the relative ages of fossils (e.g., from a very long time ago).
- Make claims from evidence that the existence of modern counterparts to the fossilized plants and animals and information on where they currently live.
- Determine that fossils represent plants and animals that lived long ago.
- Compare relationships between the fossils of organisms and the environments in which they lived

(e.g., marine organisms, like fish, must have lived in water environments).

- Compare relationships between types of fossils (e.g., those of marine animals) and the current environments where similar organisms are found.
- Determine that fossils represent organisms that lived long ago and have no modern counterparts.
- Compare the relationships between fossils of organisms that lived long ago and their modern counterparts.
- Compare the relationships between existing animals and the environments in which they currently live.
- Provide evidence that fossils of organisms that lived long ago but have become extinct (e.g., dinosaurs, mammoths, other organisms that have no clear modern counterpart).
- Provide evidence that features of fossils of organisms that lived long ago and of what types of environments those organisms must have lived in (e.g., fossilized seashells indicate shelled organisms that lived in aquatic environments).
- Compare data about where fossils are found and what those environments are like, fossilized plants and animals can be used to provide evidence that some environments look very different now than they did a long time ago (e.g., fossilized seashells found on land that is now dry suggest that the area in which those fossils were found used to be aquatic; tropical plant fossils found in Antarctica, where tropical plants cannot live today, suggests that the area used to be tropical).
- Make a claim to be supported about a phenomenon. In their claim, students include the idea that in a particular habitat, some organisms can survive well, some can survive less well, and some cannot survive at all.
- Describe the characteristics of a given particular environment (e.g., soft earth, trees and shrubs, seasonal flowering plants).
- Describe the characteristics of a particular organism (e.g., plants with long, sharp leaves; rabbit coloration).
- Describe the needs of a particular organism (e.g., shelter from predators, food, water).
- Describe the characteristics of organisms that might affect survival.
- Determine similarities and differences in needs among at least three types of organisms.
- Determine how and what features of the habitat meet the needs of each of the organisms (i.e., the degree to which a habitat meets the needs of an organism).
- Determine how and what features of the habitat do not meet the needs of each of the organisms (i.e., the degree to which a habitat does not meet the needs of an organism).
- Describe that particular environment meet the needs of different organisms based on their characteristics.
- Articulate that an environment fully meets the needs of an organism, that organism can survive well within that environment.
- Articulate that If an environment partially meets the needs of an organism, that organism can survive less well (e.g., lower survival rate, increased sickliness, shorter lifespan) than organisms whose needs are met within that environment.
- Defend if an environment does not meet the needs of the organism, that organism cannot survive within that environment.
- Support with evidence suggests a causal relationship within the system between the characteristics

of a habitat and the survival of organisms within it.

- Make a claim about the merit of a given solution to a problem that is caused when the environment changes, which results in changes in the types of plants and animals that live there.
- Support with evidence how a change in the given environment causes a problem for the existing plants and animals living within that area.
- Support from evidence how well the proposed solution is able to reduce the impact of the problem created by the environment (i.e. bugs eating crops).

Understandings (Students will understand or know...)	**Essential Questions**
● **Cause-and-effect relationships are routinely identified and used to explain change.** ● **Knowledge of relevant scientific concepts and research findings is important in engineering.** ● **For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.** ● **Organisms and their habitat make up a system in which the parts depend on each other.** ● **Observable phenomena exist from very short to very long periods of time.** ● **Science assumes consistent patterns in natural systems.** ● **Some kinds of plants and animals that once lived on Earth are no longer found anywhere.** ● **Fossils provide evidence about the types of organisms that lived long ago, and also about the nature of their environments.** ● **A system can be described in terms of its components and their interactions.** ● **People's needs and wants change over time, as do their demands for new and improved technologies.** ● **Populations live in a variety of habitats, and change in those habitats affects**	1. *In a particular habitat, why do some organisms survive well, some survive less well, and some not survive at all?* 2. *What do fossils tell us about the organisms and the environments in which they lived?* 3. *What happens to the plants and animals when the environment changes?*

the organisms living there. ● **When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, others move into the transformed environment, and some die.** ● **Possible solutions to a problem are limited by available materials and resources (constraints).** ● **The success of a designed solution is determined by considering the desired features of a solution (criteria).** ● **Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each**	

Assessment Evidence	
Formative Assessments ● Identify cause-and-effect relationships in order to explain change. ● Construct an argument with evidence. ● Construct an argument with evidence (e.g., needs and characteristics of the organisms and habitats involved) that in a particular habitat, some organisms can survive well, some can survive less well, and some cannot survive at all. ● Observe that phenomena exist from very short to very long periods of time. ● Analyze and interpret data to make sense of phenomena using logical reasoning. ● Analyze and interpret data from fossils (e.g., type, size, distributions of fossil organisms) to provide evidence of the organisms and the environments in which they lived long ago. Examples of fossils and environments could	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

include: ● Marine fossils found on dry land; ● Tropical plant fossils found in Arctic areas; or ● Fossils of extinct organisms. ● Describe a system in terms of its components and interactions. ● Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of a problem. ● Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. (Assessment is limited to a single environmental change and does not include the greenhouse effect or climate change.) Examples of environmental changes could include changes in ● Land characteristics, ● Water distribution, ● Temperature, ● Food, or ● Other organisms. ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and that includes several criteria for success and constraints on materials, time, or cost. ● Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.	

Learning Activities

What it looks like in the classroom…

Organisms and their habitats make up a system in which they are interdependent. Environmental factors affect the growth and survival of every type of organism, and organisms in turn affect the environment. The focus of this unit of study is identifying cause-and-effect relationships between the environment and organisms' ability to survive and reproduce.

In this unit, students first learn that all organisms have a variety of behaviors and traits that enable them to survive. One of these behaviors includes forming groups. Groups serve different functions and can vary dramatically in size. Animals may form groups to obtain food, to defend themselves, and/or to cope with changes in their environment. Students should have opportunities to conduct research on animals that form groups in order to understand how being part of a group is beneficial to survival and reproduction. Students might begin with studying animals that are indigenous to the local environment (e.g., squirrels, coyotes, deer, birds, or fish), and then investigate other animals of interest, such as (but not limited to) lions, sea turtles, or penguins. For each animal that is studied, students should identify the social structure of the group and how this structure supports individuals in their need to obtain food, defend themselves, and reproduce.

Topics to focus on might be the roles of males and females within a group as well as the interactions between parents and offspring. For example, within some groups of animals, the offspring leave the nest or pack early while others remain for longer periods of time. Those that stay within the group for longer periods of time may do so because of the benefits provided by the group structure. As students compare group structures of different animals and the functions that define each, they should also think about how the size of the group and the roles of individuals within the group affect the animal's' overall ability to obtain food, defend themselves, and reproduce. Students will construct arguments with evidence, using cause-and-effect relationships to show why some animals form groups and how this is advantageous to survival and reproduction.

In this unit, students also learn that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. As students explore the components of a given environment, they learn that each environment has a particular climate as well as finite sources of water and space. Each environment will support organisms (both plants and animals) with structures and behaviors that are best suited to the climate and resources available. Students will need opportunities to investigate the organisms (plants and animals) that live in certain environments and determine what traits and behaviors allow these organisms to survive and reproduce in that environment. In addition, students should identify some examples of organisms that would survive less well, or not at all, in that environment, and give evidence to support their thinking. Students construct arguments with evidence, using cause-and-effect relationships, to show how the needs and characteristics of the organisms are not well suited for the given environment.

In this unit, students will study fossils or organisms that lived long ago. Students will use that understanding to make a claim about the merit of a solution to problem created by some environmental change. (Assessment is limited to one change.) Additionally, they will learn that solutions are limited by available resources (constraints), and that the success of a solution is determined by considering the desired features of a solution (criteria). This process is outlined in greater detail in the previous section.

Students gather evidence from fossils to learn about the types of organisms that lived long ago and the nature of their environments. As they learn about organisms from long ago, they come to understand that when the environment changes, some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.

To begin the progression of learning in this unit, students need multiple opportunities to study fossils. If actual fossils are not available, pictures and diagrams found in books and other media sources can be used. Students should observe fossils of a variety of organisms, both plant and animal, and they should observe diagrams of fossils within layers of rock. As students examine each fossil, they should be asked to identify whether the organism lived on land or in water and to give evidence to support their thinking. As students examine diagrams of fossils in layers of rock, they should be asked to identify the type of environment that existed when the layers of rock were formed. Students should consider the types of organisms that are fossilized in the rock layers in order to provide evidence to support their thinking.

If the type of environment in which the fossil was found is different from the type of environment that might have existed when the organism lived (e.g., marine fossils found on dry land, or tropical plant fossils found in Arctic areas), this would provide the opportunity to ask students to think about the types of changes that might have occurred in the environment and what effects these changes might have had on the organisms that lived in the environment as it changed over time. As students observe and analyze fossils, they learn that fossils provide evidence about the types of organisms that lived long ago and the nature of their environments. They also learn that some kinds of plants and animals that once lived on Earth are no longer found anywhere, and that this could be a result of changes that occurred in the environment.

During this unit, students also learn that populations of organisms live in a variety of habitats, and change in those habitats affects the organisms living there. When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms will survive and reproduce, some will move to new locations, others will move into the transformed environment, and others will die.

Students will need the opportunity to engage in a portion of the engineering design process in order to investigate the merit of solutions to problems caused when the environment changes. This process should include the following steps:

Students brainstorm a list of environmental changes that might affect the organisms that live in the environment. This could include changes in

- Land characteristics,
- Water distribution,
- Temperature,
- Food,
- Other organisms.

As a class or in small groups, students define a problem that occurs when the environment changes. For example, if the distribution of water changes, the available water may no longer support the types of organisms that are found in the environment.

As a class, determine criteria that can be used to weigh a possible solution's viability. For example, the response (solution) to the problem should not result in the extinction of a species.

Small groups conduct research, using books and other reliable media sources, to determine possible solutions/ways in which organisms can solve the problem. For example, if the available water supply is no longer adequate for the organisms in the environment, there are a number of ways in which organisms respond (i.e., solve the problem); these include:

- Plants do not grow as large as before (shorter plant, smaller or fewer leaves);
- Fewer seeds germinate, thereby resulting in a smaller population;
- Herd animals may move to another environment where the water supply is adequate;
- Populations of some species may decrease, either through lower rate of reproduction or death;
- Some populations completely die out; or
- Other organisms (plants and animals) that require less water to survive may move into the environment.

Students make claims about the merit of each of the various responses (solutions) by organisms based on how well the responses meet criteria; students use research data as evidence to support their thinking.

At every stage, communicating with peers is an important part of the design process. Students should identify cause-and-effect relationships throughout the process and use these relationships to explain the changes that might occur in the environment and in the populations of organisms that live there.

Example Activities

Ecosystems and Biological

This unit includes five lessons that build student understanding on why certain organisms survive better than others in a specific habitat. The lessons include: 1) Lesson 1-Biomes (students learn what biomes are by gathering information and creating a biomes chart after watching a video and viewing a PowerPoint. They make predictions about what animals they think might live in each biome and why they think that), 2) Lesson 2-Adaptations (students discuss different animals in the area where they live and why they think the animals are adapted to survive there. Then students become experts on specific biomes in small groups, fill out a graphic organizer, and write a short informational piece about their biome to share with others), 3) Lesson 3-Biomes Experts (students share their expert informational pieces with the class), 4) Lesson 4-An Animal That Can Survive in All Biomes (students use the information they have learned to create an animal with at least 2 adaptations to help it survive in all the biomes. Student share and explain their drawings to others. Then they fill out an animal adaptation chart for their created animal -self assessment - and can revise their animal drawings if needed), and 5) Lesson 5-Adaptations and Environmental Changes (students share their work and drawings from the lessons so far with each other to review what they learned prior to completing an open-ended adaptation quiz).

https://betterlesson.com/user/325050/68214/167406/michelle-marcus/curriculum

Muskox Maneuvers

In this activity, students create a physical model showing how muskoxen work together as a group to protect their young from predators (wolves).

Musk Ox Save Calf from Wolves Video

In this short video, Arctic wolves attack a musk ox calf on Canada's Ellesmere Island, but the herd rushes to its defense by forming a defensive circle around the calves.

What's inside the termite mound

In this short video, scientists at the American Museum of Natural History explain the role of the different types of termites (queens, kings, workers, and soldiers) that work together to help the termites survive within the termite mound. The importance of termites in the ecosystem is also described

https://www.youtube.com/watch?v=lH4RbMbU74E

Insects That Work Together

This nonfiction book summarizes how some insects work together to increase their chances of survival. Details are provided on four types of insects: honeybees, hive wasps (hornets, yellow jackets, and paper wasps), termites, and ants. A short section on insect migration and building a hive model are also included.

Battle at Kruger: Water Buffalo Save Calf from Lions Video

This short video captures student imagination and elicits ideas about how groups of organisms work together for survival. The video contains real footage of a pack of lions attack on a water buffalo calf. The footage filmed by amateur tourists features a surprising plot twist (featuring a crocodile), and exciting finale with the water buffalo herd rescues the calf and chases off the lions.

A Walk in the Desert (Biomes of North America)

This nonfiction text describes the climate, soil, plants and animals of the North American deserts. It provides detailed information on how plants and animals adapt and survive there.

A Walk in the Deciduous Forest (Biomes of North America)

This nonfiction text describes the climate, soil, plants and animals of the North American deciduous forests. It provides detailed information on how plants and animals adapt and survive there.

A Walk in the Rain Forest (Biomes of North America)

This nonfiction text describes the climate, soil, plants and animals of the North American rain forests. It provides detailed information on how plants and animals adapt and survive there.

A Walk in the Prairie (Biomes of North America)

This nonfiction text describes the climate, soil, plants and animals of the North American prairies. It provides detailed information on how plants and animals adapt and survive there.

A Walk in the Tundra (Biomes of North America)

This nonfiction text describes the climate, soil, plants and animals of the North American tundra. It provides detailed information on how plants and animals adapt and survive there.

A Walk in the Boreal Forest (Biomes of North America)

This nonfiction text describes the climate, soil, plants and animals of the North American boreal forests. It provides detailed information on how plants and animals adapt and survive there.

A Journey into the Ocean (Biomes of North America)

This nonfiction text describes the organisms and features of the ocean environment. It provides detailed information on how plants and animals adapt and survive there.

Journey Into an Estuary (Biomes of North America)

This nonfiction text describes the features and plants and animals of North American estuaries. It provides detailed information on how plants and animals adapt and survive there.

Mass Environmental Change: In this lesson, students explore what happens to organisms when they cannot meet their needs due to changes in the environment. They categorize scenario cards representing different changes to an environment, then discuss in a whole group. Using what they have learned, they write about how changes to the environment can affect organisms. The resource link takes you to a full unit titled Effects of Changes in an Environment on the Survival of Organisms, of which Mass Environmental Change is a lesson.

Ant Colonies "The power of Cooperation" - In this lesson, students gather evidence from multiple sources to construct an argument that living in groups helps ants survive.
http://the-curious-scientist.weebly.com/uploads/2/3/6/6/23667706/lesson_1-ant_colonies_complete2.pdf

Creature Features
Students use the Kratts' Creatures "Creaturepedia" to gather information about the adaptations of animals from different environments. Students are then prompted with a series of questions around how an animal's relocation might affect its ability to survive before considering the relationship between a well adapted animal, its environment, and how it came to be so well adapted.
http://sciencenetlinks.com/lessons/animal-adaptations/

Fossilization and adaptation
This lesson focuses on what we have learned and what we can learn from fossils about the organisms and the environments in which they lived.
http://sciencenetlinks.com/lessons/fossils-1-fossils-and-dinosaurs/

http://www.ucmp.berkeley.edu/fosrec/Breithaupt2.html#FIG3

Resources

Next Generation Science Standards https://www.nextgenscience.org
National Science Teachers Association www.NSTA.org

Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161
Teach engineering www.teachengineering.org

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students need opportunities use informational text and other resources to gather information about organisms and the environments in which they live. Students should be able to ask and answer questions to demonstrate understanding of content-specific text and be able to cite evidence from the text to support their thinking. For example, after reading an article about wolves, students ask and answer questions such as:

- How does being a member of a pack help wolves survive?
- What characteristics do wolves have that enable them to survive in their environment?
- What characteristics and resources does the environment have that allow wolves to survive and reproduce in that environment?

Students should be able to refer specifically to the text when answering questions, articulating the main idea and describing key details in their explanations. Students also need opportunities to write informative/explanatory texts and opinion pieces with supporting evidence to convey their ideas and understanding of cause-and-effect relationships between the environment and an organism's ability to survive and reproduce. For example, after reading text about a given animal, students should be expected to use key details and appropriate facts about that animal to compose an informative piece of writing that describes the animal's characteristics and behaviors that aid in its survival. Students should also have the opportunity to orally report on a given topic, sharing relevant facts and details while speaking clearly and at a reasonable pace.

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS2-1), (3-LS4-3) RI.3.1
- Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS4-3) RI.3.2
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS2-1),(3-LS4-3) RI.3.3
- Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS2-1), (3-LS4-3) W.3.1
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS4-3) W.3.2
- Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant,

descriptive details, speaking clearly at an understandable pace. (3-LS4-3) SL.3.4

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS4-4) RI.3.1
- Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS4-1),(3-LS4-4) RI.3.2
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS4-1),(3-LS4-4) RI.3.3
- Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS4-1),(3-LS4-4) W.3.1
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS4-1),(3-LS4-4) W.3.2
- Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1) W.3.8
- Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1) W.5.7
- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-1) W.5.8
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1) W.5.9
- Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS4-4) SL.3.

Mathematics

Students can model with mathematics by graphing the average number of organisms that make up a group among a variety of species. For example, some species live in small groups of six to eight members, while others live in groups that include thousands of organisms. Students will also reason abstractly and quantitatively as they describe and compare these groups and their ability to survive and reproduce in a given environment.

- Model with mathematics. (3-LS2-1),(3-LS4-3) MP.4
- Number and Operations in Base Ten. (3-LS2-1) 3.NBT
- Reason abstractly and quantitatively. (3-LS4-1),(3-LS4-4), (3-5-ETS1-1) MP.2
- Model with mathematics. (3-LS4-1),(3-LS4-4), (3-5-ETS1-1) MP.4
- Use appropriate tools strategically. (3-LS4-1), (3-5-ETS1-1) MP.5
- Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. (3-LS4-2),(3-LS4-3) 3.MD.B.3
- Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS4-1) 3.MD.B.4

- Operations and Algebraic Thinking (3-ETS1-1) 3-5.OA

Accommodations/Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented

- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives, and choices

English Language Learners

- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modified assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic success

Career and Technical Education

9.3.12.AG-NR.4 Demonstrate responsible management procedures and techniques to protect or maintain natural resources.
Integration of Technology
8.1.5.D.2 Analyze the resource citations in online materials for proper use. 8.1.5.A.1 Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
Pacing Guided
https://docs.google.com/document/d/1cZvypqfLeNLNwcjI1X4cvwpdGqf9Li9vmQ1uAd9AHQo/edit?usp=sharing

Unit Title	Traits
Length of Unit	Marking Period 3
Summary/Overview	*What kinds of traits are passed on from parent to offspring?* *What environmental factors might influence the traits of a specific organism?* In this unit of study, students acquire an understanding that organisms have different inherited traits and that the environment can also affect the traits that an organism develops. The crosscutting concepts of *patterns* and *cause and effec*t are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency *in analyzing and interpreting data, constructing explanations*, and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 3-LS3-1 and 3-LS3-2. *Do all living things have the same life cycle?* *Are there advantages to being different?* In this unit of study, students develop an understanding of the similarities and differences in organisms' life cycles. In addition, students use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. The crosscutting concepts of *patterns* and *cause and effect* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *developing and using models and constructing explanations and designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 3-LS1-1 and 3-LS4-2.

Desired Outcomes
Standards

[3-LS3-1]()	**Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.**
[3-LS3-2]()	**Use evidence to support the explanation that traits can be influenced by the environment.**
[3-LS1-1]()	**Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.**
[3-LS4-2]()	**Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.**
Focus Standards	
LS3.A: Inheritance of Traits	● Many characteristics of organisms are inherited from their parents. (3-LS3-1) ● Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)
LS3.B: Variation of Traits	● Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) ● The environment also affects the traits that an organism develops. (3-LS3-2)
LS1.B: Growth and Development of Organisms	● Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)
LS4.B: Natural Selection	● Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)

Learning Objectives (Students will be able to…)

- Develop models (e.g., conceptual, physical, drawing) to describe the phenomenon. In their models, students identify the relevant components of their models including: Organisms (both plant and animal), Birth, Growth, Reproduction and Death.
- Using a models, students describe relationships between components, including: organisms are born, grow, and die in a pattern known as a life cycle, different organisms' life cycles can look very different and a causal direction of the cycle (e.g., without birth, there is no growth; without reproduction, there are no births). Organize the data (e.g., from students' previous work, grade-appropriate existing datasets) using graphical displays (e.g., table, chart, graph). The organized data include: traits of plant and animal parents, traits of plant and animal offspring, variations in similar traits in a grouping of similar organisms.
- Determine the similarities in the traits of a parent and the traits of an offspring (e.g., tall plants typically have tall offspring).
- Determine the similarities in traits among siblings (e.g., siblings often resemble each other).
- Determine the differences in traits in a group of similar organisms (e.g., dogs come in many shapes and sizes, a field of corn plants have plants of different heights).
- Determine the differences in traits of parents and offspring (e.g., offspring do not look exactly like their parents). Determine the differences in traits among siblings (e.g., kittens from the same mother may not look exactly like their mother).
- Describe that the pattern of similarities in traits between parents and offspring, and between siblings, provides evidence that traits are inherited.
- Describe that the pattern of differences in traits between parents and offspring, and between siblings, provides evidence that inherited traits can vary.
- Describe that the variation in inherited traits results in a pattern of variation in traits in groups of organisms that are of a similar type.
- Identify the given explanation to be supported, including a statement that relates the phenomenon to a scientific idea, including that many inherited traits can be influenced by the environment.
- Articulate that Inherited traits that vary between organisms of the same type (e.g., height or weight of a plant or animal, color or quantity of the flowers).
- Observe inherited traits of organisms in varied environmental conditions
- Use reasoning to connect the evidence and support an explanation about environmental influences on inherited traits in organisms. In their chain of reasoning, students describe a cause- and-effect relationship between a specific causal environmental factor and its effect of a given variation in a trait (e.g., not enough water produces plants that are shorter and have fewer flowers than plants that had more water available).
- Use the models to describe that although organisms can display life cycles that look different, they all follow the same pattern.
- Use the models to describe that although organisms can display life cycles that look different, they all follow the same pattern.
- Use the models to make predictions related to the phenomenon, based on patterns identified among life cycles (e.g., prediction could include that if there are no births, deaths will continue and

eventually there will be no more of that type of organism).

- Articulate a statement that relates the given phenomenon to a scientific idea, including that variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
- Use evidence and reasoning to construct an explanation for the phenomenon. For example the patterns of variation of a given characteristic among individuals in a species (e.g., longer or shorter thorns on individual plants, dark or light coloration of animals) or the potential benefits of a given variation of the characteristic (e.g., the light coloration of some moths makes them difficult to see on the bark of a tree).
- Use reasoning to logically connect the evidence to support the explanation for the phenomenon. Students describe a chain of reasoning that includes:
- That certain variations in characteristics make it harder or easier for an animal to survive, find mates, and reproduce (e.g., longer thorns prevent predators more effectively and increase the likelihood of survival; light coloration of some moths provides camouflage in certain environments, making it more likely that they will live long enough to be able to mate and reproduce). Characteristics that make it easier for some organisms to survive, find mates, and reproduce give those organisms an advantage over other organisms of the same species that don't have those traits. That there can be a cause-and-effect relationship between a specific variation in a characteristic (e.g., longer thorns, coloration of moths) and its effect on the ability of the individual organism to survive and reproduce (e.g., plants with longer thorns are less likely to be eaten, darker moths are less likely to be seen and eaten on dark trees).

Understandings (Students will understand or know...)	**Essential Questions**
● Similarities and differences in patterns can be used to sort and classify natural phenomena (e.g., inherited traits that occur naturally). **● Many characteristics of organisms are inherited from their parents.** **● Different organisms vary in how they look and function because they have different inherited information.** **● Cause-and-effect relationships are routinely identified and used to explain change.** **● Other characteristics, which can range from diet to learning, result from individuals' interaction with the environment.** **● Many characteristics involve both**	1. *What kinds of traits are passed on from parent to offspring?* 2. *What environmental factors might influence the traits of a specific organism?* 3. *Do all living things have the same life cycle?* 4. *Are there advantages to being different?*

inheritance and environment. ● **The environment also affects the traits that an organism develops.** ● **Science findings are based on recognizing patterns.** ● **Similarities and differences in patterns can be used to sort and classify natural phenomena.** ● **Patterns of change can be used to make predictions.** ● **Reproduction is essential to the continued existence of every kind of organism.** ● **Plants and animals have unique and diverse life cycles.** ● **Cause-and-effect relationships are routinely identified and used to explain change.** ● **Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing**	

Assessment Evidence	
Formative Assessments ● Sort and classify natural phenomena using similarities and differences. ● Analyze and interpret data to make sense of phenomena using logical reasoning. ● Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. ● Identify cause-and-effect relationships in order to explain change. ● Use evidence (e.g., observations, patterns) to support an explanation. ● Use evidence to support the explanation that traits can be influenced by the	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

environment. Examples of the environment's effect on traits could include: ● Normally tall plants that grow with insufficient water are stunted. ● A pet dog that is given too much food and little exercise may become overweight. ● Sort organism's (inherited traits) using similarities and differences in patterns. ● Make predictions using patterns of change. ● Develop models to describe phenomena. ● Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. (I.e., Changes organisms go through during their life form a pattern.) ● Identify cause-and-effect relationships in order to explain change. ● Use evidence (e.g., observations, patterns) to construct an explanation. ● Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Examples of cause-and-effect relationships could include: ● Plants that have larger thorns than other plants may be less likely to be eaten by predators. ● Animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.	

Learning Activities
What is looks like in the classroom…

Scientists sort and classify organisms based on similarities and differences in characteristics or traits. Students can easily observe external traits of animals such as body coverings; type, shape, and number of external features; and type, shape, and color of eyes. Similarly, they can observe external traits of plants such as the type of root system or the shape, color, and average size of leaves. The characteristics that organisms inherit influence how they look and how they function within their environment. As students observe parents and their offspring, they will notice that parents and offspring share many traits. As they observe a larger number of organisms from the same group, they will notice similarities and differences in the traits of individuals within a group. Students can observe similarities and differences in the traits of organisms and use these observations as evidence to support the idea that offspring inherit traits from parents, but these traits do vary within a group of similar organisms.

Sometimes, variations among organisms within a group are due to fact that individuals inherit traits from different parents. However, traits can also be influenced by an individual's interaction with the environment. For example, all lions have the necessary inherited traits that allow them to hunt, such as sharp claws, sharp teeth, muscular body type, and speed. However, being a successful hunter also depends on the interaction that individual lions have with their parents and their environment. A lion cub raised in captivity without parents will have the same type of claws, teeth, and muscular body as all other lions, but it may never have the opportunity to learn to use its traits to hunt. Additionally, the environment can affect an organism's physical development. For example, any plant that lacks sufficient nutrients or water will not thrive and grow as it should. It will most likely be smaller in size, have fewer leaves, and may even look sickly. Likewise, too much food and lack of exercise can result in an overweight dog.

To investigate how the environment influences traits, students can plant the same type of seedling in different locations, which will provide variations of light, water, or soil. Data can be collected about rates of growth, height, and heartiness of the plant. The information gathered can be analyzed to provide evidence as to how the environment influenced the traits of the plant. As students read about, observe, and discuss these ideas, they learn that even though every organism inherits particular traits from its parents, the environment can have a marked effect on those traits and the development of others.

In third grade, students learn that the changes an organism goes through during its life form an observable pattern. Although different types of organisms have unique and diverse life cycles, they follow a pattern of birth, growth, reproduction, and death. While observing and studying life cycles, students should look closely for patterns of change and use these observed patterns to make predictions. They should also sort and classify a variety of organisms using the similarities and differences they observe. For example, flowering plants begin as seeds. With the right conditions, the seeds germinate and grow, from small seedlings to adult plants. Adult plants then produce flowers that, once pollinated, will produce seeds from which the next generation will grow.

Animals, likewise, go through observable patterns of change, which allow students to sort and classify them based on the stages of their life cycles. Some animals, for example, undergo complete metamorphosis; others go through incomplete metamorphosis; while others do not undergo metamorphosis at all. Some animals begin their life cycles with a live birth, while others hatch from eggs. Students should develop models to describe the unique and diverse life cycles of organisms. They can draw diagrams, build physical models, or create presentations to show the patterns of change that make up the life cycles of given organisms. As students become familiar with the stages in the life cycles of different types of plant and animals, they will come to understand that reproduction is essential to the continued existence of every kind of organism.

In Unit 4: Traits, students learned that organisms have traits that are inherited from their parents. This process occurs during reproduction. While observing and identifying traits of a specific species or type of organism, students also learned that there are differences in characteristics within the same species. In this unit, students learn that these differences in characteristics among individuals of the same species sometimes provide advantages in survival, finding mates, and reproducing. For example, when comparing plants from the same species, those with larger or more abundant thorns may be less likely to be eaten by a predator. Likewise, animals with better camouflage coloration may be more likely to survive and therefore more likely to leave offspring. As students read about, observe, and discuss variations in organisms' characteristics, they should identify cause-and-effect relationships that help explain why any variation might give an advantage in surviving or reproducing to some members of a species over others.

Guppies Galore: Groups of students set up a small freshwater aquarium (made from gallon jars) that feature a male guppy, a female guppy, and a green plant. After the female guppy goes through her pregnancy and gives birth, the students will then observe, over time, the development of the fry into male and female guppies with characteristics similar to the parents.

Let's Hear It For Ladybugs!

This article describes a ladybug life cycle unit that incorporates language arts and science concepts. Students build on their prior knowledge of butterflies as they explore the metamorphosis of ladybugs. To create their final project, clay life cycle models, students synthesize what they learned from live observation and nonfiction texts.

Simply Butterflies!

This article gives suggestions for building a simple walk-in classroom butterfly observatory and using the observatory to hatch out Painted Lady butterflies as part of a four-week unit on life cycle stages.

Traits - 20 various lessons - Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms https://betterlesson.com/next_gen_science/browse/2121/ngss-3-ls3-1-analyze-and-interpret-data-to-provide-evidence-that-plants-and-animals-have-traits-inherited-from-parents-and-that?from=domain_core_lesson_count

Traits influenced by the environment - 19 various lessons - Students in these lessons will Use evidence to support the explanation that traits can be influenced by the environment. https://betterlesson.com/next_gen_science/browse/2122/ngss-3-ls3-2-use-evidence-to-support-the-explanation-that-traits-can-be-influenced-by-the-environment?from=domain_core_lesson_count

Variation in characteristics - 15 various lessons in which student will use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing

https://betterlesson.com/next_gen_science/browse/2125/ngss-3-ls4-2-use-evidence-to-construct-an-explanation-for-how-the-variations-in-characteristics-among-individuals-of-the-same-sp?from=domain_core

Resources

Next Generation Science Standards https://www.nextgenscience.org
National Science Teachers Association www.NSTA.org
Liberty Science Center www.lsc.org
Better Lesson https://betterlesson.com
TBAISD https://tbamoodle.tbaisd.org/course/view.php?id=161
Teach engineering www.teachengineering.org

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

In order to integrate the CCSS for English language arts, students will need opportunities to read about inherited traits of animals and plants in a variety of texts and resources. During discussions, teachers might pose questions such as “What kinds of traits are passed on from parent to offspring?” or “What environmental factors might influence the traits of a specific organism?” Students should be able to refer specifically to the text when answering questions, articulate the main idea, and describe the key ideas using supporting details in their explanations. Additionally, they should describe the relationship between scientific ideas or concepts, using language that pertains to time, sequence, and cause and effect.

During this unit, students also need opportunities to write informative/explanatory texts to convey ideas and information gathered through investigations and from other resources. For example, after reading texts about a given organism, students should be expected to use key details and appropriate facts about that organism to compose an informative piece of writing. This piece should list some of the organism’s traits that were passed on from its parents, describe how those traits enable the organism to interact in its environment to meet its needs, and describe any influence the environment has on the organism’s traits. Students should also have the opportunity to report orally on a given topic related to traits and the way they are influenced by the environment. They should share relevant facts, details, and information while speaking clearly and at an understandable pace.

Students need opportunities to read about the life cycles and inherited traits of organisms in a variety of texts and resources. During discussions, teachers might pose questions such as

- What are the stages of an organism’s life cycle?
- How do the life cycles of organisms compare?
- What makes an organism’s life cycle unique?
- How do organisms use their characteristics to survive, find mates, and reproduce?

Students need access to a variety of books, pictures, and maps. They should be able to refer to these resources specifically when answering questions, articulating the main idea, and describing the key ideas using supporting details in their explanations. Additionally, they should describe the relationship between scientific ideas or concepts and using language that pertains to time, sequence, and cause and effect.

Students also need opportunities to write informative/explanatory texts to convey ideas and information gathered through investigations and from other resources. For example, after reading texts about a given organism, students should be expected to use key details and appropriate facts about that organism to compose an informative piece of writing that lists some of the organism’s traits that might give it an advantage in survival, growth, or reproduction over others of its kind. Students can also use Venn diagrams or T-charts to compare traits among individuals from a common species. These data can be used to explain how variations in characteristics can give an advantage to one or another individual in reproduction, growth, or survival. Students should also have the opportunity to report on how one or more traits of an organism give it an advantage in survival, growth, and/or reproduction in its environment. As students speak, they should share relevant facts, details, and information while speaking clearly and at an understandable pace.

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2) RI.3.1
- Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-1),(3-LS3-2) RI.3.2
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1),(3-LS3-2) RI.3.3
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-1),(3-LS3-2),(3-LS4-2) W.3.2
- Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS3-1),(3-LS3-2) SL.3.4
- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS4-2) RI.3.1
- Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS4-2) RI.3.2
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS4-2) RI.3.3
- Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). (3-LS1-1) RI.3.7
- Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS4-2) SL.3.4
- Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details. (3-LS1-1) SL.3.5
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS4-2) W.3.2

Mathematics

This unit also has connections to the CCSS for mathematics. Students can use rulers to measure the growth of organisms, then generate and plot the data they collected on line plots, making sure the horizontal scale is marked off in appropriate units (whole numbers, halves, or quarters). For example, students might chart out data in line plots to document the growth (over time) of each of a number of plants grown from a single parent. As students analyze their data, they will observe that the offspring are not the same exact height as each other or as the parent, but that the height of all plants is very similar when the plants are grown under the same conditions. Students might also make similar line plots to compare the same type of plants grown with varying amounts of water or sunlight, then compare these data to the growth data of the parent plant. Analyzing this data will help students understand that environmental factors influence/affect the traits of organisms. As students collect, organize, and analyze their data, they have opportunities to reason abstractly and model with mathematics

Students can draw scaled picture graphs or bar graphs to represent a data set with several categories, such as the average length of the lifespan of a variety of organisms, which could range from days to hundreds of years, or the varying reproductive capacity of organisms, which could range from a single offspring to thousands. As students analyze their data, they may observe similarities within a category of organisms (e.g., mammals, reptiles, or insects) or marked differences across these same categories. Analyzing data will help students understand that organisms have unique and diverse life cycles, but all have in common birth, growth, reproduction, and death. As students collect, organize, and analyze their data, they have opportunities to reason abstractly and model with mathematics.

- Reason abstractly and quantitatively. (3-LS3-1),(3-LS3-2) MP.2
- Model with mathematics. (3-LS3-1),(3-LS3-2) MP.4
- Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS3-1),(3-LS3-2) 3.MD.B.4

- Reason abstractly and quantitatively. (3-LS4-2) MP.2
- Model with mathematics. (3-LS1-1), (3-LS4-2) MP.4
- Number and Operations in Base Ten (3-LS1-1) 3.NBT
- Number and Operations—Fractions (3-LS1-1) 3.NF
- Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. (3-LS4-2) 3.MD.B.3
- Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS4-1) 3.MD.B.4

Accommodations/Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented
- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives, and choices

English Language Learners
- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s
- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

Deal School Curriculum
Grades 6-8 Earth and Space Science – Earth and Human Activity
Desired Outcomes
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. **MS-ESS3-2.** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment **MS-ESS3-4.** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. **MS-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
21st Century Skills and Career Education
9.2B3, 9.2B4 **https://www.state.nj.us/education/cccs/2014/career/** **CRP (2,3,4,5,7,8)** **https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf**

Enduring Understandings	**Essential Questions**
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.	• How does understanding the properties of Earth materials and the physical laws that govern behavior lead to prediction of Earth events? • How do changes in one part of an Earth system affect other parts of the system? • How do geologic events occurring today provide insight into Earth's past? • How does technology extend human senses and understanding of Earth?

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).	● What predictable, observable patterns occur as a result of the interaction between the Earth, Moon, and Sun? What causes these patterns? ● How are planets and other objects in the Solar System similar to and different from Earth? ● ▪What implication does this have for the existence and sustaining of life? ● Is there order to the Universe? ● How can change in one part of an ecosystem affect change in other parts of the ecosystem?
Learners will know…	**Learners will be able to….**
ESS3.A: Natural Resources ▪ Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) ESS3.B: Natural Hazards ▪ Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2) ESS3.C: Human Impacts on Earth Systems ▪ Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) ▪ Typically as human populations and per-capita consumption of natural	● Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. ● Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. ● Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment ● Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. ● Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4) ESS3.D: Global Climate Change ▪ Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	
Cross Cutting Concepts	**Connections to Engineering, Technology, and Application of Science**
Patterns ▪ Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2) **Cause and Effect** ▪ Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3) ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1),(MS-ESS3-4) **Stability and Change** ▪ Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4) ▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS- ESS3-3)

	Connections to Nature of Science
	Science Addresses Questions About the Natural and Material World ▪ Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-ESS3-4)

Assessment Evidence

Formative Assessments	**Summative Assessments**
Homework Classwork Section Review Chapter review Review games (including but not limited to) Nerf basketball Trivial Pursuit Bird race Student derived lists Student derived questions Quizzes Class discussion Smartboard touch activities Student self-assessment	Projects Lab reports Tests (written, oral, hands-on practical) Monthly science current event Group projects Individual projects Research reports (oral and written) **Alternative Assessments** Oral Presentations Models Teacher Conference Observations

Suggested Learning Plan

Science taught for 86 minutes
Review of previous topic
Review of homework or tests
Introduction of new material (to include some of the following)
- Lecture
- Video
- Demonstration
- Hands-on activity
- Virtual activity
- Student presentations
- Group work
- Posing questions requiring application of knowledge
- Student questions
- Sampling students knowledge

Suggested Learning Resources

Next Generation Science Standards
https://www.nextgenscience.org
Learning Center NSTA
http://learningcenter.nsta.org
National Science Teacher Association
http://nsta.org

Holt Science and Technology Integrated Science
Various NewPath Learning guides
Various Milliken Discover guides
Various science reference books (classroom library)
Various video sites (including, but not limited to)
- www.teachertube.com
- www.youtube.com
- Google Images
- Kahn Academy

Various virtual lab sites (including, but not limited to)
- www.phet.colorado.edu
- www.mhhe.com
- www.hhmi.org
- www.classzone.com
- www.glencoe.com

Various diagrams, models and displays
Various science based games
Various laboratory equipment
Holt Science Spectrum Physical Science
Glencoe Physical Science with associates workbook and activity guides

NJSLS Connections

ELA/Literacy –
RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-4),(MS-ESS3-5)
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)
WHST.6-8.1
Write arguments focused on discipline content. (MS-ESS3-4)
WHST.6-8.2
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)
WHST.6-8.7

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8
Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3)
WHST.6-8.9
Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1),(MS-ESS3-4)

Mathematics –
MP.2
Reason abstractly and quantitatively. (MS-ESS3-2),(MS-ESS3-5)
6.RP.A.1
Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3),(MS-ESS3-4)
7.RP.A.2
Recognize and represent proportional relationships between quantities. (MS-ESS3-3),(MS-ESS3-4)
6.EE.B.6
Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)
7.EE.B.4
Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)

Accommodations and Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504

- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

Integration of Technology

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing Guide

Grade 6

Marking period 1
Weeks
1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

5-6 Unit 1a: Geology: Inside the Earth

In this unit students will examine surface and subsurface processes that are involved in the formation and destruction of earth materials.

Marking period 2
Weeks
5-6 Unit 1b: Geology: Rocks and Minerals

In this unit students investigate the three types of rocks found in the rock cycle — igneous, sedimentary, and metamorphic — and compare and contrast their origins and processes of formation. Additionally, students will study how fossils provide evidence of constant
environmental change.

4-5 Unit 1c: Geology: Weathering and Erosion

In this unit students will investigate processes of weathering and erosion in the formation of earth's structures.

Marking period 3
Weeks
4-5 Unit 2: Hydrology: Water in Earth's Processes

In this unit students will study the movement of water through the crust, ocean, and atmosphere.

4-5 Unit 3: Meteorology: Climate and Weather

In the unit, students will investigate the interaction of atmospheric conditions and the effects of these on weather and climate.

Marking period 4
Weeks
4-5 Unit 4b: Astronomy: Earth, Moon and Sun

In this unit students will explore how objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

5-6 Unit 4a: Astronomy: Universe and Solar System

In this unit students will examine how scientific theories of the solar system and universe have changed and how gravity shapes and drives the universe.

Grade 7

Marking period 1
Weeks
1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

9-10 Unit 1: Matter and Atoms

In this unit students will focus on the nature of matter, the periodic table, and phases of matter. Students will investigate the arrangement of the periodic table and phase changes.

Finally students will evaluate heat transfer through matter.

Marking period 2

Weeks

9-10 Unit 1: Matter and Atoms (cont.)

8-9 Unit 2: Forces and Motion

In this unit students will focus on forces and motion. Students will analyze motion and understand that forces are required for motion to initialize. Additionally students will evaluate Newton's Three Laws and simple machines.

8-9 Unit 3: Energy

In this unit students will study types of energy as well as energy transfer. Students will analyze and evaluate the relationship between energy transfer and motion. Finally students will understand the Law of Conservation of Energy.

Marking period 3

Weeks

8-9 Unit 3: Energy(cont.)

10-11 Unit 4: Waves and Electricity

In this unit students will evaluate wave structure and function. Students will analyze the organization of wave types. Finally, students will evaluate electricity, circuits, magnetism, and electromagnets.

Grade 8

Marking period 1
Weeks
1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

4-5 Unit 1a: Organization of Life: Structure and Function of Cells

In this unit students will investigate organisms' organization from basic to complex.

4-5 Unit 1b: Organization: Tissues, Organs and Organ System

In this unit students will investigate organisms' organization from basic to complex. Students will investigate processes associated with systems that function in the acquisition and utilization of energy e.g. digestion and respiration, and excretion

Marking period 2
Weeks
4-5 Unit 1b: Organization: Tissues, Organs and Organ System(cont)

3-4 Unit 1c: Organization: Classification

In this unit students will examine system processes through a comparative study of the six kingdoms of life and the Modern Classification System.

5-6 Unit 2: Biological Traits and Heredity: Genetics

In this unit students will examine biological traits and heredity. Students will explore the roles that genes and chromosomes have in how traits are passed through

Marking period 3
Weeks
5-6 Unit 2: Biological Traits and Heredity: Genetics(cont)

3-4 Unit 4: Evolution

In this unit students will examine the evolution of living organisms through inherited characteristics and natural selection. Students will investigate the survival of
organisms and their successive generations as related to their inherited characteristics and
adaptation and use of the fossil records.

Marking period 4
Weeks
10-11 Unit 3: Ecology

In this unit students will examine energy as it is transformed from one form to another and as it flows through organisms and ecosystems. Additionally, identification of organisms in
biomes and aquatic communities. Feeding and symbiotic relationships and human and environmental conditions are also part of this unit.

1-2 Dissection

Students will examine anatomy and physiology of an organism (fetal pig). Additionally invaluable experience will be gained in dissection skills and science practices.

Deal School Curriculum
Grades 6-8 Earth and Space Science – Earth's Place in the Universe
Desired Outcomes
MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. **MS-ESS1-2.** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. **MS-ESS1-3.** Analyze and interpret data to determine scale properties of objects in the solar system. **MS-ESS1-4.** Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
21st Century Skills and Career Education
9.2B3, 9.2B4 **https://www.state.nj.us/education/cccs/2014/career/** **CRP (2,3,4,5,7,8)** **https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf**

Enduring Understandings	**Essential Questions**
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources	• How does understanding the properties of Earth materials and the physical laws that govern behavior lead to prediction of Earth events? • How do changes in one part of an Earth system affect other parts of the system? • How do geologic events occurring today provide insight into Earth's past? • How does technology extend human senses and understanding of Earth? • What predictable, observable patterns occur as a result of the interaction between the Earth, Moon, and Sun? What causes these patterns?

of evidence consistent with scientific ideas, principles, and theories.	● How are planets and other objects in the Solar System similar to and different from Earth? ● ▪What implication does this have for the existence and sustaining of life? ● Is there order to the Universe? ● How can change in one part of an ecosystem affect change in other parts of the ecosystem?
Learners will know…	**Learners will be able to….**
ESS1.A: The Universe and Its Stars ▪ Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) ▪ Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) ESS1.B: Earth and the Solar System ▪ The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS- ESS1-3) ▪ This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) ▪ The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) ESS1.C: The History of Planet Earth ▪ The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only	● Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. ● Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. ● Analyze and interpret data to determine scale properties of objects in the solar system. ● Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

relative dates, not an absolute scale. (MS-ESS1- 4)	
Cross Cutting Concepts	**Connections to Engineering, Technology, and Application of Science**
Patterns ▪ Patterns can be used to identify cause- and-effect relationships. (MS-ESS1-1) **Scale, Proportion, and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4) **Systems and System Models** ▪ Models can be used to represent systems and their interactions. (MS-ESS1-2)	**Interdependence of Science, Engineering, and Technology** ▪ Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS- ESS1-3) **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1- 1),(MS-ESS1-2)
Assessment Evidence	
Formative Assessments Homework Classwork Section Review Chapter review Review games (including but not limited to) Nerf basketball Trivial Pursuit Bird race Student derived lists Student derived questions Quizzes Class discussion Smartboard touch activities Student self-assessment	**Summative Assessments** Projects Lab reports Tests (written, oral, hands-on practical) Monthly science current event Group projects Individual projects Research reports (oral and written) **Alternative Assessments** Oral Presentations Models Teacher Conference Observations

Suggested Learning Plan

Science taught for 86 minutes
Review of previous topic
Review of homework or tests
Introduction of new material (to include some of the following)

- Lecture
- Video
- Demonstration
- Hands-on activity
- Virtual activity
- Student presentations
- Group work
- Posing questions requiring application of knowledge
- Student questions
- Sampling students knowledge

Suggested Learning Resources

Next Generation Science Standards
https://www.nextgenscience.org
Learning Center NSTA
http://learningcenter.nsta.org
National Science Teacher Association
http://nsta.org

Holt Science and Technology Integrated Science
Various NewPath Learning guides
Various Milliken Discover guides
Various science reference books (classroom library)
Various video sites (including, but not limited to)

- www.teachertube.com
- www.youtube.com
- Google Images
- Kahn Academy

Various virtual lab sites (including, but not limited to)

- www.phet.colorado.edu
- www.mhhe.com
- www.hhmi.org
- www.classzone.com
- www.glencoe.com

Various diagrams, models and displays
Various science based games
Various laboratory equipment
Holt Science Spectrum Physical Science
Glencoe Physical Science with associates workbook and activity guides

NJSLS Connections
ELA/Literacy – **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3),(MS-ESS1-4) **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3) **WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS1-4) **SL.8.5** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS1-1),(MS-ESS1-2) *Mathematics –* **MP.2** Reason abstractly and quantitatively. (MS-ESS1-3) **MP.4** Model with mathematics. (MS-ESS1-1),(MS-ESS1-2) **6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3) **7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3) **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-2),(MS-ESS1-4) **7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-2),(MS-ESS1-4)
Accommodations and Modifications (*What accommodations will you make for Sp. Ed; G&T; ELL; at-risk, 504?)*
Gifted and Talented ● Provide appropriate challenge for wide ranging skills and development areas. ● Participate in inquiry and project-based learning units of study. English Language Learners ● Pair visual prompts with verbal presentations ● Provide students with visual models, sentence stems, concrete objects, and

hands on materials.

Students with IEPs/504

- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

Integration of Technology (*How will students integrate technology throughout the unit? How will students achieve the NJSLS)*

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing Guide (*Approximately how long will students needs to master the content and skills presented in this unit?)*

Grade 6

Marking period 1

Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

5-6 Unit 1a: Geology: Inside the Earth

In this unit students will examine surface and subsurface processes that are involved in the formation and destruction of earth materials.

Marking period 2

Weeks

5-6 Unit 1b: Geology: Rocks and Minerals

In this unit students investigate the three types of rocks found in the rock cycle — igneous, sedimentary, and metamorphic — and compare and contrast their origins and processes of formation. Additionally, students will study how fossils provide evidence of constant environmental change.

4-5 Unit 1c: Geology: Weathering and Erosion

In this unit students will investigate processes of weathering and erosion in the formation of earth's structures.

Marking period 3

Weeks

4-5 Unit 2: Hydrology: Water in Earth's Processes

In this unit students will study the movement of water through the crust, ocean, and atmosphere.

4-5 Unit 3: Meteorology: Climate and Weather

In the unit, students will investigate the interaction of atmospheric conditions and the effects of these on weather and climate.

Marking period 4

Weeks

4-5 Unit 4b: Astronomy: Earth, Moon and Sun

In this unit students will explore how objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

5-6 Unit 4a: Astronomy: Universe and Solar System

In this unit students will examine how scientific theories of the solar system and universe have changed and how gravity shapes and drives the universe.

Grade 7

Marking period 1

Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

9-10 Unit 1: Matter and Atoms

In this unit students will focus on the nature of matter, the periodic table, and phases of matter. Students will investigate the arrangement of the periodic table and phase changes.

Finally students will evaluate heat transfer through matter.

Marking period 2

Weeks

9-10 Unit 1: Matter and Atoms (cont.)

8-9 Unit 2: Forces and Motion

In this unit students will focus on forces and motion. Students will analyze motion and understand that forces are required for motion to initialize. Additionally students will evaluate Newton's Three Laws and simple machines.

8-9 Unit 3: Energy

In this unit students will study types of energy as well as energy transfer. Students

will analyze and evaluate the relationship between energy transfer and motion. Finally students will understand the Law of Conservation of Energy.

Marking period 3

Weeks

8-9 Unit 3: Energy(cont.)

10-11 Unit 4: Waves and Electricity

In this unit students will evaluate wave structure and function. Students will analyze the organization of wave types. Finally, students will evaluate electricity, circuits, magnetism, and electromagnets.

Grade 8

Marking period 1

Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

4-5 Unit 1a: Organization of Life: Structure and Function of Cells

In this unit students will investigate organisms' organization from basic to complex.

4-5 Unit 1b: Organization: Tissues, Organs and Organ System

In this unit students will investigate organisms' organization from basic to complex. Students will investigate processes associated with systems that function in the acquisition and utilization of energy e.g. digestion and respiration, and excretion

Marking period 2

Weeks

4-5 Unit 1b: Organization: Tissues, Organs and Organ System(cont)

3-4 Unit 1c: Organization: Classification

In this unit students will examine system processes through a comparative study of the six kingdoms of life and the Modern Classification System.

5-6 Unit 2: Biological Traits and Heredity: Genetics

In this unit students will examine biological traits and heredity. Students will explore the roles that genes and chromosomes have in how traits are passed through

Marking period 3
Weeks
5-6 Unit 2: Biological Traits and Heredity: Genetics(cont)

3-4 Unit 4: Evolution

In this unit students will examine the evolution of living organisms through inherited characteristics and natural selection. Students will investigate the survival of organisms and their successive generations as related to their inherited characteristics and adaptation and use of the fossil records.

Marking period 4
Weeks
10-11 Unit 3: Ecology

In this unit students will examine energy as it is transformed from one form to another and as it flows through organisms and ecosystems. Additionally, identification of organisms in biomes and aquatic communities. Feeding and symbiotic relationships and human and environmental conditions are also part of this unit.

1-2 Dissection

Students will examine anatomy and physiology of an organism (fetal pig). Additionally invaluable experience will be gained in dissection skills and science practices.

Deal School Curriculum

Grades 6-8 Earth and Space Science – Earth's Systems

Desired Outcomes

MS-ESS2-1.
Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS2-2.
Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

MS-ESS2-3.
Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

MS-ESS2-4.
Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS2-5.
Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS-ESS2-6.
Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Enduring Understandings	Essential Questions
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide	• How does understanding the properties of Earth materials and the physical laws that govern behavior lead to prediction of Earth events? • How do changes in one part of an Earth system affect other parts of the system? • How do geologic events occurring today provide insight into Earth's past?

evidence to support explanations or solutions. **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.	● How does technology extend human senses and understanding of Earth? ● What predictable, observable patterns occur as a result of the interaction between the Earth, Moon, and Sun? What causes these patterns? ● How are planets and other objects in the Solar System similar to and different from Earth? ● ▪What implication does this have for the existence and sustaining of life? ● Is there order to the Universe? ● How can change in one part of an ecosystem affect change in other parts of the ecosystem?
Learners will know…	**Learners will be able to….**
ESS1.C: The History of Planet Earth ▪ Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) ESS2.A: Earth's Materials and Systems ▪ All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) ▪ The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) ESS2.B: Plate Tectonics and Large-Scale System Interactions	● Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. ● Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. ● Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. ● Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. ● Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. ● Develop and use a model to describe how unequal heating and rotation of the Earth cause

▪ Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) ESS2.C: The Roles of Water in Earth's Surface Processes ▪ Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) ▪ The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS- ESS2-5) ▪ Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) ▪ Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) ▪ Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2) ESS2.D: Weather and Climate ▪ Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) ▪ Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)	patterns of atmospheric and oceanic circulation that determine regional climates.

Cross Cutting Concepts	Connections to Engineering, Technology, and Application of Science
Patterns ▪ Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) **Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS- ESS2-5) **Scale Proportion and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2- 2) **Systems and System Models** ▪ Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems. (MS-ESS2-6) **Energy and Matter** ▪ Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4) **Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)	**(NA)**
Assessment Evidence	
Formative Assessments	**Summative Assessments**

Homework
Classwork
Section Review
Chapter review
Review games (including but not limited to)
    Nerf basketball
    Trivial Pursuit
    Bird race
Student derived lists
Student derived questions
Quizzes
Class discussion
Smartboard touch activities
Student self-assessment
	Projects
	Lab reports
	Tests (written, oral, hands-on practical)
	Monthly science current event
	Group projects
	Individual projects
	Research reports (oral and written)
	
	Alternative Assessments
	Oral Presentations
	Models
	Teacher Conference
	Observations

Suggested Learning Plan

Science taught for 86 minutes
Review of previous topic
Review of homework or tests
Introduction of new material (to include some of the following)
- Lecture
- Video
- Demonstration
- Hands-on activity
- Virtual activity
- Student presentations
- Group work
- Posing questions requiring application of knowledge
- Student questions
- Sampling students knowledge

Suggested Learning Resources

Next Generation Science Standards
https://www.nextgenscience.org
Learning Center NSTA
http://learningcenter.nsta.org
National Science Teacher Association
http://nsta.org

Holt Science and Technology Integrated Science
Various NewPath Learning guides
Various Milliken Discover guides
Various science reference books (classroom library)
Various video sites (including, but not limited to)

www.teachertube.com
www.youtube.com
Google Images
Kahn Academy
Various virtual lab sites (including, but not limited to)
www.phet.colorado.edu
www.mhhe.com
www.hhmi.org
www.classzone.com
www.glencoe.com
Various diagrams, models and displays
Various science based games
Various laboratory equipment
Holt Science Spectrum Physical Science
Glencoe Physical Science with associates workbook and activity guides

NJSLS Connections

ELA/Literacy –

RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)

RST.6-8.7

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS2-3)

RST.6-8.9

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3),(MS-ESS2-5)

WHST.6-8.2

Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)

WHST.6-8.8

Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS2-5)

SL.8.5

Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-6)

Mathematics –

MP.2

Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)
6.NS.C.5
Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)
6.EE.B.6
Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS2-2),(MS-ESS2-3)
7.EE.B.4
Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS2-2),(MS-ESS2-3)

Accommodations and Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

Integration of Technology

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing Guide

Grade 6

Marking period 1
Weeks
1 Rules and procedures

3-4 Science and engineering practices
In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

5-6 Unit 1a: Geology: Inside the Earth
In this unit students will examine surface and subsurface processes that are involved in the formation and destruction of earth materials.

Marking period 2
Weeks
5-6 Unit 1b: Geology: Rocks and Minerals
In this unit students investigate the three types of rocks found in the rock cycle — igneous, sedimentary, and metamorphic — and compare and contrast their origins and processes of formation. Additionally, students will study how fossils provide evidence of constant
environmental change.

4-5 Unit 1c: Geology: Weathering and Erosion
In this unit students will investigate processes of weathering and erosion in the formation of earth's structures.

Marking period 3
Weeks
4-5 Unit 2: Hydrology: Water in Earth's Processes
In this unit students will study the movement of water through the crust, ocean, and atmosphere.

4-5 Unit 3: Meteorology: Climate and Weather
In the unit, students will investigate the interaction of atmospheric conditions and the effects of these on weather and climate.

Marking period 4
Weeks

4-5 Unit 4b: Astronomy: Earth, Moon and Sun

In this unit students will explore how objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

5-6 Unit 4a: Astronomy: Universe and Solar System

In this unit students will examine how scientific theories of the solar system and universe have changed and how gravity shapes and drives the universe.

Grade 7

Marking period 1

Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

9-10 Unit 1: Matter and Atoms

In this unit students will focus on the nature of matter, the periodic table, and phases of matter. Students will investigate the arrangement of the periodic table and phase changes. Finally students will evaluate heat transfer through matter.

Marking period 2

Weeks
9-10 Unit 1: Matter and Atoms (cont.)

8-9 Unit 2: Forces and Motion

In this unit students will focus on forces and motion. Students will analyze motion and understand that forces are required for motion to initialize. Additionally students will evaluate Newton's Three Laws and simple machines.

8-9 Unit 3: Energy

In this unit students will study types of energy as well as energy transfer. Students
will analyze and evaluate the relationship between energy transfer and motion. Finally students will understand the Law of Conservation of Energy.

Marking period 3
Weeks
8-9 Unit 3: Energy(cont.)

10-11 Unit 4: Waves and Electricity

In this unit students will evaluate wave structure and function. Students will analyze the organization of wave types. Finally, students will evaluate electricity, circuits, magnetism, and electromagnets.

Grade 8

Marking period 1

Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

4-5 Unit 1a: Organization of Life: Structure and Function of Cells

In this unit students will investigate organisms' organization from basic to complex.

4-5 Unit 1b: Organization: Tissues, Organs and Organ System

In this unit students will investigate organisms' organization from basic to complex. Students will investigate processes associated with systems that function in the acquisition and utilization of energy e.g. digestion and respiration, and excretion

Marking period 2

Weeks

4-5 Unit 1b: Organization: Tissues, Organs and Organ System(cont)

3-4 Unit 1c: Organization: Classification

In this unit students will examine system processes through a comparative study of the six kingdoms of life and the Modern Classification System.

5-6 Unit 2: Biological Traits and Heredity: Genetics

In this unit students will examine biological traits and heredity. Students will explore the roles that genes and chromosomes have in how traits are passed through

Marking period 3

Weeks
5-6 Unit 2: Biological Traits and Heredity: Genetics(cont)

3-4 Unit 4: Evolution

In this unit students will examine the evolution of living organisms through inherited characteristics and natural selection. Students will investigate the survival of organisms and their successive generations as related to their inherited characteristics and adaptation and use of the fossil records.

Marking period 4
Weeks
10-11 Unit 3: Ecology

In this unit students will examine energy as it is transformed from one form to another and as it flows through organisms and ecosystems. Additionally, identification of organisms in
biomes and aquatic communities. Feeding and symbiotic relationships and human and environmental conditions are also part of this unit.

1-2 Dissection

Students will examine anatomy and physiology of an organism (fetal pig). Additionally invaluable experience will be gained in dissection skills and science practices.

Deal School Curriculum

Grades 6-8 Engineering Design

Desired Outcomes

MS-ETS1-1.
Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2.
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3.
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4.
Develop a model to generate data for iteractive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Enduring Understandings	Essential Questions
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ▪ Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1) **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and	

predict more abstract phenomena and design systems. ▪ Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.	
Learners will know…	**Learners will be able to….**
ETS1.A: Defining and Delimiting Engineering Problems ▪ The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) ETS1.B: Developing Possible Solutions ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ▪ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)	● Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. ● Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. ● Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. ● Develop a model to generate data for iterative testing and modification of a proposed object, tool, or

▪ Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) ▪ Models of all kinds are important for testing solutions. (MS-ETS1-4) ETS1.C: Optimizing the Design Solution ▪ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS- ETS1-4)	process such that an optimal design can be achieved.
Cross Cutting Concepts	**Connections to Engineering, Technology, and Application of Science**
	Influence of Science, Engineering, and Technology on Society and the Natural World ▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) ▪ The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)
Assessment Evidence	

Formative Assessments	Summative Assessments

Homework
Classwork
Section Review
Chapter review
Review games (including but not limited to)
    Nerf basketball
    Trivial Pursuit
    Bird race
Student derived lists
Student derived questions
Quizzes
Class discussion
Smartboard touch activities
Student self-assessment
	Projects
	Lab reports
	Tests (written, oral, hands-on practical)
	Monthly science current event
	Group projects
	Individual projects
	Research reports (oral and written)
	
	Alternative Assessments
	Oral Presentations
	Models
	Teacher Conference
	Observations

Suggested Learning Plan

Science taught for 86 minutes
Review of previous topic
Review of homework or tests
Introduction of new material (to include some of the following)
- Lecture
- Video
- Demonstration
- Hands-on activity
- Virtual activity
- Student presentations
- Group work
- Posing questions requiring application of knowledge
- Student questions
- Sampling students knowledge

Suggested Learning Resources

Next Generation Science Standards
https://www.nextgenscience.org
Learning Center NSTA
http://learningcenter.nsta.org
National Science Teacher Association
http://nsta.org

Holt Science and Technology Integrated Science
Various NewPath Learning guides
Various Milliken Discover guides
Various science reference books (classroom library)

Various video sites (including, but not limited to)

www.teachertube.com
www.youtube.com
Google Images
Kahn Academy

Various virtual lab sites (including, but not limited to)

www.phet.colorado.edu
www.mhhe.com
www.hhmi.org
www.classzone.com
www.glencoe.com

Various diagrams, models and displays
Various science based games
Various laboratory equipment
Holt Science Spectrum Physical Science
Glencoe Physical Science with associates workbook and activity guides

LGBTQ+ and Disabilities Resources

What Does A Scientist Look Like
https://www.teach.lgbt/lesson/do%e2%80%8c-%e2%80%8cyou%e2%80%8c-%e2%80%8csee%e2%80%8c-%e2%80%8cyourself%e2%80%8c-%e2%80%8cas%e2%80%8c-%e2%80%8ca%e2%80%8c-%e2%80%8cscientist%e2%80%8c-middle-school/

NJSLS Connections

ELA/Literacy –
RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)
RST.6-8.9
Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)
WHST.6-8.7
Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)
WHST.6-8.8
Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ETS1-1)
WHST.6-8.9

Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)

SL.8.5

Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ETS1-4)

Mathematics –

MP.2

Reason abstractly and quantitatively.
(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4)

7.EE.3

Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)

7.SP

Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)

Accommodations and Modifications (*What accommodations will you make for Sp. Ed; G&T; ELL; at-risk, 504?)*

Gifted and Talented

- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners

- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504

- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

Integration of Technology (*How will students integrate technology throughout the unit? How will students achieve the NJSLS)*

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing Guide (*Approximately how long will students needs to master the content and skills presented in this unit?)*

Grade 6

Marking period 1
Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

5-6 Unit 1a: Geology: Inside the Earth

In this unit students will examine surface and subsurface processes that are involved in the formation and destruction of earth materials.

Marking period 2
Weeks

5-6 Unit 1b: Geology: Rocks and Minerals

In this unit students investigate the three types of rocks found in the rock cycle — igneous, sedimentary, and metamorphic — and compare and contrast their origins and processes of formation. Additionally, students will study how fossils provide evidence of constant environmental change.

4-5 Unit 1c: Geology: Weathering and Erosion

In this unit students will investigate processes of weathering and erosion in the formation of earth's structures.

Marking period 3
Weeks

4-5 Unit 2: Hydrology: Water in Earth's Processes

In this unit students will study the movement of water through the crust, ocean, and
Atmosphere.

4-5 Unit 3: Meteorology: Climate and Weather

In the unit, students will investigate the interaction of atmospheric conditions and
the effects of these on weather and climate.

Marking period 4
Weeks
4-5 Unit 4b: Astronomy: Earth, Moon and Sun

In this unit students will explore how objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

5-6 Unit 4a: Astronomy: Universe and Solar System

In this unit students will examine how scientific theories of the solar system and universe have changed and how gravity shapes and drives the universe.

Grade 7

Marking period 1
Weeks
1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

9-10 Unit 1: Matter and Atoms

In this unit students will focus on the nature of matter, the periodic table, and phases of matter. Students will investigate the arrangement of the periodic table and phase changes.
Finally students will evaluate heat transfer through matter.

Marking period 2
Weeks
9-10 Unit 1: Matter and Atoms (cont.)

8-9 Unit 2: Forces and Motion

In this unit students will focus on forces and motion. Students will analyze motion and understand that forces are required for motion to initialize. Additionally students will evaluate Newton's Three Laws and simple machines.

8-9 Unit 3: Energy

In this unit students will study types of energy as well as energy transfer. Students will analyze and evaluate the relationship between energy transfer and motion. Finally students will understand the Law of Conservation of Energy.

Marking period 3
Weeks

8-9 Unit 3: Energy(cont.)

10-11 Unit 4: Waves and Electricity

In this unit students will evaluate wave structure and function. Students will analyze the organization of wave types. Finally, students will evaluate electricity, circuits, magnetism, and electromagnets.

Grade 8

Marking period 1
Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

4-5 Unit 1a: Organization of Life: Structure and Function of Cells

In this unit students will investigate organisms' organization from basic to complex.

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In this unit students will investigate organisms' organization from basic to complex. Students will investigate processes associated with systems that function in the acquisition and utilization of energy e.g. digestion and respiration, and excretion

Marking period 2
Weeks

4-5 Unit 1b: Organization: Tissues, Organs and Organ System(cont)

3-4 Unit 1c: Organization: Classification

In this unit students will examine system processes through a comparative study of the six kingdoms of life and the Modern Classification System.

5-6 Unit 2: Biological Traits and Heredity: Genetics

In this unit students will examine biological traits and heredity. Students will explore the roles that genes and chromosomes have in how traits are passed through

Marking period 3
Weeks

5-6 Unit 2: Biological Traits and Heredity:Genetics(cont)

3-4 Unit 4: Evolution

In this unit students will examine the evolution of living organisms through inherited characteristics and natural selection. Students will investigate the survival of organisms and their successive generations as related to their inherited characteristics and adaptation and use of the fossil records.

Marking period 4
Weeks

10-11 Unit 3: Ecology

In this unit students will examine energy as it is transformed from one form to another and as it flows through organisms and ecosystems. Additionally, identification of organisms in biomes and aquatic communities. Feeding and symbiotic relationships and human and environmental conditions are also part of this unit.

1-2 Dissection

Students will examine anatomy and physiology of an organism (fetal pig). Additionally invaluable experience will be gained in dissection skills and science practices.

LGBTQ+ and Disabilities

https://safeschoolsproject.org/curriculum/9-12/social-studies/

glsen.org
Gardenstateequality.org

Just Ask! Be Different, Be Brave, Be You   by Sonja Sotomayer

https://www.teacherspayteachers.com/Product/LGBTQ-Scientists-Engineers-and-Mathematicians-Celebrating-Pride-Month-5640028

https://www.welcomingschools.org/resources/lesson-plans/lgbtq-inclusive-schools/lgbtq-with-books/

https://www.tolerance.org/classroom-resources/film-kits/bibi

https://www.glsen.org/activity/inclusive-curriculum-guide pushback included in here

https://www.facinghistory.org/educator-resources/current-events/lgbtq-history-and-why-it-matters

https://www.facinghistory.org/professional-development/ondemand/bringing-lgbtq-upstanders-your-classroom-conversation-eric-marcus

https://safeschoolsproject.org/

https://www.tolerance.org/magazine/summer-2014/toolkit-for-beautiful-differences

https://www.thetrevorproject.org/resources/trevor-support-center/a-guide-to-being-an-ally-to-transgender-and-nonbinary-youth/

https://www.thetrevorproject.org/wp-content/uploads/2020/03/Guide-to-Being-an-Ally-to-Transgender-and-Nonbinary-Youth.pdf

https://jkclegacy.com/

https://vl2storybookapps.com/

https://livingpaintings.org/

https://www.moma.org/magazine/articles/388?sc_src=email_19791&sc_lid=764369&sc_uid=0NYWqr8Vad&sc_llid=2574&sc_eh=ba2442946bf6825c1&utm_source=Emarsys&utm_medium=email&utm_campaign=EDU+-+Access+DET+videos+20200810

SCIENCE:
Sex /Gender
- https://docs.google.com/presentation/d/1nngPhXLoTnhOh1AIZ0GfCx2CsaOL_E7KOk2Qqm6FP7c/edit#slide=id.p
- https://www.genderinclusivebiology.com/scientific-evidence

Famous scientists
- http://www.reddisability.org/famous-disabled/DisFamScience.htm
- https://www.asbmb.org/asbmb-today/people/061821/lgbtq-scientists-through-history

Science and Technology aid for those with disabilities
- https://www.indiatimes.com/trending/social-relevance/inventions-designed-for-people-with-disabilities-518924.html
- https://www.indiatimes.com/trending/social-relevance/inventions-designed-for-people-with-disabilities-518924.html

Available in Alexa's library:
- "What Does a Historian Look Like?" Historian Identities
- "The ABC's of LGBT+": (Gender Identity Book for TeeThe ABC's of LGBT+: (Gender Identity Book for Teens) by Ashley Mardell
- "Queer Heroes: Meet 53 LGBTQ Heroes From Past and Present!" by Arabelle Sicardi, Sarah Tanat-Jones
- "We Make It Better: The LGBTQ Community and Their Positive Contributions to Society" (Gender Identity Book for Teens, Gay Rights, Transgender, for Readers of Nonbinary) by Eric Rosswood, Kathleen Archambeau
- "Gay & Lesbian History for Kids: The Century-Long Struggle for LGBT Rights, with 21 Activities (For Kids series)" by Jerome Pohlen
- "This Book Is Gay" by Juno Dawson, David Levithan
- "Pride: The Story of Harvey Milk and the Rainbow Flag" by Rob Sanders, Steven Salerno
- "Queer, There, and Everywhere: 23 People Who Changed the World" by Sarah Prager, Zoe More O'Ferrall
- "Simon vs. the Homo Sapiens Agenda" by Becky Albertalli

Teachers Pay Teachers Resources:
- LGBTQ Civil Rights Lesson
- Social Issues Analyzed Through Comics
- LGBTQ Awareness Interactive Bulletin Board
- Pride Information Banner

Grade 6

Marking period 1
Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

5-6 Unit 1a: Geology: Inside the Earth

In this unit students will examine surface and subsurface processes that are involved in the formation and destruction of earth materials.

Marking period 2
Weeks

5-6 Unit 1b: Geology: Rocks and Minerals

In this unit students investigate the three types of rocks found in the rock cycle — igneous, sedimentary, and metamorphic — and compare and contrast their origins and processes of formation. Additionally, students will study how fossils provide evidence of constant environmental change.

4-5 Unit 1c: Geology: Weathering and Erosion

In this unit students will investigate processes of weathering and erosion in the formation of earth's structures.

Marking period 3
Weeks

4-5 Unit 2: Hydrology: Water in Earth's Processes

In this unit students will study the movement of water through the crust, ocean, and Atmosphere.

4-5 Unit 3: Meteorology: Climate and Weather

In the unit, students will investigate the interaction of atmospheric conditions and the effects of these on weather and climate.

Marking period 4
Weeks

4-5

Unit 4b: Astronomy: Earth, Moon and Sun

In this unit students will explore how objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

5-6

Unit 4a: Astronomy: Universe and Solar System

In this unit students will examine how scientific theories of the solar system and universe have changed and how gravity shapes and drives the universe.

Grade 7

Marking period 1
Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

9-10 Unit 1: Matter and Atoms

In this unit students will focus on the nature of matter, the periodic table, and phases of matter. Students will investigate the arrangement of the periodic table and phase changes. Finally students will evaluate heat transfer through matter.

Marking period 2
Weeks

9-10 Unit 1: Matter and Atoms (cont.)

8-9 Unit 2: Forces and Motion

In this unit students will focus on forces and motion. Students will analyze motion and understand that forces are required for motion to initialize. Additionally students will evaluate Newton's Three Laws and simple machines.

8-9 Unit 3: Energy

In this unit students will study types of energy as well as energy transfer. Students will analyze and evaluate the relationship between energy transfer and motion. Finally students will understand the Law of Conservation of Energy.

Marking period 3
Weeks

8-9 Unit 3: Energy(cont.)

10-11 Unit 4: Waves and Electricity

In this unit students will evaluate wave structure and function. Students will analyze the organization of wave types. Finally, students will evaluate electricity, circuits, magnetism, and electromagnets.

Grade 8

Marking period 1
Weeks

1 Rules and procedures

3-4 Science and engineering practices

In this unit students will focus on foundations in science which include scientific thinking and basic skills. Skills include lab safety, scientific processes, measuring, graphing, organizing data, and other required math skills.

4-5 Unit 1a: Organization of Life: Structure and Function of Cells

In this unit students will investigate organisms' organization from basic to complex.

4-5 Unit 1b: Organization: Tissues, Organs and Organ System

In this unit students will investigate organisms' organization from basic to complex. Students will investigate processes associated with systems that function in the acquisition and utilization of energy e.g. digestion and respiration, and excretion

Marking period 2
Weeks

4-5 Unit 1b: Organization: Tissues, Organs and Organ System(cont)

3-4 Unit 1c: Organization: Classification

In this unit students will examine system processes through a comparative study of the six kingdoms of life and the Modern Classification System.

5-6 Unit 2: Biological Traits and Heredity: Genetics

In this unit students will examine biological traits and heredity. Students will explore the roles that genes and chromosomes have in how traits are passed through

Marking period 3
Weeks

5-6 Unit 2: Biological Traits and Heredity: Genetics(cont)

3-4 Unit 4: Evolution

In this unit students will examine the evolution of living organisms through inherited characteristics and natural selection. Students will investigate the survival of organisms and their successive generations as related to their inherited characteristics and adaptation and use of the fossil records.

Marking period 4
Weeks

10-11 Unit 3: Ecology

In this unit students will examine energy as it is transformed from one form to another and as it flows through organisms and ecosystems. Additionally, identification of organisms in biomes and aquatic communities. Feeding and symbiotic relationships and human and environmental conditions are also part of this unit.

1-2 Dissection

Students will examine anatomy and physiology of an organism (fetal pig). Additionally invaluable experience will be gained in dissection skills and science practices.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modified assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity

Career Exploration and Preparation

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic success

Integration of Technology

8.1.5.D.2 Analyze the resource citations in online materials for proper use.
8.1.5.A.1 Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.

Pacing Guide

https://docs.google.com/document/d/1cZvypqfLeNLNwcjI1X4cvwpdGqf9Li9vmQ1uAd9AHQo/edit?usp=sharing

Unit Title	Weather and Climate
Length of Unit	Marking Period 4
Summary/Overview	*What is the typical weather near our home?* *How can we protect people from weather-related hazards?* In this unit of study, students organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. The crosscutting concepts of *patterns, cause and effect*, and the *influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *asking questions and defining problems, analyzing and interpreting data, engaging in argument from evidence*, and *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 3-ESS2-1, 3-ESS2-2, 3-ESS3-1, and 3-5-ETS1-1.

Desired Outcomes	
Standards	
ESS2.D	**Develop a model using an analogy, to describe how weather and climate are related.**
3-ESS2-1	**Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.**
3-ESS2-2	**Obtain and combine information to describe climates in different regions of the world.**

3-ESS3-1	**Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.**
Focus Standards	
ESS2.D: Weather and Climate	● Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1) ● Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)
ESS3.B: Natural Hazards	A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) *(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)*

Learning Objectives
(Students will be able to...)

- Use graphical displays (e.g., table, chart, graph) to organize the given data by season using tables, pictographs, and/or bar charts, including: weather condition data from the same area across multiple seasons (e.g., average temperature, precipitation, wind direction) and weather condition data from different areas (e.g., hometown and nonlocal areas, such as a town in another state).
- Identify and describe patterns of weather conditions across: different seasons (e.g., cold and dry in the winter, hot and wet in the summer; more or less wind in a particular season), different areas (e.g., certain areas (defined by location, such as a town in the Pacific Northwest), have high precipitation, while a different area (based on location or type, such as a town in the Southwest) have very little precipitation).
- Use patterns of weather conditions in different seasons and different areas to predict: the typical weather conditions expected during a particular season (e.g., “In our town in the summer it is typically hot, as indicated on a bar graph over time, while in the winter it is typically cold; therefore, the prediction is that next summer it will be hot and next winter it will be cold.”). The typical weather conditions expected during a particular season in different areas. Climates in different regions of the world (e.g., equatorial, polar, coastal, mid-continental). Variations in climates within different regions of the world (e.g., variations could include an area’s average temperatures and precipitation during various months over several years or an area’s average rainfall and temperatures during the rainy season over several years).
- Combine obtained information to provide evidence about the climate pattern in a region that can be used to make predictions about typical weather conditions in that region.
- Use the information they obtained and combined to describe:climates in different regions of the world.
- Articulate examples of how patterns in climate could be used to predict typical weather conditions.

- Describe climate can vary over years in different regions of the world.
- make a claim about the merit of a given design solution that reduces the impact of a weather-related hazard.
- Students describe based on the given evidence about the design solution, including evidence about: the given weather-related hazard (e.g., heavy rain or snow, strong winds, lightning, flooding along river banks). Problems caused by the weather related hazard (e.g., heavy rains cause flooding, lightning causes fires).
- Evaluate the evidence using given criteria and constraints to determine: How the proposed solution addresses the problem, including the impact of the weather-related hazard after the design solution has been implemented.
- Evaluate the given solution in reducing the impact of a weather-related hazard (i.e., whether the design solution meets the given criteria and constraints].
- Evaluate the benefits and risks a given solution poses when responding to the societal demand to reduce the impact of a hazard.

Understandings **(Students will understand or know…)**	**Essential Questions**
● **Patterns of change can be used to make predictions.** ● **People record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.** ● **Patterns of change can be used to make predictions.** ● **Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over years** ● **Cause-and-effect relationships are routinely identified, tested, and used to explain change.** ● **Science affects everyday life.** ● **People's needs and wants change over time, as do their demands for new and improved technologies.** ● **A variety of natural hazards result from natural processes (e.g., *flooding, fast wind, or lightning).*** ● **Humans cannot eliminate natural hazards but can take steps to reduce their impacts.**	1. *Can we predict the kind of weather that we will see in the spring, summer, autumn, or winter?* 2. *How can climates in different regions of the world be described?* 3. *How can we protect people from natural hazards such as flooding, fast wind, or lightning?*

● **Engineers improve technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones).** ● **Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria).** ● **Different proposals for solutions can be compared on the basis of how well each one meets the criteria for success or how well each takes the constraints into account.**	

Assessment Evidence	
Formative Assessments ● Make predictions using patterns of change. ● Represent data in tables, bar graphs, and pictographs to reveal patterns that indicate relationships. ● Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. Examples of data could include: ● Average temperature ● Precipitation ● Wind direction ● Make predictions using patterns of change. ● Obtain and combine information from books and other reliable media to explain phenomena. ● Identify and test cause-and-effect relationships to explain change. ● Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

the problem. ● Make a claim about the merit of a design solution that reduces the impacts ● of a weather-related hazard. Examples of design solutions to weather-related hazards could include: ● Barriers to prevent flooding ● Wind-resistant roofs ● Lightning rods ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and include several criteria for success and constraints on materials, time, or cost. ● Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	

Learning Activities

What it looks like in the Classroom...

In this unit of study, students organize and use data to describe typical weather conditions expected during a particular season. They notice patterns as they analyze and interpret weather data, and they use this data to determine cause-and-effect relationships. By applying their understanding of weather-related hazards, students make claims about the merit of a design solution that reduces the impacts of such hazards, using evidence to support their claims.

Initially, students learn that scientists record patterns of weather across different times and locations in order to make predictions about future weather conditions. To understand how scientists use weather data, students need time, tools, and resources (both print and digital) to collect weather data. They can use a variety of tools (e.g., thermometers, anemometers, rain gauges) to collect firsthand data and multiple resources (e.g., Weather Bug, NOAA) to gather weather data that has been collected over longer periods of time. Multiple units of measurement (e.g., m, cm, °C, km/hr) should be used when recording weather conditions such as temperature, types and amounts of precipitation, and wind direction and speed. To organize the data they collect, students create graphical displays (bar graphs and pictographs) and tables. Once a sufficient amount of data is collected, students need opportunities to analyze data, looking for patterns of change that can be used to make predictions about typical weather conditions for a particular region and time of year. As they collect and analyze data over time, students learn that certain types of weather tend to occur in a given area and that combinations of weather conditions lead to certain types of weather (e.g., it is always cloudy when it rains or snows, but not all types of clouds bring precipitation).

Weather is a combination of sunlight, wind, precipitation, and temperature in a particular region at a particular time. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over the years. After learning to analyze and use data to make weather predictions, students use long-term patterns in weather to describe climates in a variety of regions around the world. To accomplish this, students use books and other reliable media to obtain information and weather data collected over a long period of time for a variety of regions. With guidance, students analyze the available data and information in order to describe the climate (e.g., average temperatures, average precipitation, average amount of sunlight) in each region.

Science affects everyday life. Whenever people encounter problems, engineers use scientific knowledge to develop new technologies or improve existing ones to solve our day-to-day problems.

After studying weather and climate, students investigate how weather-related hazards can be reduced. Students learn that there are a variety of natural hazards that result from severe weather. Severe weather, such as high winds, flooding, severe thunderstorms, tornados, hurricanes, ice or snowstorms, dust storms, or drought, has the potential to disrupt normal day-to-day routines and cause damage or even loss of life. While humans cannot eliminate natural hazards, they can take steps to reduce their impact. Students can use trade books and media resources to research types of severe weather hazards and their effects on communities and find examples of how communities solve problems caused by severe weather. As a class, students determine the types of severe weather that are common to the local area and discuss the effects on the community. (Define the problem.) In pairs or small groups, students can research ways that the community reduces the effects of severe weather. (Determine ways in which the problem is solved.) Given criteria, groups can determine how well each solution reduces the effects of severe weather. Groups can also prepare a presentation that

- Describes the solution that the group thinks is best for reducing the effects of a given type of weather hazard,
- Lists evidence to support their thinking, and
- Lists at least one possible constraint, such as materials, time, or cost

Example Activities

Weather Science content for Kids and Teens: The National Weather Service has several education resources available at this website.

NOAA Education Resources: The National Oceanic and Atmospheric Administration (NOAA) provides education resources at this website.

Waterproof the Roof - In this engineering activity, students are challenged to design and construct a roof that will protect a cardboard house from getting wet. The criteria and constraints for the design is that students need to develop a roofing system for a house that can prevent water from entering with limited materials.
http://www.discovere.org/sites/default/files/Waterproof%20the%20Roof_082616.pdf

Difference between Climate and Weather - Students are expected to collect and graph weather data, then analyze historical averages to develop an understanding of the difference between weather and climate.
http://eo.ucar.edu/educators/ClimateDiscovery/LIA_lesson1_9.28.05.pdf

Weather - 18 various lesson in which students represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
https://betterlesson.com/next_gen_science/browse/2130/ngss-3-ess2-1-represent-data-in-tables-and-graphical-displays-to-describe-typical-weather-conditions-expected-during-a-particula?from=domain_core

Climates around the world - 12 various lessons in which students obtain and combine information to describe climates in different regions of the world.

https://betterlesson.com/next_gen_science/browse/2131/ngss-3-ess2-2-obtain-and-combine-information-to-describe-climates-in-different-regions-of-the-world?from=domain_core

Designing solutions to reduce weather hazards - 11 various lessons in which students make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

https://betterlesson.com/next_gen_science/browse/2133/ngss-3-ess3-1-make-a-claim-about-the-merit-of-a-design-solution-that-reduces-the-impacts-of-a-weather-related-hazard?from=domain_core

Resources

Next Generation Science Standards **https://www.nextgenscience.org**

National Science Teachers Association www.NSTA.org

Liberty Science Center www.lsc.org

Better Lessons https://betterlesson.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts/Literacy

As students engage in the science described in this unit of study, they use books and other reliable media resources to collect weather and climate information for a given region. They compare information found in two different texts and use information to answer questions about weather and climate. To integrate writing, students can take brief notes as they conduct research and sort evidence into provided categories. Opinion pieces and short research projects should be included to build knowledge about weather and climate.

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS2-2) RI.3.1
- Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2) RI.3.9
- Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1) W.3.1
- Conduct short research projects that build knowledge about a topic. (3-ESS3-1) W.3.7
- Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-ESS2-2) W.3.9

Mathematic

Like literacy, mathematics is integrated in a variety of ways. Students use appropriate tools and units of measure when collecting and recording weather and climate data. They model with mathematics when organizing data into scaled bar graphs, pictographs, and tables. Throughout the unit, students reason abstractly and quantitatively as they analyze and compare weather data. They will use that information to answer questions and solve multistep problems.

- Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2),(3-ESS3-1) MP.2
- Model with mathematics. (3-ESS2-1),(3-ESS2-2), (3-ESS3-1) MP.4
- Use appropriate tools strategically. (3-ESS2-1) MP.5
- Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems

involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1) 3.MD.A.2

- Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1) 3.MD.B.3

Accommodations/Modifications

Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

Gifted and Talented

- Provide appropriate challenge for a wide ranging skills and development.
- Participate in inquiry and project-based learning units of study.
- Provide options, alternatives, and choices

English Language Learners

- Pair visual prompts with verbal presentations.
- Provide students with visual models, sentence stems, concrete objects, and hands-on material.
- Assign a picture or movement to vocabulary words

Students with IEPs/504s

- Review student individual education plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504.
- Modify classroom environment to support academic and physical needs of the students per IEP/504.

At-Risk Learners

- Provide Title 1 services to students not meeting academic standards in ELA and/or Math.
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom.
- Preferential seating
- Modified assessments

21st Century Life and Career Skills

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity
Career Exploration and Preparation
9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic success
Integration of Technology
8.1.5.D.2 Analyze the resource citations in online materials for proper use. 8.1.5.A.1 Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
Pacing Guide
https://docs.google.com/document/d/1cZvypqfLeNLNwcjI1X4cvwpdGqf9Li9vmQ1uAd9AHQo/edit?usp=sharing

Annual Pacing Guide

Grade Level:

Subject:

September	October	November	December	January
rce and Motion	Force and Motion	Force and Motion	Organisms and Environment	Organisms and Environment

February	March	April	May	June
ganisms and vironment aits	Traits	Traits Weather and Climate	Weather and Climate	Weather and Climate

Deal School Curriculum

Science Curriculum Guide Grade 4

Deal School

Deal, New Jersey

2018

Board of Education

Administration

Donato Saponaro, Jr.
Superintendent of Schools

Principal

Curriculum Writing

Committee Administration

Donato Saponaro, Jr.

Consultant/Curriculum Development
Science Education Consulting LLC
Jena Valdiviezo

Teacher(s)

Dr. Cicci

Developed and Written

March 2017 – May 2017

Revised

December 2018

Unit Title	Weathering, Erosion and Earth's Processes
Length of Unit	Marking Period 1
Summary/Overview	*What do the shapes of landforms and rock formations tell us about the past?* *Is it possible to engineer ways to protect humans from natural Earth?* In this unit of study, students develop understandings of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. Students apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. The crosscutting concepts of patterns and cause and effect are called out as organizing concepts. Students demonstrate grade-appropriate proficiency in planning and carrying out investigations and constructing explanations. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
4-ESS2-1	**Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation**
4-ESS1-1	**Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.**
4-ESS2-2	**Analyze and interpret data from maps to describe patterns of Earth's features.**
4-ESS3-2	**Generate and compare multiple solutions to reduce the impacts of natural Earth**

	processes on humans.
3-5-ETS1-3	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
Focus Standards	
ESS2.E:	Biogeology ● Living things affect the physical characteristics of their regions. (4-ESS2-1)
ESS1.C:	The History of Planet Earth ● Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)
ESS2.B	Plate Tectonics and Large-Scale System Interactions ● The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)
ESS3.B:	Natural Hazards ● A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) *(Note: This Disciplinary Core Idea can also be found in 3.WC.)*
ETS1.B	Designing Solutions to Engineering Problems ● Testing a solution involves investigating how well it performs under a range of likely conditions. *(secondary to 4-ESS3-2)*
ETS1.B	Developing Possible Solutions ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

	● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)
ETS1.C	Optimizing the Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Learning Objectives
(Students will be able to…)

- Identify the given explanation for a phenomenon, which includes a statement about the idea that landscapes change over time.
- Identify the evidence relevant to supporting the explanation, including local and regional patterns in the following:
  - Different rock layers found in an area (e.g., rock layers taken from the same location show marine fossils in some layers and land fossils in other layers).
  - Ordering of rock layers (e.g., layer with marine fossils is found below layer with land fossils).
  - Presence of particular fossils (e.g., shells, land plants) in specific rock layers.
  - The occurrence of events (e.g., earthquakes) due to Earth forces.
- Use reasoning to connect the evidence to support particular points of the explanation, including the identification of a specific pattern of rock layers and fossils (e.g., a rock layer containing shells and fish below a rock layer containing fossils of land animals and plants is a pattern indicating that, at one point, the landscape had been covered by water and later it was dry land). Students describe* reasoning for how the evidence supports particular points of the explanation, including:
  - Specific rock layers in the same location show specific fossil patterns (e.g., some lower rock layers have marine fossils, while some higher rock layers have fossils of land plants).
  - Since lower layers were formed first then covered by upper layers, this pattern indicates that the landscape of the area was transformed into the landscape indicated by the upper layer (e.g., lower marine fossils indicate that, at one point, the landscape was covered by water, and upper land fossils indicate that later the landscape was dry land).
  - Irregularities in the patterns of rock layers indicate disruptions due to Earth forces (e.g., a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock).
- Identify the phenomenon under investigation, which includes the following idea:
  - the effects of weathering or the rate of erosion of Earth's materials.
  - The change in the relative steepness of slope of the area (e.g., no slope, slight slope, steep slope).
  - The kind of weathering or erosion to which the Earth material is exposed.
- Determine the change in the shape of Earth materials as the result of weathering or the rate of erosion by one of the following:
  - Motion of water.
  - Ice (including melting and freezing processes).
  - Wind (speed and direction).

- Vegetation.

- identify cause and effect relationships between weathering or erosion, and Earth materials.
- Make and record observations according to the given investigation plan to provide evidence for the effects of weathering or the rate of erosion on Earth materials (e.g., rocks, soils, and sediment).
- organize data using graphical displays (e.g., table, chart, graph) from maps of Earth's features (e.g., locations of mountains, continental boundaries, volcanoes, earthquakes, deep ocean trenches, ocean floor structures).
- Identify patterns in the location of Earth features, including the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes. These relationships include:
- Use logical reasoning based on the organized data to make sense of and describe a phenomenon. In their description*, students include that Earth features occur in patterns that reflect information about how they are formed or occur (e.g., mountain ranges tend to occur on the edges of continents or inside them, the Pacific Ocean is surrounded by a ring of volcanoes, all continents are surrounded by water [assume Europe and Asia are identified as Eurasia]).
- Given a natural Earth process that can have a negative effect on humans (e.g., an earthquake, volcano, flood, landslide), students use scientific information about that Earth process and its effects to design at least two solutions that reduce its effect on humans.

Understandings (Students will understand or know...)	Essential Questions
● **Cause-and-effect relationships are routinely identified, tested, and used to explain change.** ● **Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.** ● **Rainfall helps to shape the land and affects the types of living things found in a region.** ● **Living things affect the physical characteristics of their regions.** ● **Science assumes consistent patterns in natural systems.** ● **Patterns can be used as evidence to support an explanation.** ● **Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.** ● **The presence and location of certain fossil types indicate the order in which rock layers were formed.** ● **Patterns can be used as evidence to support an explanation.**	1. *How can evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation be observed or measured?* 2. *What can rock formations tell us about the past?* 3. *What can maps tell us about the features of the world?* 4. *In what ways can the impacts of natural Earth processes on humans be reduced?*

● **Maps can help locate the different land and water features of Earth.** ● **The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns.** ● **Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans.** ● **Major mountain chains form inside continents or near their edges.** ● **Cause-and-effect relationships are routinely identified, tested, and used to explain change.** ● **Engineers improve existing technologies or develop new ones to increase benefits, decrease known risks, and meet societal demands.** ● **A variety of hazards result from natural processes (e.g., earthquakes, floods, tsunamis, volcanic eruptions).** ● **Humans cannot eliminate the hazards, but they can take steps to reduce their impacts.** ● **Research on a problem should be carried out before beginning to design a solution.** ● **Testing a solution involves investigating how well it performs under a range of likely conditions.** ● **At whatever stage, communicating with peers about proposed solutions to a problem is an important part of the design process, and shared ideas can lead to improved designs.** ● **Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.** ● **Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the**	

constraints.	

Assessment Evidence	
Formative Assessments ● Identify, test, and use cause-and-effect relationships in order to explain change. ● Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. ● Make observations and/or measurements to produce evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. ○ Examples of variables to test could include: ● Angle of slope in the downhill movement of water ● Amount of vegetation ● Speed of the wind ● Relative rate of deposition ● Cycles of freezing and thawing of water ● Cycles of heating and cooling ● Volume of water flow ● Support explanations using patterns as evidence. ● Identify the evidence that supports particular points in an explanation. ● Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. ● Examples of evidence from patterns could include ● Rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time.	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

● A canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. ● Support an explanation using patterns as evidence. ● Analyze and interpret data to make sense of phenomena using logical reasoning. ● Analyze and interpret data from maps to describe patterns of Earth's features. Maps can include: ● Topographic maps of Earth's land ● Topographic maps of Earth's ocean floor ● Locations of mountains ● Locations of continental boundaries ● Locations of volcanoes and earthquakes ● Identify and test cause-and-effect relationships in order to explain change. ● Generate multiple solutions to a problem and compare them based on how well they meet the criteria and constraints of the design solution. ● Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. ○ Examples of solutions could include: ● Designing an earthquake-resistant building ● Improving monitoring of volcanic activity. ● Generate multiple possible solutions to a problem and compare them based on how well each is likely to meet the criteria and constraints of the problem. ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. ● Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or	

prototype that can be improved.	

Learning Activities

<u>What it looks like in the classroom…</u>

In this unit of study, students are expected to develop understanding of the effects of weathering and the rate of erosion by water, ice, wind, or vegetation. As students plan and carry out investigations using models and observe the effects of earth processes in the natural environment, they learn to identify patterns of change; recognize cause-and-effect relationships among the forces that cause change in rocks, soil, and landforms; and construct explanations of changes that occur over time to earth materials.

In the first portion of the unit, fourth graders develop an understanding of cause-and-effect relationships when studying physical weathering and the rate of erosion by water, wind, ice, or vegetation. Students learn that rainfall helps to shape the land and affects the types of living things found in a region, and that living things affect the physical characteristics of a region. Students should make observations of their local environment to observe the types of living things that are common in the region, and they should look for evidence that water, ice, wind, organisms, and gravity have broken down rocks, soils, and sediments into smaller pieces and have moved them from one place to another.

In the classroom, students should build and use models that demonstrate how wind, water, and ice cause change to the surface of the earth. Students should use stream tables, soil, sand, and water to simulate the effects of moving water (rain, rivers) on rocks and soil. Following these types of experiences, students need opportunities to ask questions that will lead to further investigations. They can change a variable—such as the type of earth material (sand, soil, clay, silt), the angle of a hill's slope, the volume of water flow, the speed of water flow, and the relative rate of deposition—then collect and analyze data in order to determine the effects.

In addition to using models to understand the effects of water and ice on land, students should build and use models to simulate the effects of wind on earth materials. There are a variety of models that can be easily built. Students should have opportunities to change variables, such as the speed or volume of airflow. From these experiences, students should begin to understand that wind, water, and ice cause changes to the earth's surface, and that the stronger or faster the flow of wind or water, the greater the change it causes.

In this unit, students also need opportunities to observe ways in which plants affect the weathering and erosion of earth materials. Plants can have a variety of effects on rocks, soils, and landforms. Plants often slow or stop the effects of moving wind and water on land. Students can observe this phenomenon using models. As they make observations, students can change variables, such as the amount or type of plant used to slow or stop erosion, and they can collect and analyze data to determine cause-and-effect relationships between the amount of change and the plants used to prevent it. Then students can walk around the schoolyard and nearby neighborhoods to look for examples of plants that are used to prevent erosion.

In addition to slowing or preventing erosion, plants can cause weathering of rocks. Students can easily find examples in their own environment of growing plant and tree roots causing rocks, sidewalks, and driveways to crack and break down into smaller and smaller components. This phenomenon can also be simulated with models in the classroom. Students can soak lima beans in water overnight, then “plant” them in small cups containing a 2–3 cm. layer of wet Plaster of Paris on top of potting soil. (One or two seeds should be placed in the wet layer of plaster.) After a few days, the seeds will germinate and grow, eventually causing the dried plaster to crack. Again, students need opportunities to change variables, such as the number of seeds planted (one seed vs. multiple seeds, for example) and the type of seeds, then make observations and collect data to determine the amount of weathering each change causes to the dried plaster.

Students learn that patterns can be used as evidence to explain changes to the earth’s landforms and rock formations, and that local, regional, and global patterns of rock formations reveal changes over time due to earth forces. If possible, students should make observations of local landforms; however, pictures from books and online sources can give students the opportunity to identify evidence of change from patterns in rock formations and fossils in rock layers. Students can support explanations for changes in a landscape over time in multiple ways, including the following:

- Pictures of a variety of landforms, such as sand dunes and canyons, can be used to show change due to weathering and erosion that have occurred over time.
- Pictures or diagrams of rock layers with marine shell fossils above rock layers with plant fossils and no shells can be used to indicate a change from land to water over long periods of time.
- Pictures of a canyon with different rock layers in the walls and a river at the bottom can be used to show that over time a river cut through the rock to form the canyon.

As students collect evidence, either from firsthand observations or from media resources, they should attempt to explain the changes that have occurred over time in each of the landscapes observed

In this unit of study, students analyze and interpret data from maps to describe patterns of Earth’s features. Students can use topographic maps of Earth’s land and ocean floor in order to locate features such as mountains, mountain ranges, deep ocean trenches, and other ocean floor structures. As students analyze and interpret these types of maps, they begin to notice patterns in the types of structures and where these structures are found. Students learn that major mountain chains often form along or near the edge of continents. Once students locate continental boundaries, a further analysis of data can show students that there is a noticeable pattern of earth events, including volcanoes and earthquakes, which occur along these boundaries.

During this unit, students also learn that engineers develop or improve technologies to solve societal problems. A variety of hazards result from natural processes (e.g. earthquakes, floods, tsunamis, volcanic eruptions). Although we cannot eliminate the hazards, we can take steps to reduce their impacts. Students must have the opportunity to engage in the engineering design process in order to generate and compare multiple solutions that reduce the impacts of natural Earth processes on humans. This process should include the following steps:

- Students brainstorm possible problems that Earth processes can cause for humans. (Earth processes should be limited to earthquakes, volcanic eruptions, tsunamis, and floods.)
- Either as a class or in small groups, have students select one problem (such as the effects of volcanic eruptions on humans) to research.
- Small groups conduct research to determine possible solutions (such as consistent monitoring of volcanic activity and the use of early warning systems) that reduce the impacts of the chosen Earth process on humans.
- As a class, determine criteria and possible constraints on the design solutions. Criteria might include: saving lives and/or reducing property loss.
- Small groups investigate how well the solutions perform under a range of likely conditions. This may involve additional research and analysis of available data or planning and conducting investigations to produce data that will serve as the basis for evidence. During this process, students should plan and carry
- out fair tests in which variables are controlled and failure points are considered in order to identify elements of the design solution that do and do not meet criteria.
- Students compare the solutions based on how well they meet criteria and constraints, using data as evidence to support their thinking. At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. Students should routinely identify and test cause-and-effect relationships and use these relationships to explain the changes that they observe as they test design solutions.

At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. Students should routinely identify and test cause-and-effect relationships and use these relationships to explain the changes that they observe as they test design solutions.

Engineering design performance expectations are an integral part of this unit of study. Students are expected to research a problem, generate and compare possible design solutions, and test the design solutions to determine how well each performs under a range of likely conditions. Using data as evidence, students identify elements of each design that need improvement and determine which design solution best solves the problem, given the criteria and the constraints. This process is outlined in greater detail in the previous section.

Example Activities

Gary's Sand Journal: This book allows students to observe illustrations of magnified sand particles with guided dialogue from an earth scientist who discusses sand origins. This book can be used to introduce students to types of sand, explain how earth processes were responsible for their creation, and discuss the work of earth scientists. After reading this book, students may use it as a resource when examining their own sand samples. They could list properties, discuss sand origins, and illustrate samples in a science journal.

Explaining Glaciers, Accurately: Fourth grade lessons on glacial erosion demonstrate and explain the manner in which glaciers erode the earth. The mechanisms of plucking and abrasion are discussed. Activities (either whole-class or small group) include a teacher creation of a glacier model (using dirt and rocks to simulate a mountain, ice cubes and a small amount of water for glacier), then teacher demonstration of glacier "plucking" earth as it travels in a simulation activity. Students then experiment with rock samples, wood, sandpaper, and ice as they rub materials against each other to explore how glacial striations form and abrade other surfaces. In each simulation, students are asked to predict what would happen when glacial model water freezes, as they draw before and after pictures of the model. Students are also asked to predict how glacial striations were formed as they view photos, then record results of their abrasive materials activity. Students could benefit from the expertise of a mentoring geologist who shares illustrations and information with students and teachers.

Coastal Erosion: This engineering design lesson focuses on the effects of erosion on Florida's coastline. It is one lesson offered within a larger weathering and erosion unit. Students groups work to create and use a model able to slow erosion, without damaging the coastal ecosystem. Students are responsible for developing scale diagram of their coastline erosion solution before building and testing their models in a pan to simulate the coastline. Students then complete a redesign cycle. Similar lessons from the developer can be used in conjunction with this lesson to incorporate the effects of erosion on humans and wildlife.

Building for the Big One: This lesson plan details a Design Challenge in which students build and test structures while learning about the earthquakes that shake them. It is designed as a review or culmination of an Earthquake unit of study. The lesson plan allows teachers to connect back to previous lessons. The Tech Museum of Innovation also suggests that the lesson might be used as a form of introduction to a unit about earthquakes. The lesson would then be used to determine students' prior knowledge to set the stage for the design challenge. This resource often mentions the effects of tectonic plates on earthquake location. Grade 4 curriculum does not include tectonic plates in their earth science curriculum. Tectonic plate information is included in the lesson as a resource for the teacher.

Earthquakes in the Classroom: Students investigate which building types are structured to withstand

earthquake damage. They take on the role of engineers as they design their own earthquake resistant buildings, then test them in a simulated earthquake activity. Students also develop an appreciation for the job of engineers who need to know about earthquakes and their causes in order to design resistant buildings. This lesson is one of several in the "Earthquakes Rock" unit provided by the Teach Engineering site. The unit "URL" listed here is not being reviewed for the Performance Expectation listed. It is offered as a supplemental concept and lesson background aid for teachers.
https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_natdis/cub_natdis_lesson03.xml

Getting the Right Angle on the Story: This informational text shows students how tsunamis form and behave. It also describes how scientists are collecting data to create models that can be used to predict tsunamis. Animations/computer models are also included to enhance student knowledge of how tsunami warnings work. Models integrate new, unfamiliar vocabulary. Students could use the resource as a starting point for an earth systems unit; teachers could assign the site as a form of research where students gather data, take notes, and draw inferences from text. As students begin their study, they could generate a list of the earth's natural disasters and define their impact on human life and the environment. Their possible solutions for lessening that impact could also be incorporated as an informal formative assessment to determine student prior knowledge.

Glaciers, Water, and Wind, Oh My! This hands-on activity allows students to explore five earth forces that may cause erosion as they model, observe, and record the effects of erosion on earth surfaces. Stations include demonstrations of chemical, wind, water, ice and heat forces as they affect weathering.

https://www.teachengineering.org/activities/view/cub_earth_lesson5_activity1

Add weather and acid student learning center… at the end of the activity have students rotate through a learning walk of all earth's force that may cause erosion.

Bill Nye Video-Erosion: Bill Nye, "The Science Guy", presents a video describing the effects of weathering (wind, water, ice) on landforms. **Bryce Canyon** is used as an example of the ways in which freezing water, plant roots, and wind weather the earth's surface creating the means for erosion. Students in video simulate effects of weathering which can be duplicated in a classroom setting. Nye also emphasizes the passage of time in millions of years as he explains the slower erosive effects of certain types of weathering.

https://www.schooltube.com/video/9522ccca25154ea897ff/Bill%20Nye%20erosion

Guy? Weathering One more Time - Students grappling with understanding effects of weathering on the Earth's surface benefit from this video as they jigsaw their new information to prepare for a group presentation

https://betterlesson.com/lesson/635296/what-s-with-that-crazy-nye-guy-weathering-one-more-time-day-1

https://betterlesson.com/lesson/635688/what-s-with-that-crazy-nye-guy-weathering-one-more-time-day-2

Engineering for the Three Little Pigs: This activity helps to demonstrate the importance of rocks, soils, and minerals in engineering and how using the right material for the right job is important. The students build 3 different sand castles composed of varying amounts of sand, water, and glue. The 'buildings' in this lesson are made of sand and glue, sand being a soil and glue being composed of different minerals. They then test them for strength (load bearing), and resistance to weathering. The students will then compare possible solutions and discuss how well each is likely to work while meeting the criteria and constraints of the problem. The students will be the engineers who figure out which materials are best for the buildings they are making, taking into consideration all the properties of materials that are discussed in the lesson.

Video for Three little Pigs https://www.youtube.com/watch?v=6f3O7Ur-G1Y

Example lessons in which students identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (36 Lessons)

https://betterlesson.com/next_gen_science/browse/2151/ngss-4-ess1-1-identify-evidence-from-patterns-in-rock-formations-and-fossils-in-rock-layers-to-support-an-explanation-for-change?from=domain_core_container

Example of multiple lessons for students to make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (54 Lessons)

https://betterlesson.com/next_gen_science/browse/2153/ngss-4-ess2-1-make-observations-and-or-measurements-to-provide-evidence-of-the-effects-of-weathering-or-the-rate-of-erosion-by-w?from=domain_core

Examples of multiple lessons in which students analyze and interpret data from maps to describe patterns of Earth's features. (18 Lessons)

https://betterlesson.com/next_gen_science/browse/2154/ngss-4-ess2-2-analyze-and-interpret-data-from-maps-to-describe-patterns-of-earth-s-features?from=domain_core_container

Examples of multiple lessons in which student obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

(24 sample lessons) **(These lessons will link with energy unit)**

https://betterlesson.com/next_gen_science/browse/2156/ngss-4-ess3-1-obtain-and-combine-information-to-describe-that-energy-and-fuels-are-derived-from-natural-resources-and-their-uses?from=domain_core_lesson_count

Example lessons in which students generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. (33 Lessons)

https://betterlesson.com/next_gen_science/browse/2157/ngss-4-ess3-2-generate-and-compare-multiple-solutions-to-reduce-the-impacts-of-natural-earth-processes-on-humans?from=domain_core_container

Computer Simulations

https://phet.colorado.edu/en/simulations/category/earth-science

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu
YouTube www.youtube.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts/Literacy

To support integration of the language arts standards in this unit, students can read content-specific texts to deepen their understanding of the cause-and-effect relationships within earth systems. As they read, students should take notes, which can be used to help them understand and explain how earth processes affect the world around them. They should ask questions, such as,

- *What types of soil erode faster?*
- *Why do some rocks weather more easily or more quickly than others?*
- *What patterns of change can be observed using models?*

As they attempt to answer these questions, students can cite evidence from observations and from texts to support their thinking. In addition, students can conduct short research projects that will help them gather additional evidence to support explanations. Throughout this unit, students should collect and record data in science journals and analyze the data to identify patterns of change.

To support integration of the CCSS for English Language Arts in this unit, students should have access to multiple sources of information about Earth's features and earth processes. Students should have opportunities to read, analyze, and interpret information from nonfiction text, charts, graphs, diagrams, timelines, and interactive elements on the Internet. Students use this information, along with data they collect during investigations, to help explain, both orally and in writing, the patterns they observe in the features of the Earth and in the natural hazards that occur on the Earth.

As students engage in the engineering design process, they need opportunities to conduct research to build their understanding of how earth processes affect humans and to find examples of ways in which engineers reduce the effect of volcanic eruptions, earthquakes, floods, and tsunamis. Students should take notes as they read and summarize or paraphrase their notes to support their work throughout the engineering design process.

In addition, students should provide a list of sources when using this type of information.

- Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1) W.4.7 (3-5-ETS1-3) W.5.7
- Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1),(4-ESS1-1)W.4.8 (3-5-ETS1-3) W.5.8
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1) W.4.9 (3-5-ETS1-3) W.5.9
- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2) RI.4.1
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2) RI.4.7
- Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2) RI.4.9 (3-5-ETS1-2) RI.5.9
- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2) RI.5.1

Mathematics

To support integration of the Mathematics standards into this unit, students are expected to use mathematics when analyzing quantitative data to identify patterns, explain cause-and-effect relationships, and make predictions. Students need opportunities to measure earth materials using tools, such as balances and graduated cylinders, and to measure distances and heights using rulers or tape measures. Students should also be required to solve problems involving measurement and data.

Use measurements to determine how far earthquakes and volcanoes tend to occur from continental boundaries.

Analyze data to determine patterns of change that occur in areas where volcanoes erupt, earthquakes occur, and in flood zones.

Reason abstractly and quantitatively to draw diagrams to build scale models.

Analyze timelines, charts, and graphs to determine patterns in Earth's features and patterns of change caused by earth processes.

Reason abstractly and quantitatively when discussing the effects of an earth process on humans. For example, on average, 3,000 lives are lost every year due to tsunamis. When early warning systems are in place, fewer than 1,000 lives are lost annually.

Analyze constraints on materials, time, or cost to in order to determine criteria for design solutions.

- Reason abstractly and quantitatively. (4-ESS2-1), (4-ESS1-1) MP.2 (4-ESS3-2), (3-5-ETS1-2),(3-5-ETS1-3) MP.2
- Model with mathematics. (4-ESS2-1), (4-ESS1-1) MP.4 (4-ESS3-2), (3-5-ETS1-2),(3-5-ETS1-3) MP.4
- Use appropriate tools strategically. (4-ESS2-1) MP.5 (3-5-ETS1-2),(3-5-ETS1-3) MP.5
- Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1), (4-ESS1-1) 4.MD.A.1
- Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1) 4.MD.A.2
- Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2) 4.OA.A.1
- Operations and Algebraic Thinking (3-ETS1-2) 3-5.OA

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations

- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504

- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Integration of Technology

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September – November	9 Weeks	1	Energy
December – January	9 Weeks	2	Waves
January – March	9 Weeks	3	Processes that Shape the Earth

Course Title: 4th Grade Science

April – June	9 Weeks	4	Structure, Function, and Information Processing

Unit Title	Organisms Processing, Structures and Functions
Length of Unit	Marking Period 2
Summary/Overview	***How do the internal and external parts of plants and animals support their survival, growth, behavior, and reproduction?*** ***How do animals use their perceptions and memories to make decisions?*** In this unit of study, students develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Students are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. The crosscutting concepts of *systems and system models* are called out as organizing concepts for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency *in engaging in argument from evidence*. Students are also expected to use this practice to demonstrate understanding of the core idea.

Desired Outcomes	
Standards	
4-LS1-1	**Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.**
4-LS1-2	**Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.**
4-LS4-2	**Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.**
Focus Standards	

LS1.A:	Structure and Function ● Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)
LS1.D	Information Processing ● Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)
PS4.B	Electromagnetic Radiation ● An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)

Learning Objectives
(Students will be able to…)

- Make a claim to be supported about a phenomenon. In the claim, students include the idea that plants and animals have internal and external structures that function together as part of a system to support survival, growth, behavior, and reproduction.
- Describe using the given evidence, including:
  - The internal and external structures of selected plants and animals.
  - The primary functions of those structures
- Determine the strengths and weaknesses of the evidence, including whether the evidence is relevant and sufficient to support a claim about the role of internal and external structures of plants and animals in supporting survival, growth, behavior, and/or reproduction.
- use reasoning to connect the relevant and appropriate evidence and construct an argument that includes the idea that plants and animals have structures that, together, support survival, growth, behavior, and/or reproduction. Students describe* a chain of reasoning that includes:
  - Internal and external structures serve specific functions within plants and animals (e.g., the heart pumps blood to the body, thorns discourage predators).
  - The functions of internal and external structures can support survival, growth, behavior, and/or reproduction in plants and animals (e.g., the heart pumps blood throughout the body, which allows the entire body access to oxygen and nutrients; thorns prevent predation, which allows the plant to grow and reproduce).
  - Different structures work together as part of a system to support survival, growth, behavior, and/or reproduction (e.g., the heart works with the lungs to carry oxygenated blood throughout the system; thorns protect the plant, allowing reproduction via stamens and pollen to occur).
- From a given model, students identify and describe the relevant components for testing interactions concerning the functioning of a given natural system, including:
  - Different types of information about the surroundings (e.g., sound, light, odor, temperature).
  - Sense receptors able to detect different types of information from the environment.
- Describe the relationships between components in the model, including:
  - Different types of sense receptors detect specific types of information within the environment.
  - Sense receptors send information about the surroundings to the brain.
  - Information that is transmitted to the brain by sense receptors can be processed immediately as perception of the environment and/or stored as memories.

- Immediate perceptions or memories processed by the brain influence an animal's action or responses to features in the environment.
- Information in the environment interacts with animal behavioral output via interactions mediated by the brain.
- Different types of sensory information are relayed to the brain via different sensory receptors, allowing experiences to be perceived, stored as memories, and influence behavior (e.g., an animal sees a brown, rotten fruit and smells a bad odor — this sensory information allows the animal to use information about other fruits that appear to be rotting to make decisions about what to eat; an animal sees a red fruit and a green fruit — after eating them both, the animal learns that the red fruit is sweet and the green fruit is bitter and then uses this sensory information, perceived and stored as memories, to guide fruit selection next time).
- Sensory input, the brain, and behavioral output are all parts of a system that allow animals to engage in appropriate behaviors.

Understandings (Students will understand or know...)	Essential Questions
● **A system can be described in terms of its components and their interactions.** ● **Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction** ● **A system can be described in terms of its components and its interactions.** ● **Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.** ● **Animals are able to use their perceptions and memories to guide their actions.** ● **Cause-and-effect relationships are routinely identified.** ● **An object can be seen when light reflected from its surface enters the eyes.**	1. *How do internal and external parts of plants and animals help them to survive, grow, behave, and reproduce?* 2. *How do animals receive and process different types of information from their environment in order to respond appropriately?* 3. *What happens when light from an object enters the eye?*

Assessment Evidence	
Formative Assessments ● Describe a system in terms of its components and their interactions.	**Summative Assessments** ● Labs ● Projects

● Construct an argument with evidence, data, and/or a model. ● Construct an argument to support the claim that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Examples of structures could include: ● Thorns ● Stems ● Roots ● Colored petals ● Heart ● Stomach ● Lung ● Brain ● Skin ● Describe a system in terms of its components and their interactions. ● Use a model to test interactions concerning the functioning of a natural system. ● Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. ● Emphasis is on systems of information transfer. ● Identify cause-and-effect relationships. ● Develop a model to describe phenomena. ● Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

Learning Activities

What it looks like in the classroom…

In this unit of study, students spend time observing plants and animals in order to gather evidence that organisms are living systems. A system is made up of structures and processes that interact and enable the system to function. Every plant and animal can be described in terms of its internal and external structures and their interactions, and these structures each have specific functions that support survival, growth, behavior, and reproduction for the organism.

Using a variety of plants and animals as examples, students need multiple opportunities to:

- Describe the internal and external structures of a plant or animal and the function of each of those structures. Description should explain how each structure serves various functions in growth, survival, behavior, and/or reproduction.
- Describe the interactions that occur among the structures within the plant or animal system.

As students observe the structures of an animal or plant, explain the function of each, and describe how these structures help the animal grow, survive, and/or reproduce, they should use evidence from their observations to support their explanations.

In this unit of study, students use the concept of *systems* to understand that every animal has internal and external structures that allow it to take in information from the environment in which it lives, process that information, and respond in ways that increase its chances to grow, reproduce, and survive. The way in which an organism gathers information will depend on the organism and the body structures that pick up signals from the environment. Many animals, like humans, have sense organs that gather information from the environment through seeing, hearing, feeling, smelling, and tasting. Some animals have sensory receptors or other mechanisms that allow them to sense such things as light, temperature, moisture, and movement. Students need to understand that all animals pick up information from their environment through senses or sensory receptors. In many animals, nerves or neurons then transfer that information to a centralized place (the brain) where it is processed; then, through reflex reactions or learned behaviors, the organism responds in ways that will help it survive and reproduce. In addition, animals often store this information in their brains as memories and use these memories to guide future actions. As students observe animals, either through direct observation or using text and digital resources, they should use models, such as drawings, diagrams, and pictures, to describe the ways that animals (and humans) receive, process, store, and respond to information from the environment in order to survive, grow, and reproduce.

To continue the progression of learning, fourth graders focus on the sense of sight, using models to understand and describe that light reflects from objects and enters the eye, allowing objects to be seen. In first grade, students learned that objects can be seen only when illuminated, and they determined the effect of placing different materials in the path of a beam of light. In this unit, students need opportunities to develop a conceptual understanding of the role that light plays in allowing us to see objects. Using a model can help with this process, which might include the following steps:

- To review prior learning, ask students to describe what happens to our ability to see objects in a room with no light, and what happens when different types of materials are placed in the path of a beam of light. (If necessary, demonstrate using flashlights and a variety of transparent, translucent, and opaque materials).
- Using penlights, a variety of lenses, mirrors, and pieces of cardboard, allow students to explore the behavior of light when it comes into contact with these objects. Have students draw and describe what they observe.

- Using a cardboard shoebox with a 1-cm. slit at one end, shine a flashlight into the box through the slit, and ask students to describe what they see. Place a clear plastic cup of water in the path of the light, and ask students to describe what they observe.
- Students should first observe that light travels in a straight line. Lenses and water allow the light to pass through; however, the beam of light is refracted (bent). Mirrors do not allow the light to pass through, but do reflect light, sending the beam in a different direction. The cardboard does not allow any light to pass through, and the beam of light is no longer visible in the same way.
- Next have students observe a large object, such as a book. Ask them to describe what they see. Place a sheet of transparency film or clear plastic wrap in front of the book, and ask students to again describe what they see. Ask, "How are you able to see the book even though I have placed something in between you and the object?"
- Take away the clear plastic wrap and place a sheet of dark construction paper in front of the book, and ask student to describe what they see. Ask,
- "Why are you no longer able to see the book?"
- To help students as they try to understand the role that light plays in allowing us to see objects, tell them that they will be using a model that demonstrates how we see objects.
- Have students use pinhole viewers. (If possible, make these ahead of time. You can find a variety of models and types that are easy to build on the Internet. YouTube has a number of videos that show pinhole viewers made from a variety of materials such as a Pringles tube or black poster board.) Show students how the pinhole viewers are constructed and what is inside each. Then have students go outside and view objects using the pinhole viewers. As students make observations, they should document what they observed.
- As a class, discuss what students observed, then draw a model on the board that depicts the phenomenon. (Light bounces off of an object, travels through the pinhole, and is visible—upside down—on the tracing paper inside the pinhole viewer.)
- Tell students that this is what happens with our eyes. Light bounces off objects, similar to the way in which it bounces off a mirror, and that light travels into the eye, enabling us to see the objects. We could see the book through the clear plastic wrap because the light that bounces off the object is able to travel through the transparent material and still reach our eyes. We could not see the book through the dark construction paper because the light that was bouncing off the object could not travel through the paper, so our eyes did not receive that light. Therefore, we did not see the book.
- With guidance, as needed, have students draw models/diagrams of the pinhole viewer and the human eye, and have them describe what they observed.

Example Activities

Animal Mouth Structures: In this lesson, students gather evidence to understand features that enable them to meet their needs. In particular, they examine the mouth structures of different animals to help them understand how animals are adapted to obtain food in their environment

Camouflage, Countershading, and Adaptations: This resource provides some background information and discussion questions about camouflage and countershading as an example of penguin adaptation. Then students engage in an experiment to simulate the effectiveness of blubber as an insulator against the cold temperatures penguins typically experience. A worksheet is provided that explains other penguin adaptations and asks comprehension questions based on the text.

Pinhole Cameras and Eyes: In this activity, students make a pinhole camera and see images formed on an internal screen. They then use a lens to see how this affects the images. Students investigate variables in its construction, and explore how it models the human eye's ability to receive and process information.

The Life of Environments: This unit is designed to address the concept that organisms sense the environment in order to live. It is a far-ranging and comprehensive unit that is designed to address multiple NGSS performance expectations (4-LS1-2, 4LS1-2, 4-PS3-2, 4-PS4-2) in seven explorative sections, with an additional summative assessment step.

Time to Think?: This resource allows the user to accurately measure and experiment with human reaction time. An interactive program measures reaction times in milliseconds and compares them in different cases (from simply reacting to a visual cue to having to read and then make a decision before reacting). This site provides a wide range of information and activities on the connection between the brain and behavior. Note: Link is to main introductory page. Scroll down to find links for the activity and others pages that allow users to view the results of other participants and guidance for conducting further research.

Catch It! : This lesson sequence involves student investigation of human reaction time and variables that may affect it. An initial phase has students practice catching a dropped ruler and converting the distance it drops to the length of time it took to react. This provides an opportunity for data collection, graphing, and writing a conclusion. After this guided inquiry phase, students may conduct research on human senses and reaction time, or move on to designing their own investigations of the effects of variables of their choosing on their reaction times. *PLEASE NOTE - the link is to the CT Department of Education Science Curriculum page. Scroll to find that you can select Word, PDF, and Spanish versions of this resource under the title Grade 5 Embedded Task*

Muscular: https://www.youtube.com/watch?v=C6u0u_59UDc

Senses: Ear https://www.youtube.com/watch?feature=player_detailpage&v=HMXoHKwWmU8

Animal adaptations: http://www.eduplace.com/kids/hmsc/activities/simulations/gr5/unitb.html

http://www.eduplace.com/kids/hmsc/activities/simulations/gr3/unitb.html

Plant adaptations: https://www.youtube.com/watch?v=1PRRWFyzAS0

https://www.youtube.com/watch?v=D1Ymc311XS8

https://www.youtube.com/watch?v=At1BJJDcXhk

https://www.youtube.com/watch?v=Mbj_WQ76F1Q&t=12s

https://www.youtube.com/watch?v=fVfV5LMXh2s

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu
YouTube www.youtube.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students use the evidence from their observations of plants and animals to support the claim that all organisms are systems with structures that function in growth, survival, behavior, and/or reproduction. Students need opportunities to observe plants and animals closely, taking notes and drawing pictures, so that they can describe various structures and their functions.

Students should use text and online media resources when appropriate to help them understand how animals receive and process information they receive from the environment, and to develop a conceptual understanding of what happens when light reflects off objects and enters the eye. They should also use visual displays to enhance their observations and explanations of the concepts in this unit of study.

- Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1) W.4.1
- Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2),(4-LS4-2) SL.4.5

Mathematics

Students describe the symmetry that can be observed in an organism's structures. For example, the leaves of many plants and the bodies of many animals display bilateral symmetry. Students should be encouraged to draw each organism that they observe, pointing out any structures that are symmetrical. Students should also trace lines of symmetry in their drawings to support their thinking. In addition, students can conduct research to determine whether the symmetry serves a function in the growth, reproduction, or survival of the organism.

Students should model with mathematics as they draw points, lines, line segments, and angles to describe how light behaves when coming into contact with lenses, mirrors, and other objects. Students will also use points, lines, and angles when drawing pictures and diagrams that show how light reflects off objects and into the pinhole viewer or into the human eye.

- Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1) 4.G.A.3
- Model with mathematics. (4-PS4-2) MP.4
- Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2) 4.G.A.1

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Integration of Technology
8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1 https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September – November	9 Weeks	1	Energy
December – January	9 Weeks	2	Waves
January – March	9 Weeks	3	Processes that Shape the Earth
April – June	9 Weeks	4	Structure, Function, and Information Processing

Unit Title	Transfer of Energy, waves and information
Length of Unit	Marking Period 3
Summary/Overview	*Where do we get the energy we need for modern life?* *How can we use waves to gather and transmit information?* In this unit of study, fourth-grade students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents. Students also obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. In continuation in this unit of study, students use a model of waves to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move. The crosscutting *concepts of cause and effect, energy and matter,* and the *interdependence of science, engineering, and technology, and influence of science, engineering, and technology on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
4-PS3-2	**Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.**
4-ESS3-1	**Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.**
4-PS4-1	**Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.**

4-PS4-3	**Generate and compare multiple solutions that use patterns to transfer information.**
3-5-EST-1-2	**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**
3-5-ETS1-3	**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
Focus Standards	
PS3.A	Definitions of Energy ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2)
PS3.B	Conservation of Energy and Energy Transfer ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) ● Light also transfers energy from place to place. (4-PS3-2) ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2)
ESS3.A	Natural Resources ● Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)
PS4.A	Wave Properties ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and

	wavelength (spacing between wave peaks). (4-PS4-1)
PS4.C	Information Technologies and Instrumentation ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)
ETS1.C	Optimizing The Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*
ETS1.B	Developing Possible Solutions ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)
ETS1.C	Optimizing the Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Learning Objectives
(Students will be able to...)

- From the given investigation plan, students describe the phenomenon under investigation, which includes the following ideas:
    - The transfer of energy, including:
    - Collisions between objects.
    - Light traveling from one place to another.
    - Electric currents producing motion, sound, heat, or light.
    - Sound traveling from one place to another.
    - Heat passing from one object to another.
    - Motion, sound, heat, and light causing a different type of energy to be observed after an interaction (e.g., in a collision between two objects, one object may slow down or stop, the other object may speed up, and the objects and surrounding air may be heated; a specific sound may cause the movement of an object; the energy associated with the motion of an object, via an electrical current, may be used to turn on a light).
- Describe the purpose of the investigation, which includes providing evidence for an explanation of

the phenomenon, including the idea that energy can be transferred from place to place by:
  - Moving objects.
  - Sound.
  - Light.
  - Heat.
  - Electric currents.
- From the given investigation plan, students describe the data to be collected that will serve as the basis for evidence, including:
  - The motion and collision of objects before and after an interaction (e.g., when a given object is moving fast, it can move another object farther than when the same object is moving more slowly).
  - The relative presence of sound, light, or heat (including in the surrounding air) before and after an interaction (e.g. shining a light on an object can increase the temperature of the object; a sound can move an object).
  - The presence of electric currents flowing through wires causally linking one form of energy output (e.g., a moving object) to another form of energy output (e.g., another moving object; turning on a light bulb).
- Describe how their observations will address the purpose of the investigation, including how the observations will provide evidence that energy, in the form of light, sound, heat, and motion, can be transferred from place to place by sound, light, heat, or electric currents (e.g., in a system in which the motion of an object generates an observable electrical current to turn on a light, energy (from the motion of an object) must be transferred to another place (energy in the form of the light bulb) via the electrical current, because the motion doesn't cause the light bulb to light up if the wire is not completing a circuit between them; when a light is directed at an object, energy (in the form of light) must be transferred from the source of the light to its destination and can be observed in the form of heat, because if the light is blocked, the object isn't warmed.
- From the given investigation plan, students identify and describe how the data will be observed and recorded, including the tools and methods for collecting data on:
  - The motion and collision of objects, including any sound or heat producing the motion/collision, or produced by the motion/collision.
  - The presence of energy in the form of sound, light, or heat in one place as a result of sound, light, or heat in a different place.
  - The presence of energy in the form of sound, light, or heat in one place as a result of sound, light, or heat in a different place.
- Students make and record observations according to the given investigation plan to provide evidence that:
  - Energy is present whenever there are moving objects, sound, light, or heat.
  - That energy has been transferred from place to place (e.g., a bulb in a circuit is not lit until a switch is closed and it lights, indicating that energy is transferred through electric current in a wire to light the bulb; a stationary ball is struck by a moving ball, causing the stationary ball to move and the moving ball to slow down, indicating that energy has been transferred from the moving ball to the stationary one).
- Develop a model (e.g., diagrams, analogies, examples, abstract representations, physical models) to make sense of a phenomenon that involves wave behavior. In the model, students identify the relevant components, including:
  - Waves.
  - Wave amplitude.
  - Wavelength.
  - Motion of objects.

- Describe waves in terms of patterns of repeating amplitude and wavelength (e.g., in a water wave there is a repeating pattern of water being higher and then lower than the baseline level of the water).
- Determine waves can cause an object to move
- Determine the motion of objects varies with the amplitude and wavelength of the wave carrying it.
- Determine the patterns in the relationships between a wave passing, the net motion of the wave, and the motion of an object caused by the wave as it passes.
- Calculate how waves may be initiated (e.g., by disturbing surface water or shaking a rope or spring).
- Determine that the repeating pattern produced as a wave is propagated.
- Use a model to describe that waves of the same type can vary in terms of amplitude and wavelength and describe how this might affect the motion, caused by a wave, of an object.
- identify similarities and differences in patterns underlying waves and use these patterns to describe* simple relationships involving wave amplitude, wavelength, and the motion of an object (e.g., when the amplitude increases, the object moves more).
- Generate at least two design solutions, for a given problem, that use patterns to transmit a given piece of information (e.g., picture, message). Students describe* how the design solution is based on:
    - Knowledge of digitized information transfer (e.g., information can be converted from a sound wave into a digital signal such as patterns of 1s and 0s and vice versa; visual or verbal messages can be encoded in patterns of flashes of light to be decoded by someone else across the room).
    - Ways that high-tech devices convert and transmit information (e.g., cell phones convert sound waves into digital signals, so they can be transmitted long distances, and then converted back into sound waves; a picture or message can be encoded using light signals to transmit the information over a long distance).
- Describe the given criteria for the design solutions, including the accuracy of the final transmitted information and that digitized information (patterns) transfer is used.
- Identify similarities and differences in the types of patterns used in the solutions to determine whether some ways of transmitting information are more effective than others at addressing the problem.
- Use the information they obtained and combined to describe the causal relationships between:
    - Energy resources and the environmental effects of using that energy source.
    - The role of technology in extracting and using an energy resource.

Understandings **(Students will understand or know…)**	**Essential Questions**
● **Energy can be transferred in various ways and between objects.** ● **Energy can be moved from place to place through sound, light, or electric currents.** ● **Energy is present whenever there are moving objects, sound, light, or heat.** ● **Light also transfers energy from**	1. *How does energy move?* 2. *From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?* 3. *If a beach ball lands in the surf, beyond the breakers, what will happen to it?*

place to place. ● **Energy can also be transferred from place to place by electric currents; the currents may have been produced to begin with by transforming the energy of motion into electrical energy** ● **Cause-and-effect relationships are routinely identified and used to explain change.** ● **Knowledge of relevant scientific concepts and research findings is important in engineering.** ● **Over time, people's needs and wants change, as do their demands for new and improved technologies.** ● **Energy and fuels that humans use are derived from natural sources.** ● **The use of energy and fuels from natural sources affects the environment in multiple ways.** ● **Some resources are renewable over time, and others are not** ● **Science findings are based on recognizing patterns.** ● **Similarities and differences in patterns can be used to sort and classify natural phenomena.** ● **Waves, which are regular patterns of motion, can be made in water by disturbing the surface.** ● **When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.** ● **Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks)** ● **Similarities and differences in patterns can be used to sort and classify designed products.** ● **Knowledge of relevant scientific**	4. *Which team can design a way to use patterns to communicate with someone across the room?*

concepts and research findings is important in engineering. ● **Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.** ● **Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—that is, convert it from digitized form to voice and vice versa.** ● **Different solutions need to be tested in order to determine which of them best solve the problem, given the criteria and the constraints.** ● **Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.** ● **At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.** ● **Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.**	

Assessment Evidence	
Formative Assessments ● Make observations to produce data that can serve as the basis for evidence for an explanation of a phenomenon or for a test of a	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments**

design solution.
● Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
● Identify cause-and-effect relationships in order to explain change.
● Obtain and combine information from books and other reliable media to explain phenomena.
● Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
● Examples of renewable energy resources could include:
  ● Wind energy,
  ● Water behind dams, and
  ● Sunlight.
● Examples of nonrenewable energy resources are:
  ● Fossil fuels,
  ● Fissile materials
● Examples of environmental effects could include:
  ● Loss of habitat due to dams
  ● Loss of habitat due to surface mining
  ● Air pollution from burning of fossil fuels.
● Sort and classify natural phenomena using similarities and differences in patterns.
● Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
● Develop a model (e.g., diagram, analogy, or physical model) of waves to describe patterns in terms of amplitude and wavelength, and that waves can cause objects to move.
● Sort and classify designed products using similarities and differences in patterns.
● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design
	● Oral Presentations
	● Teacher Observations
	● Making Models

solution. ● Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. ● Generate and compare multiple solutions that use patterns to transfer information. Examples of solutions could include: ● Drums sending coded information through sound waves; ● Using a grid of ones and zeroes representing black and white to send ● information about a picture; ● Using Morse code to send text. ● Plan and conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. ● Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	

Learning Activities

What it looks like in the classroom…

Students conduct investigations to observe that energy can be transferred from place to place by sound, light, heat, and electrical currents. They describe that energy and fuels are derived from natural resources and that their uses affect the environment. Throughout this unit, students obtain, evaluate, and communicate information as they examine cause-and-effect relationships between energy and matter.

To begin the unit of study's progression of learning, students need opportunities to observe the transfer of heat energy. They can conduct simple investigations, using thermometers to measure changes in temperature as heat energy is transferred from a warmer object to a colder one. For example, hot water can be poured into a large Styrofoam cup, and then a smaller plastic cup of cold water can be placed inside the larger cup of water. A thermometer can be placed in each cup, and students can observe and record changes in the temperature of the water in each cup every minute over the course of about 10–15 minutes, or until the temperatures are the same. Students can use their data as evidence to explain that some of the heat energy from the hot water transferred to the cold water. This transfer of heat caused the cold water to become gradually warmer and the hot water to cool. This process continued until the cups of water reached the same temperature.

Students can also place a thermometer in the palm of their hands, close their hands around it, and measure the temperature. They can then place a piece or two of ice into their palms and close their fists around the ice until it melts. When they again measure the temperature of their palms, they will observe a change. Students can use these data to describe how some of the heat from their hands transferred to the ice, causing it to melt, while the ice also decreased the temperature of their hand. It is important that students understand that heat is transferred from warmer to colder objects. When an object cools, it loses heat energy. When an object gets warmer, it gains heat energy.

To continue learning about energy transfer, students can build simple electric circuits. As students work in small groups to build circuits, they should add a bulb and/or a buzzer to the circuit in order to observe and describe the ways in which energy is transferred in the circuit. (The word “transfer” can refer to a change in the type of energy or a change in the location of energy.) For example, stored energy in a battery is transferred into electrical energy, which is then transferred into light energy if a bulb is added to the circuit. The energy transfers from the battery to the wire and then to the bulb. The same holds true if a buzzer is added to the circuit. The stored energy in the battery is transferred into electrical energy, which is then transferred into sound energy. (Keep in mind that energy is not actually produced. When we say that energy is “produced,” this typically refers to the conversion of stored energy into a desired form for practical use. Students should be encouraged to use the term “transferred” rather than “produced”).

After conducting these types of investigations, the class can create a list of events in which energy is transferred. For example, when a ball is thrown against a wall, some of the motion energy is transferred to sound energy; when water boils on the stove top, heat energy from the stove is transferred to the pot and to the water in the pot; and when a doorbell is rung, electrical energy is transferred into sound energy.

Next, students learn about fuels and energy, and conduct research using books and other reliable media to determine which natural resources are sources of energy. Light, heat, sound, and electricity are all forms of energy. Energy is not matter. Fuels, however, are matter. For example, fossil fuels, such as coal, oil, and natural gas, are matter. When fossil fuels are burned, energy stored in the fuel can be transferred from stored energy to heat, light, electrical, and/or motion energy. Therefore, fuels are considered to be a source of energy.

Energy can also be obtained from other sources, such as wind, water, and sunlight. Air and water are both matter, but when they are moving, they have motion energy. Energy from wind (moving air) and from moving water can be transferred into electrical energy. Light energy from the sun can also be transferred to heat energy or electrical energy. In addition, energy can be released through nuclear fission using materials known as fissile materials.

As students learn about fuels and other sources of energy, they should determine which sources are renewable and which are nonrenewable. Generally, a fuel or source of energy is considered nonrenewable if that source is limited in supply and cannot be replenished by natural means within a reasonable amount of time. Renewable sources of energy are those that are replenished constantly by natural means. Using this general description, all fossil fuels are considered nonrenewable, because these resources were naturally created over millions of years. Fissile materials are also nonrenewable. On the other hand, wind, moving water, and sunlight are renewable sources of energy.

As the population continues to grow, so does the demand for energy. Human use of natural resources for energy, however, has multiple effects on the environment. Students should conduct further research to determine how the use of renewable and nonrenewable resources affects the environment. Some examples include:

- Changes in and loss of natural habitat due to the building of dams and the change in the flow of water;
- Changes in and loss of natural habitat due to surface mining; and
- Air pollution caused by the burning of fossil fuels in factories, cars, and homes.

As students conduct research and gather information from a variety of reliable resources, they can take notes and use the information to describe and explain the impact that human use of natural resources has on the environment.

In this unit of study, students plan and carry out investigations, analyze and interpret data, and construct explanations. They also develop and use models to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move.

Waves, which are regular patterns of motion, can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). Students can model the properties of waves by disturbing the surface of water in a variety of pans and buckets. Students should make observations as they strike the surface of the water with small and large objects, such as marbles and rocks. In addition, smaller pans can be tilted in different directions in order to observe the effect on the wave patterns created on the surface of the water. Students should observe and describe a number of similarities and differences in the wave patterns created, including the following:

- When an object hits the surface of water, waves move across the surface.
- Waves move up and down across the surface of the water away from the point of contact.
- Waves on the surface of the water move away from the point of contact in increasingly larger circles.
- When waves hit another surface, the waves change direction and move away from the surface with which they come into contact.
- The height of the wave (amplitude) and the distance between the peaks of waves (wavelength) varies depending upon the intensity of the disturbance, and/or the size (mass, volume) of the object disturbing the surface of the water.

When describing the properties of waves, students should also develop a model using drawings, diagrams, or physical models (such as a slinky or jump rope) to show the basic properties of waves (amplitude and wavelength). In addition, the class should discuss other real-world examples of waves, including sound and light waves, using understandings developed in prior units of study.

To begin the engineering design process, students are challenged to design a way to use patterns to transfer information. This process should include the following steps:

- As a class, brainstorm a list of ways in which patterns have been used in the past to communicate over distance. Some examples include the use of smoke signals, drums, and Morse code on a telegraph.
- Small groups collaboratively conduct research to determine other possible ways of communicating using patterns over distances.
- As a class, determine criteria and possible constraints on the design solutions.
- Criteria might include that groups must communicate information using patterns, the design solution must communicate over a predetermined distance, and groups must be able to describe how patterns were used in the design to communicate over a distance.
- Possible constraints might include materials available to build/create a device and the amount of time available to design and build.
- Small groups work collaboratively to design and build a device or design a process for communicating information over a distance. Some examples could include:
- Drums sending coded information through sound waves.
- Use a flashlight to convey information using a pattern of on and off.
- Use Morse code to send information.
- Build an instrument with a box and rubber bands of varying sizes that can be plucked in a pattern to communicate information.
- Use musical patterns on a xylophone or tuning forks to convey information.
- Use string and cups to build a simple "phone" to send information.
- After small groups finish designing and building, they should put together a presentation that includes a written description/explanation of how patterns are used to communicate information. They can also include pictures, video or audio recordings, and/or models to support their explanation.
- Each group presents their design solution to the class. After observing each design solution, students should classify each based on the type or types of patterns used to communicate (e.g., sound, light, or both).
- Students investigate how well the solutions perform under a range of likely conditions (e.g., environmental noise or light, increases in distance). This may involve additional research, planning and conducting multiple investigations to produce data, and collecting and analyzing additional data that can be used as evidence to support conclusions. All tests that are planned and carried out should be fair tests in which variables are controlled and failure points are considered in order to identify elements of the design solution that do and do not meet criteria and constraints.
- Students compare the solutions, determining which can be used to successfully communicate information over a distance using patterns. Students should determine how well each design solution meets criteria, using data as evidence to support their thinking.

Throughout this process, communicating with peers is important, and can lead to better designs. After completing the engineering design process, students should discuss ways in which we use patterns in today's technology to communicate over long distances and how engineers have improved existing technologies over time in order to increase benefits, decrease known risks, and meet societal demands.

Integration of engineering-

Engineering design is an integral part of this unit of study. Students are expected to research a problem and communicate proposed solutions to others; define a simple design problem including specified criteria for success and constraints on materials time, or cost; and plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of the design solution that can be improved. This process is outlined in greater detail in the previous section.

Example Activities

Switch Energy Project: The Educator Portal provides free access to a documentary, energy labs, videos, and study guides.

Wind Generator: Windmills have been used for hundreds of years to collect energy from the wind in order to pump water, grind grain, and more recently generate electricity. There are many possible designs for the blades of a wind generator and engineers are always trying new ones. Design and test your own wind generator, then try to improve it by running a small electric motor connected to a voltage sensor.

Thermal Energy Transfer: Explore the three methods of thermal energy transfer: conduction, convection, and radiation, in this interactive from WGBH, through animations and real-life examples in Earth and space science, physical science, life science, and technology.

Making Waves: How does energy move through water?

This Science and Children article includes background information for the teacher and three investigations to share with the students. First, students create waves using a jump rope, then water, and then they model the movement of molecules using marbles and a book. Through these activities, students will develop an understanding of how energy moves through all types of waves, and they will model the process of energy transfer. The activities use simple materials, but are effective at demonstrating wave energy. The instructional guide suggests questions (with answers) that may be used to guide student learning

Bite Size Physics: Energy and Waves Bite

The Bite Size Physics website uses humor and simple hands-on activities to teach physics principles. This lesson gives a background lesson on waves, followed by several simple experiments to teach transverse and longitudinal waves, frequency, wavelength, and amplitude. The activities use only a rope, a slinky and colored tape to teach the concept, so they would be easy for the classroom teacher to reproduce for his or her students.

Morse Code Messaging

This activity introduces the students to sending and deciphering Morse Code. The children use flashlight signals rather than sounds (which is a plus when you have thirty children trying to send signals in one classroom) to compose and send a short message to their partner. Each child composes and sends one message. A worksheet with background information about Morse Code and a pictorial model of the code is provided

Simon Says Big Amplitude, Small Wavelength!

Found deep within this multi-unit document are directions for playing the game Simon Says! with waves. This simple simulation allows the students an opportunity to move around and participate in a guided model of amplitude and wavelength. The students create kinesthetic models of “waves” of varying amplitudes and wavelengths by walking and jumping.

Breaking the Sound Barrier

This 2007 "Science and Children" sound article shares ideas and instructional suggestions for four hands-on discovery centers to explore sound titled, 'Tuning Fork Vibrations', 'Rubber Band Guitars', 'Drum it Up' and 'The First Phone'. Students investigate the provided phenomena before sketching and explaining what they have discovered at that center. The finale to this lesson is a whole class demonstration featuring a huge trashcan wave generator.

What Are Waves?

Students explore making waves using everyday objects to begin developing an understanding of how waves are made, that waves carry energy, and that there are different types of waves. Students investigate examples of transverse and longitudinal waves at stations and use their science notebooks to record observations and predict the type of wave they are creating.

Pop Bottle Waves and Hair Dryer Ripples

This is the first lesson in a series of lessons on waves. It is an exploratory lesson where students observe, draw and think about how waves are shaped, how they move and what creates them. The teachers creates a model using a plastic bottles with colored water inside. The students then make their own models using the materials and procedures set up by the teacher. Students observe and record the waves and how they change. Students also observe how a hair dryer creates ripples on water that the teacher models for them. Students then gather together to discuss their observations. The teacher creates a collaboration board as a means of recording their ideas/explanations around the speed of the waves and evidence to support these ideas from their observations and investigation

Electric Messages: Then and Now

This lesson integrates social studies and energy transfer concepts as students explore the history of electronic messaging systems (Morse Code and text messaging) before applying concepts of energy transfer through the construction of a simple signaling device by which they can send messages to each other via Morse Code.

Speaking in Phases

Students model how NASA uses radios waves signals to encode, transmit and decode information using a metronome and musical instruments. Students are then challenged to design a faster way to send signals.

Breaking the Sound Barrier

Students explore and explain characteristics of sound through a series of hands-on learning centers and the sensory phenomena of waves produced by a "trashcan wave generator". Students sketch and explain what they discover at each of the centers which serve as the basis for teaching the concepts of amplitude and wavelength, and how waves can cause objects to move.

Making Sense of Sound- December 2016 Science & Children Article

This article describes a 5E lesson focused on the exploration of sound and sound waves. Many opportunities for hands-on investigations, discourse, and the use of technology are integrated into the lesson. Investigations follow where students talk and record their thinking both individually and collaboratively. Students use PhET wave simulation models to help them develop their understanding of waves and the Twisted Wave app to understand wavelength and amplitude. Detailed supporting documents are provided, which include teachers questions to guide the discussions.

https://phet.colorado.edu

Playdough Circuits

http://www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p073/electricity-electronics/squishy-circuits-project-1

Activity resources Sound and Magnetism: http://www.ndt-ed.org/EducationResources/HighSchool/Sound/dopplereffect.htm

https://www.youtube.com/watch?v=O5rqMPdQMQ8&feature=player_detailpage

https://www.youtube.com/watch?v=h4OnBYrbCjY&feature=player_detailpage

https://www.youtube.com/watch?feature=player_detailpage&v=BHBevPYVzaY#t=27

Magnetism: http://www.youtube.com/watch?feature=player_detailpage&v=20Vb6hlLQSg

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu
YouTube www.youtube.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students will conduct research to build their understanding of energy, transfer of energy, and natural sources of energy. Students will recall relevant information from in-class investigations and experiences and gather relevant information from print and digital sources. They should take notes and categorize information and provide a list of sources. Students also draw evidence from literary and informational texts in order to analyze and reflect on their findings. Students can also read, take notes, and construct responses using text and digital resources such as Scholastic News, Nat Geo Kids, Study Jams (Scholastic), Reading A–Z.com, NREL.com, switchenergyproject.com, and NOVA Labs by PBS.

To support integration of English language arts into this unit, students conduct short research projects, using both print and digital sources, to build their understanding of wave properties and of the use of waves to communicate over a distance. Students should take notes, categorize information collected, and document a list of the sources used. Using the information they collect during research, as well as information from their experiences with waves, sound, and light, students integrate the information and use it to design a device or process that can be used to communicate over a distance using patterns. As students create presentations that detail how their design solutions can be used to communicate, they should use details and examples from both their research and experiences to explain how patterns are used in their design to communicate over a distance. They can include audio or video recordings and visual displays to enhance their presentations.

- Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-ESS3-1) W.4.7
- Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-2),(4-ESS3-1) W.4.8 (3-5-ETS1-3) W.5.8
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS3-1) W.4.9 (3-5-ETS1-3) W.5.9
- Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3) RI.4.9
- Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-PS4-1)* SL.4.5
- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS1-2) RI.5.1
- Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2) RI.5.9
- Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-3) W.5.7

Mathematics

Students reason abstractly and quantitatively as they gather and analyze data during investigations and while conducting research about transfer of energy and energy sources. Students model with mathematics as they represent and/or solve word problems. As students research the environmental effects of obtaining fossil fuels, they might be asked to represent a verbal statement of multiplicative comparison as a multiplication equation. For example, students might find information about a spill that was 5 million gallons of oil and was 40 times larger that a previous oil spill in the same location. They can be asked to represent this mathematically using an equation to determine the number of gallons of oils that were spilled in the previous event.

To support the integration of the CCSS for mathematics into this unit of study, students should have opportunities to draw points, lines, line segments, rays, angles, and perpendicular and parallel lines, and identify these in two-dimensional drawings as they identify rays and angles in drawings of the ways in which waves move. Students should also have opportunities to use the four operations to solve problems. Students can analyze constraints on materials, time, or cost to draw implications for design solutions. For example, if a design calls for 20 screws and screws are sold in boxes of 150, how many copies of the design could be made?

As students represent and solve word problems, such as these, they reason abstractly and quantitatively and model with mathematics. As students create models of waves and engage in engineering design, they have opportunities to use tools strategically while measuring, drawing, and building.

- Reason abstractly and quantitatively. (4-ESS3-1) MP.2 (3-5-ETS1-2),(3-5-ETS1-3) MP.2
- Model with mathematics. (4-ESS3-1) MP.4 (4-PS4-2),(3-5-ETS1-2),(3-5-ETS1-3) MP.4
- Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1) 4.OA.A.1
- Use appropriate tools strategically. (3-5-ETS1-2),(3-5-ETS1-3) MP.5
- Operations and Algebraic Thinking (3-ETS1-2) 3-5.OA
- Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2) 4.G.A.1

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Course Title: 4th Grade Science

Integration of Technology
8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1 https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September – November	9 Weeks	1	Energy
December – January	9 Weeks	2	Waves
January – March	9 Weeks	3	Processes that Shape the Earth
April – June	9 Weeks	4	Structure, Function, and Information Processing

Course Title: 4th Grade Science

Unit Title	Force and Motion
Length of Unit	Marking Period 4
Summary/Overview	***What is the relationship between the speed of an object and the energy of that object?*** ***How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?*** In this unit of study, students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object, and are expected to develop an understanding that energy can be transferred from object to object through collisions. The crosscutting concept of *energy and matter* is called out as an organizing concept. In continuation in this unit of study, students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from objects through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.Students are expected to demonstrate grade-appropriate proficiency in *asking questions, defining problems,* and *constructing explanations*, *and designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
4-PS3-1	**Use evidence to construct an explanation relating the speed of an object to the energy of that object.**
4-PS3-3	**Ask questions and predict outcomes about the changes in energy that occur when objects collide.**

4-PS3-4	**Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.**
Focus Standards	
PS3.A	Definitions of Energy ● The faster a given object is moving, the more energy it possesses. (4-PS3-1) ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-3)
PS3.B	Conservation of Energy and Energy Transfer ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-3)
PS3.C	Relationship Between Energy and Forces ● When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)
	PS3.B: Conservation of Energy and Energy Transfer ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4)
PS3.C	Relationship Between Energy and Forces ● When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)
PS3.D	Energy in Chemical Processes and Everyday Life ● The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)
ETS1.A	Defining and Delimiting Engineering Problems ● Possible solutions to a problem are limited by available materials and resources

	(constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)
ETS1.B	Developing Possible Solutions ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)
ETS1.C	Optimizing the Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Learning Objectives
(Students will be able to...)

- Articulate a statement that relates the given phenomenon to a scientific idea, including that the speed of a given object is related to the energy of the object (e.g., the faster an object is moving, the more energy it possesses).
- Use the evidence and reasoning to construct an explanation for the phenomenon.
- Identify and describe the relevant given evidence for the explanation, including:
    - The relative speed of the object (e.g., faster vs. slower objects).
    - Qualitative indicators of the amount of energy of the object, as determined by a transfer of energy from that object (e.g., more or less sound produced in a collision, more or less heat produced when objects rub together, relative speed of a ball that was stationary following a collision with a moving object, more or less distance a stationary object is moved).
- Use reasoning to connect the evidence to support an explanation for the phenomenon. In the explanation, students describe a chain of reasoning that includes:
    - Motion can indicate the energy of an object.
    - The faster a given object is moving, the more observable impact it can have on another object (e.g., a fast-moving ball striking something (a gong, a wall) makes more noise than does the same ball moving slowly and striking the same thing).
    - The observable impact of a moving object interacting with its surroundings reflects how much energy was able to be transferred between objects and therefore relates to the energy of the moving object.
    - Because faster objects have a larger impact on their surroundings than objects moving more slowly, they have more energy due to motion (e.g., a fast-moving ball striking a gong makes

more noise than a slow-moving ball doing the same thing because it has more energy that can be transferred to the gong, producing more sound). [Note: This refers only to relative bulk motion energy, not potential energy, to remain within the DCI.]
    - Therefore, the speed of an object is related to the energy of the object.
- Ask questions about the changes in energy that occur when objects collide, the answers to which would clarify:
    - A qualitative measure of energy (e.g., relative motion, relative speed, relative brightness) of the object before the collision.
- Articulate the mechanism of energy transfer during the collision, including:
    - The transfer of energy by contact forces between colliding objects that results in a change in the motion of the objects.
    - The transfer of energy to the surrounding air when objects collide resulting in sound and heat.
- Predict reasonable outcomes about the changes in energy that occur after objects collide, based on patterns linking object collision and energy transfer between objects and the surrounding air.
- Given a problem to solve, students collaboratively design a solution that converts energy from one form to another. In the design, students:
    - Specify the initial and final forms of energy (e.g., electrical energy, motion, light).
    - Identify the device by which the energy will be transformed (e.g., a light bulb to convert electrical energy into light energy, a motor to convert electrical energy into energy of motion).

Understandings (Students will understand or know...)	Essential Questions
• **Energy can be transferred in various ways and between objects.** • **The faster a given object is moving, the more energy it possesses.** • **Energy can be transferred in various ways and between objects.** • **Energy can be moved from place to place by moving objects or through sound, light, or electric currents.** • **Energy is present whenever there are moving objects, sound, light, or heat.** • **When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.** • **When objects collide, the contact forces**	1. *What is the relationship between the speed of an object and its energy* 2. *In what ways does energy change when objects collide?* 3. *How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?*

transfer energy so as to change the object's' motions. ● **Science affects everyday life.** ● **Most scientists and engineers work in teams.** ● **Engineers improve existing technologies or develop new ones.** ● **People's needs and wants change over time, as do their demands for new and improved technologies.** ● **Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.** ● **Energy can be transferred in various ways and between objects.** ● **Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.** ● **The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.** ● **Possible solutions to a problem are limited by available materials and resources (constraints).** ● **The success of a designed solution is determined by considering the desired features of a solution (criteria).** ● **Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.** ● **Research on a problem should be carried out before beginning to design a solution.** ● **Testing a solution involves investigating how well it performs under a range of**	

likely conditions. ● **At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.** ● **Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.** ● **Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.**	

Assessment Evidence	
Formative Assessments ● Describe various ways that energy can be transferred between objects. ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation. ● Use evidence to construct an explanation relating the speed of an object to the energy of that object. ● Describe the various ways that energy can be transferred between objects. ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. ● Ask questions and predict outcomes about the changes in energy that occur when objects collide. Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. ● Describe the various ways that energy can be transferred between objects. ● Apply scientific ideas to solve design problems.	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

● Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.) ● Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. ● Define a simple design problem reflecting a need or a want that include ● Describe the various ways that energy can be transferred between objects. ● Apply scientific ideas to solve design problems. ● Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.) ● Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. ● Define a simple design problem reflecting a	

need or a want that includes specified criteria for success and constraints on materials, time, or cost. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. ● Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. ● Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	

Learning Activities
What it looks like in the classroom… In order to understand and explain the relationship between an object's speed and its energy, students need multiple opportunities to observe objects in motion. Students can roll balls down ramps, build and race rubber band cars, or build roller coasters. As they observe the motion of objects, they should collect data about the relative speed of objects in relation to the strength of the force applied to them. For example, when a ball is placed at the top of a ramp, it has stored energy, due to the force of gravity acting on it. When the ball is released, that stored energy is changed (transferred) into motion energy. Increasing the height of a ramp also increases the amount of stored energy in the ball at the top of the ramp. If the ball is released from a higher starting point, it rolls faster and farther. Likewise, winding the rubber band in a rubber band car stores energy in the rubber band, which is then changed, or transferred, into motion energy (kinetic) as the car moves forward. The more times you wind the rubber band, the greater the amount of stored energy in the rubber band, and the farther and faster the car goes. As students investigate these types of force and motion systems, they should conduct multiple trials, increasing and decreasing the amount of energy, then collect qualitative data as they observe the impact differing amounts of energy have on the relative speed of the object in motion. Students should then use their data as evidence to support their explanation of the relationship between the relative speed of an object and its

energy.

Once students understand that the faster an object moves, the more energy it possesses, they can begin to explore ways in which energy can be transferred. As they investigated the relationship between speed and energy, students learned that stored energy was changed, or transferred, into motion energy. To broaden their understanding of energy transfer, students should be provided with opportunities to observe objects colliding and should be encouraged to ask questions that lead to further investigation. For example, if students roll a ball towards a wall, or roll two balls so that they collide, they may observe any or all of the following:

- Change(s) in the direction of motion
- Change(s) in speed
- Change(s) in the type of energy (e.g., motion energy to sound energy, sound energy to heat energy)
- Change(s) in the type of motion (rolling to bouncing).

As students continue to investigate interactions between moving objects, they should notice that when a moving object collides with a stationary object, some of the motion energy of one is transferred to the other. In addition, some of the motion energy is changed, or transferred to the surrounding air, and as a result, the air gets heated and sound is produced. Likewise, when two moving objects collide, they transfer motion energy to one another and to the surrounding environment as sound and heat. It is important that as students observe these types of interactions, they collect observational data, document the types of changes they observe, look for patterns of change in both the motion of objects and in the types of energy transfers that occur, and make predictions about the future motion of objects. Their investigations will help them understand that:

- Energy can be transferred in various ways and between objects.
- Energy is present whenever there are moving objects.
- Energy can be moved, or transferred, from place to place by moving objects.
- When objects collide, some energy may be changed or transferred into other types of energy.

Note: In the prior unit of study, students observed objects in motion in order to understand the relationship between the speed of an object and its energy, and they investigated the transfer of energy from one object to another, as well as from one form to another. In this unit, students will apply scientific ideas about force, motion, and energy in order to design, test, and refine a device that converts energy from one form to another. Through this process, students will learn that science affects everyday life and that engineers often work in teams, using scientific ideas, in order to meet people’s needs for new or improved technologies.

To begin the engineering design process, students must be presented with the problem of designing a device that converts energy from one form to another. This process should include the following steps:

- As a class, students should create a list of all the concepts that they have learned about force, motion, and energy.
  - The faster a given object is moving, the more energy it possesses.

- Energy is present whenever there are moving objects, sound, light, or heat.
- Energy can be transferred in various ways and between objects.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- When objects collide, the contact forces transfer energy so as to change the objects' motions.

- Have students brainstorm examples of simple devices that convert energy from one form to another. As students give examples, the teacher should draw one or two and have students describe how each device converts energy from one form to another.
- Next, the teacher can present a "Design Challenge" to students: Design and build a simple device that converts energy from one form to another. Please note that teachers should limit the devices to those that convert motion energy to electric energy or that use stored energy to cause motion or produce light or sound.
- Small groups of students should conduct research, using several sources of information, to build understanding of "stored energy." Students can look for examples of objects that have stored energy. Stretched rubber bands, compressed springs, wound or twisted rubber bands, batteries, wind-up toys, and objects at the top of a ramp or held at a height above the ground all have stored energy.
- As a class, determine criteria and possible constraints on the design solutions. For example, devices are only required to perform a single energy conversion (i.e., transfer energy from one form to another), and devices must transfer stored energy to motion, light, or sound. Constraints could include the use of materials readily available in the classroom or provided by the teacher. (An assortment of materials can be provided, including batteries, wires, bulbs, buzzers, springs, string, tape, cardboard, balls, rubber tubing, suction cups, rubber bands of various sizes, construction paper, craft sticks, wooden dowels or skewers, buttons, spools, glue, brads, paper clips, plastic cups, paper plates, plastic spoons, straws, Styrofoam, and cloth.) A time constraint could also be set, if desired. All criteria and constraints should be posted on chart paper so that groups can refer to them as needed.
- Students should work in small, collaborative groups to design and build their device. Examples of possible devices could include:
    - A simple rubber band car that converts the stored energy in a twisted rubber band into motion energy.
    - A simple roller coaster that converts the stored energy in a marble held at the top of the roller coaster into motion energy.
    - A whirly bird that converts stored energy (in a student's muscles) into motion energy.
    - A ball launcher that converts stored energy in a compressed spring, compressed suction cup, or stretched rubber band into motion energy when the ball is launched.
- Students should create a poster that includes a diagram of the device and a description of how the

device transfers energy from one form to another. Every group should have the opportunity to present their device and explain how it works.

- As a class, students compare each of the design solutions based on how well they meet criteria and constraints, giving evidence to support their thinking. When giving feedback to the groups, students should identify which criteria were/were not met, and how the design might be improved.
- Small groups should then have the opportunity to refine their designs based on the feedback from the class.
- At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. It is also important that students describe the ways in which energy is transferred between objects and from one form to another.

Example Activities

Spool Racers: This resource includes three parts: a video clip from the TV show, Zoom, to introduce the activity, an essay with background information about energy, and a set of printable instructions. Students use a spool, a toothpick, a washer, a rubber band, and a pencil to build a racer. They conduct tests with the racer by varying the number of twists in the rubber band or changing other design features. These websites provide additional ideas for modifying the basic rubber band racer design: http://www.scienceworld.ca/resources/activities/popcan-porsche and http://pbskids.org/designsquad/build/rubber-band-car/.

Force and Motion: This video segment from Idaho PTV's D4K defines gravity, force, friction and inertia through examples from amusement park rides. Examples and explanations of Sir Isaac Newton's Three Laws of Motion are also included.

Advanced High-Powered Rockets: Students select a flight mission (what they want the rocket to do) and design and construct a high-power paper rocket that will achieve the mission. They construct their rocket, predict its performance, fly the rocket, and file a post-flight mission report. Missions include achieving high altitude records, landing on a "planetary" target, carrying payloads, testing a rocket recovery system, and more.

The Sound of Science: Students are given a scenario/problem that needs to be solved: Their school is on a field trip to the city to listen to a rock band concert. After arriving at the concert, the students find out that the band's instruments were damaged during travel. The band needs help to design and build a stringed instrument with the available materials, satisfying the following criteria and constraints: 1) Produce three different pitched sounds. 2) Include at least one string. 3) Use only available materials. 4) Be no longer than 30 cm / 1 foot. The challenge is divided into 4 activities. Each activity is designed to build on students' understanding of the characteristics and properties of sound. By using what they learn about sound from these activities, students are then encouraged to apply what they know about sound to complete the engineering design challenge.

Energy Makes Things Happen: The Boy Who Harnessed the Wind: This article from Science and Children provides ideas for using the trade book, The Boy Who Harnessed the Wind, as a foundation for a lesson on generators. This beautiful book is the inspiring true story of a teenager in Malawi who built a generator from found materials to create much-needed electricity. The lesson allows students to explore the concept of energy transfer using crank generators. Students then design improvements to the crank mechanism on the generator. The lesson may be extended by having students build their own generators.

Light Your Way: Using the engineering design process, students will be designing and building a lantern that they will hypothetically be taking with them as they explore a newly discovered cave. The criteria of the completed lantern will include: hands need to be free for climbing, the lantern must have an on/off switch, it must point ahead when they are walking so they can see in the dark, and the lantern must be able to stay lit for at least 15 minutes. The constraints of the activity will be limited materials with which to build. At the completion of the activity, the students will present their final lantern to the class explaining how they revised and adapted the lantern to meet the criteria of the project. Students will include in the presentation the sketch of the model they created prior to building showing the labeled circuit they designed. This activity was one of numerous engineering lessons from the Virginia Children's Engineering Council geared towards Grades 1-5.
http://www.childrensengineering.org/technology/designbriefs.php.

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu
YouTube www.youtube.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students will conduct a short research project to build their understanding of the transfer of energy (motion, heat, and sound) in force and motion systems. They will need access to a variety of texts and should use information from their class experiences and from print and digital sources to write informative/explanatory texts. As students gather information, they should take notes and categorize information. In their writing, students should detail what they observed as they investigated simple force and motion systems, describe procedures they followed as they conducted investigations, and use information from their observations and research to explain the patterns of change that occur when objects move and collide. As students participate in discussions and write explanations, they should refer specifically to text, when appropriate. Students conduct research that builds their understanding of energy transfers. They will gather relevant information from their investigations and from multiple print or digital sources, take notes, and categorize their findings. They should use this information to construct explanations and support their thinking.

- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1) RI.4.1
- Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1) RI.4.3
- Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1) RI.4.9 (3-5-ETS1-2) RI.5.9
- Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1) W.4.2
- Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-3) W.4.7 (3-5-ETS1-1),(3-5-ETS1-3) W.5.7
- Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-3) W.4.8 (3-5-ETS1-1),(3-5-ETS1-3) W.5.8 (4-PS3-4) W.4.8
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1) W.4.9 (3-5-ETS1-1),(3-5-ETS1-3) W.5.9 (3-5-ETS1-2) RI.5.1
- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2) RI.5.1

<u>Mathematics</u>

Solve multistep word problems, using the four operations.

Represent these problems using equations with a letter standing for the unknown quantity.

Assess the reasonableness of answers using mental computation and estimating strategies, including rounding.

For example, “The class has 144 rubber bands with which to make rubber band cars. If each car uses 6 rubber bands, how many cars can be made? If there are 28 students in the class, how many rubber bands can each car have (if every car has the same number of rubber bands)?”

Students can also analyze constraints on materials, time, or cost to determine what implications the constraints have for design solutions. For example, if a design calls for 20 screws and screws are sold in boxes of 150, how many copies of the design can be made?

Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4) 4.OA.A.3

- Operations and Algebraic Thinking (3-ETS1-1),(3-ETS1-2) 3.OA
- Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) MP.2
- Model with mathematics. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) MP.4
- Use appropriate tools strategically. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) MP.5
- Operations and Algebraic Thinking (3-ETS1-1),(3-ETS1-2) 3-5.O

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Integration of Technology

Course Title: 4th Grade Science

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September – November	9 Weeks	1	Energy
December – January	9 Weeks	2	Waves
January – March	9 Weeks	3	Processes that Shape the Earth
April – June	9 Weeks	4	Structure, Function, and Information Processing

Course Title: 5th Grade Science

Deal School Curriculum

Science Curriculum Guide Grade 5

Deal School

Deal, New Jersey

2018

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Developed and Written

March 2017 – May 2017

Revised

December 2018

Unit Title	Structure of Matter
Length of Unit	Marking Period 1
Summary/Overview	***When matter changes, does its weight change?*** ***If I have a frozen water bottle that weighs 500 mg, how much will it weigh if the water melts?*** In this unit of study, students describe that matter is made of particles too small to be seen by developing a model. The crosscutting concept of *scale, proportion, and quantity* is called out as an organizing concept for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *developing and using models*, *planning and carrying out investigations*, and use these practices to demonstrate understanding of the core ideas. In the second half of the unit of study, students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. The crosscutting concepts of *cause and effect* and *scale, proportion, and quantity* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *using mathematics and computational thinking*. Students are expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
5-PS1-1	**Make observations and measurements to identify materials based on their properties.**
5-PS1-2	**Develop a model to describe that matter is made of particles too small to be seen.**
5-PS1-3	**Make observations and measurements to identify materials based on their**

	properties.
Focus Standards	
PS1.A	Structure and Properties of Matter ● Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) ● Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)
PS1.A	Structure and Properties of Matter ● The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
PS1.B	Chemical Reactions ● When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)

Learning Objectives
(Students will be able to...)

- Develop a model to describe a phenomenon that includes the idea that matter is made of particles too small to be seen. In the model, students identify the relevant components for the phenomenon, including:
  - Bulk matter (macroscopic observable matter; e.g., as sugar, air, water).
  - Particles of matter that are too small to be seen.
- In the model, students identify and describe* relevant relationships between components, including the relationships between:
  - Bulk matter and tiny particles that cannot be seen (e.g., tiny particles of matter that cannot be seen make up bulk matter).
  - The behavior of a collection of many tiny particles of matter and observable phenomena involving bulk matter (e.g., an expanding balloon, evaporating liquids, substances that dissolve in a solvent, effects of wind).
- Use the model to describe* how matter composed of tiny particles too small to be seen can account for observable phenomena (e.g., air inflating a basketball, ice melting into water).
- Measure and graph the given quantities using standard units, including:

- The weight of substances before they are heated, cooled, or mixed.
- The weight of substances, including any new substances produced by a reaction, after they are heated, cooled, or mixed.
- Measure and/or calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed.

- Describe the changes in properties they observe during and/or after heating, cooling, or mixing substances.
- Use their measurements and calculations to describe* that the total weights of the substances did not change, regardless of the reaction or changes in properties that were observed.
- Use measurements and descriptions* of weight, as well as the assumption of consistent patterns in natural systems, to describe* evidence to address scientific questions about the conservation of the amount of matter, including the idea that the total weight of matter is conserved after heating, cooling, or mixing substances.
- From a given investigation plan, students identify the phenomenon under investigation, which includes the observable and measurable properties of materials.
- Identify the purpose of the investigation, which includes collecting data to serve as the basis for evidence for an explanation about the idea that materials can be identified based on their observable and measurable properties.
- From the given investigation plan, students describe* the evidence from data (e.g., qualitative observations and measurements) that will be collected, including:
    - Properties of materials that can be used to identify those materials (e.g., color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility).
- Describe how the observations and measurements will provide the data necessary to address the purpose of the investigation.
- From the given plan investigation plan, students describe* how the data will be collected. Examples could include:
    - Quantitative measures of properties, in standard units (e.g., grams, liters).
    - Observations of properties such as color, conductivity, and reflectivity.
    - Determination of conductors vs. nonconductors and magnetic vs. nonmagnetic materials.
- Describe how the observations and measurements they make will allow them to identify materials based on their properties.
- From the given investigation plan, students identify the phenomenon under investigation, which includes the observable and measurable properties of materials.

Understandings (Students will understand or know...)	**Essential Questions**
• **Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.** • **Measurements of a variety of properties can be used to identify materials.** • **Natural objects exist from the very small to the immensely large.** • **Matter of any type can be subdivided into**	1. *How can properties be used to identify materials?* 2. *What kind of model would best represent/describe matter as made of particles that are too small to be seen?* 3. *How can we make slime?*

particles that are too small to see, but even then the matter still exists and can be detected by means other than seeing. ● **A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.** ● **Cause-and-effect relationships are routinely identified, tested, and used to explain change.** ● **When two or more different substances are mixed, a new substance with different properties may be formed.** ● **Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.** ● **The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.** ● **No matter what reaction or change in properties occurs, the total weight of** ● **the substances does not change.** ● **Science assumes consistent patterns in natural systems.**	4. *How can baking soda and vinegar burst a zip-lock bag?*

Assessment Evidence	
Formative Assessments ● Measure and describe physical quantities such as weight, time, temperature, and volume. ● Make observations and measurements to produce data that can serve as the basis for evidence for an explanation of a phenomenon. ● Make observations and measurements to identify materials based on their properties. Examples of materials to be identified could	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

include: ● Baking soda and other powders ● Metals ● Minerals ● Liquids Examples of properties could include: ● Color ● Hardness ● Reflectivity ● Electrical conductivity ● Thermal conductivity ● Response to magnetic forces ● Solubility ● Develop a model to describe phenomena. ● Develop a model to describe that matter is made of particles too small to be seen. (Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.) Examples of evidence could include: ● Adding air to expand a basketball ● Compressing air in a syringe ● Dissolving sugar in water ● Evaporating salt water ● Identify, test, and use cause-and-effect relationships to explain change. ● Conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered. ● Conduct an investigation to determine whether the mixing of two or more substances results in new substances. ● Measure and describe physical quantities such as weight, time, temperature, and volume. ● Measure and graph quantities such as weight to address scientific and engineering questions and problems.	

● Measure and graph quantities to provide evidence that regardless of the type of change that occurs when substances are heated, cooled, or mixed, the total weight is conserved. ● Examples of reactions or changes could include: ● Phase changes ● Dissolving ● Mixing	

Learning Activities

What it looks like in the classroom...

The concepts and practices in this unit are foundational for understanding the relationship between changes to matter and its weight. During this unit of study, students will observe, measure, and identify materials based on their properties and begin to get a conceptual understanding of the particle nature of matter (i.e., all matter is made of particles too small to be seen).

In the first portion of the unit, students will focus on measuring and describing a variety of physical properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces and solubility. These observations and measurements are used to produce data that serves as the basis for evidence that can be used to identify materials. Students need opportunities to observe, measure, and describe a variety of types of matter, such as baking soda and other powders; metals; minerals; and liquids. Standard units should be used to measure the properties of weight, time, temperature, and volume; however, at this grade level, mass and weight are not distinguished. In addition, students are not expected to understand density as a physical property, and no attempt should be made to define unseen particles or explain the atomic-scale mechanism of evaporation and condensation.

In the second portion of the unit, students make observations, gather evidence, and develop models in order to understand that matter is made up of particles too small to be seen. Matter of any type can be subdivided into small particles. In planning and carrying out simple investigations, students will produce data to be used as evidence to support the idea that even though matter is made of particles too small to be seen, matter can still exist and can be detected by means other than seeing. This evidence will be used to support students' thinking as they develop models that depict matter. For example, a model that represents solids at the particle level would show particles tightly packed, while a model that represents gases would show particles moving freely around in space. Observing such phenomena as adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, or evaporating salt water could help students to understand matter at the particle level and to build models that represent this phenomenon.
Although engineering design is not explicitly called out in this unit, students could incorporate engineering design in a number of ways as they explore the particle nature of matter.

- Students can design ways/tools to measure a given physical property, such as hardness, reflectivity, electrical or thermal conductivity, or response to magnetic forces.
- The engineering design process can be used to analyze students' models using criteria. Then students can improve their designs based on analysis.

In the third portion of the unit of study, students will use mathematical and computational thinking to understand the cause and effect relationship between physical changes in matter and conservation of weight. Throughout the unit, students need multiple opportunities to observe and document changes in matter due to physical changes, and to analyze data to explain changes that do or do not occur in the physical properties of matter.

Students begin by planning and conducting investigations to determine whether or not a new substance is made when two or more substances are mixed (see the Sample Open Education Resources). As they work with a variety of substances, they should:

- Measure, observe, and document physical properties (e.g., color, mass, volume, size, shape, hardness, reflectivity, conductivity, and response to magnetic forces) of two or three substances.
- Mix the original substances.
- Measure, observe, and document the physical properties of the substance produced when the original substances are mixed.
- Compare data from the original substances to data from the substance produced, and determine what changes, if any, have occurred.
- Use observations and data as evidence to explain whether or not a new substance was produced, and to explain any changes that occurred when the original substances were mixed.

With each set of substances that students investigate, it is important that they use balances to measure the mass of the original substances and the mass of the substance made when the original substances are mixed. These data should be documented so that students can analyze the data. As they compare the data, they should recognize that when two or more substances are mixed, the mass of the resulting substance equals the sum of the masses of the original substances. In other words, the total mass is conserved.

Conservation of mass is a critical concept that is developed over time; therefore, students need multiple opportunities to investigate this phenomenon. Students should measure the mass of each substance, document the data they collect in a table or chart, and use the data as evidence that regardless of the changes that occur when mixing substances, the total weight of matter is conserved.

In addition to observing changes that occur when substances are mixed, students should also have opportunities to investigate other types of physical changes. For example, students can observe changes in matter due to heating, cooling, melting, freezing, and/or dissolving. As before, students should measure, observe, and document the physical properties of the substance before and after a physical change, and use the data as evidence to explain any changes that occur. The data should also provide evidence that regardless of the type of change that matter undergoes, the mass is conserved.

Example Activities

Material Properties: The dangerous Androvax has crash-landed on Earth! Sabotage his escape plans by tricking him into building a spaceship out of the wrong materials.

Time for Slime: Students combine water and borax to create slime. Be sure to read and follow all of the cautions on the borax box label.

Bubble Burst! How can baking soda and vinegar burst a zip-lock bag?

Flame Out: A candle flame is actually a chemical reaction in action! Candle wax is one of the chemicals in the reaction.

Crime Scene Soil Investigation: Billy's bike has been stolen and it is up to your students to crack the case by analyzing the soil tagged as evidence at the crime scene. Students use handheld digital microscopes connected to iPads to capture images of the soil for analysis

Nails in A Jar: "Nails in a Jar" is a formative assessment from Page Keeley's *Uncovering Student Ideas in Science, Volume 4.* Students are asked whether the mass of a sealed jar of wet nails would change as the nails rusted.

Bursting Bubbles The Story of an Improved Investigation: Bursting Bubbles models how to plan, carry out, and communicate about an investigation through the fictional account of two children investigating how bread is made. As they investigate mixtures including yeast, sugar, and different temperatures.

Teacher and Student Discourse Moves Combined Tool: This is a chart designed to assist teachers in facilitating and supporting scientific discourse between students in their classrooms.

Sugar Water: Uncovering Student Ideas Volume 4: This probe introduces the phenomena of dissolving sugar and elicits students understanding of what happens when substances are added to a liquid, what happens when sugar dissolves in water. T

Now You See it Now, Now You Don't ...Dissolving Matter: Students explore mixtures and solutions in this 5E lesson. Students add soil to water, stir it and repeat the procedure with salt, then compare the two. Students then collaborate to explain differences in changes between the mixtures and compounds.

The Cookie Dilemma Chapter 21 Everyday Physical Science Mysteries: This lesson invites students to plan an investigation and use their collective knowledge to identify individual substances in a "mystery mix."

Changes : Addressing Students Misconceptions about Physical and Chemical Changes: Students investigate and describe multiple indicators of both physical and chemical changes over a 10 day unit. The learning opportunities students were provided specifically addressed misconceptions about the reversibility of changes and the

Air, A Gas: In this instructional sequence students investigate air to better model and understand how it is a form of matter, has weight, and takes up space like solids and liquids, but is invisible because the particles are spread too far apart.

Chemical Cafe: In this set of learning experiences arranged in a the linear 5 E lesson format, students will perform a series of investigations to further their understanding of the structures and properties of matter;and more specifically, what happens to matter

What's the Matter in Mr. Whisker's Room?: This classroom read-aloud leads students to engage in the science and engineering practices through the exploration of the structure and properties of matter. Questions presented by Mr. Whisker's facilitates student observations.

Modeling Particles of Matter: This is the first instructional sequence in a teacher's guide built with the purpose of helping students build a deeper understanding of the Structures and Properties of Matter standard.Students have the opportunity to engage with interactive simulations.

Google classroom activities:

-sort by properties

-Matter

- measurements of matter labs (mass, volume, density)

-density lab (phet)

https://phet.colorado.edu/sims/density-and-buoyancy/density_en.html

- states of matter

-chemical properties

- physical/chemical changes

- conservation of matter lab (before and after masses)

Physical change (ice to water)

Chemical change (vinegar/baking soda)

- reactants vs. products

https://www.youtube.com/watch?v=tbPxwDiX1NU

https://www.youtube.com/watch?v=wg_dcSEZrt4

https://www.youtube.com/watch?v=Pu0uZUKSC-s

https://www.youtube.com/watch?v=EwzkYTfHFbo

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu
YouTube www.youtube.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

In order to integrate literacy into this unit of study, students can conduct research by using text and media resources to build their knowledge of the physical properties of matter. In researching this topic, students can recall and gather information by summarizing or paraphrasing their research as they take notes in their science journals. Students can also draw evidence from informational texts to support their design choices as they build and share their models of matter at the particle level. They can also create foldables, charts, or PowerPoint presentations to accompany their models. In addition, if students use research to support their work, they should provide a list of the sources used.

Students can conduct short research projects, using both print and digital sources, to build their understanding of physical changes to matter. While reading, they should take notes of relevant information, and summarize that information so that it can be used as evidence to explain the changes that occur as substances are heated, cooled, dissolved, or mixed. When drawing evidence from texts to support analysis, reflection, and research, students should provide a list of sources.

- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1) RI.5.7
- Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-3) (5-PS1-2),(5-PS1-4) W.5.7
- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-PS1-3)(5-PS1-2)(5-PS1-4) W.5.8 W.5.9
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-3) W.5.9

Mathematics

Mathematics is integrated into this unit when students use appropriate tools, such as balances, thermometers, and graduated cylinders, to measure properties of matter like mass, temperature, and volume. In addition, students reason quantitatively and abstractly when analyzing and interpreting data collected when measuring physical properties of matter. Students also model with mathematics as they attempt to understand that matter exists even though it is made of particles too small to be seen. They interpret mathematical data in the context of the situation, reflect on how the data helps explain the particle nature of matter, and modify or improve their models if they do not adequately represent the phenomenon they are meant to represent. Use appropriate tools in strategic ways when measuring physical properties of substances, such as weight or volume. Model with mathematics when organizing data into tables or charts, and using the data as evidence to explain changes that occur. Convert among different-sized standard measurement units within a given measurement system and use these conversions to explain changes that occur.

- Reason abstractly and quantitatively. (5-PS1-1)(5-PS1-2) (5-PS1-3) MP.2
- Model with mathematics. (5-PS1-1) (5-PS1-2)MP.4
- Use appropriate tools strategically. (5-PS1-2)(5-PS1-3) MP.5
- Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1) 5.NBT.A.1
- Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1) 5.NF.B.7
- Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1) 5.MD.C.3
- Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft., and improvised units. (5-PS1-1) 5.MD.C.4
- Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. (5-PS1-2) 5.MD.A.1

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per

IEP/504
At Risk Learners:
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education
9.2B3, 9.2B4 **https://www.state.nj.us/education/cccs/2014/career/** **CRP (2,3,4,5,7,8)** **https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf**

Integration of Technology (*How will students integrate technology throughout the unit? How will students achieve the NJSLS*)
8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1 https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September - November	9 Weeks	1	Structure, Properties, and Interactions of Matter
November – January	9 Weeks	2	Matter and Energy in Organisms and Ecosystems
February – April	9 Weeks	3	Earth's Systems
April - June	9 Weeks	4	Space Systems: Stars and the Solar System

Course Title: 5th Grade Science

Unit Title	Earth's Systems
Length of Unit	Marking Period 2
Summary/Overview	***How do individual communities use science ideas to protect Earth's resources and environment?*** In this unit of study, students describe and graph data to provide evidence about the distribution of water on Earth. In addition students are able to describe ways in which the geosphere, biosphere, hydrosphere, and atmosphere interact.The crosscutting concepts of *scale, proportion, quantity* and *systems, and systems models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *using mathematics and computational thinking* and in *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
5-ESS2-1	**Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.**
5-ESS2-2	**Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.**
5-ESS3-1	**Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**
Focus Standards	
ESS2.C	The Roles of Water in Earth's Surface Processes

	● Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)
ESS3.C	Human Impacts on Earth Systems ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)
ESS2.A	Earth Materials and Systems ● Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)
ESS3.C	Human Impacts on Earth Systems ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

Learning Objectives
(Students will be able to...)

- Develop a model, using a specific given example of a phenomenon, to describe ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. In their model, students identify the relevant components of their example, including features of two of the following systems that are relevant for the given example:
    - Geosphere (i.e., solid and molten rock, soil, sediment, continents, mountains).
    - Hydrosphere (i.e., water and ice in the form of rivers, lakes, glaciers).
    - Atmosphere (i.e., wind, oxygen).
    - Biosphere (i.e., plants, animals [including humans]).
- Identify and describe relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example (e.g., the atmosphere and the hydrosphere interact by exchanging water through evaporation and precipitation; the hydrosphere and atmosphere interact through air temperature changes, which lead to the formation or melting of ice).

- Use the model to describe a variety of ways in which the parts of two major Earth systems in the specific given example interact to affect the Earth's surface materials and processes in that context. Students use the model to describe* how parts of an individual Earth system:
  - Work together to affect the functioning of that Earth system.
  - Contribute to the functioning of the other relevant Earth system.
- Graph the given data (using standard units) about the amount of salt water and the amount of fresh water in each of the following reservoirs, as well as in all the reservoirs combined, to address a scientific question:
  - Oceans.
  - Lakes
  - Rivers
  - Glaciers
  - Ground water
  - Polar Caps
- Use the graphs of the relative amounts of total salt water and total fresh water in each of the reservoirs to describe that:
  - The majority of water on Earth is found in the oceans.
  - Most of the Earth's freshwater is stored in glaciers or underground.
  - A small fraction of freshwater is found in lakes, rivers, wetlands, and the atmosphere.
- Obtain information from books and other reliable media about:
  - How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
  - How a given community uses scientific ideas to protect a given natural resource and the environment in which the resource is found.
- Combine information from two or more sources to provide and describe* evidence about:
  - The positive and negative effects on the environment as a result of human activities.
  - How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.

Understandings (Students will understand or know...)	**Essential Questions**
● **Standard units are used to measure and describe physical quantities such as weight and volume.** ● **Nearly all of Earth's available water is in the ocean.** ● **Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.** ● **A system can be described in terms of its components and their interactions.** ● **Science findings are limited to**	1. *Where is water found on the Earth? What percentage of the Earth's water is freshwater?* 2. *How do individual communities use science ideas to protect Earth's resources and environment?* 3. *In what ways do the geosphere, biosphere, hydrosphere, and/or atmosphere interact?* 4. *How do individual communities use science*

questions that can be answered with empirical evidence. ● **Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.** ● **Individuals and communities are doing things to help protect Earth's resources and environments.** ● **A system can be described in terms of its components and their interactions.** ● **Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans).** ● **The Earth's major systems interact in multiple ways to affect Earth's surface materials and processes.** ● **The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate.** ● **Winds and clouds in the atmosphere interact with landforms to determine patterns of weather.** ● **A system can be described in terms of its components and their interactions.** ● **Science findings are limited to questions that can be answered with empirical evidence.** ● **Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.** ● **Individuals and communities are doing things to help protect Earth's resources and environments.**	*ideas to protect Earth's resources and environment?*

Assessment Evidence

Formative Assessments	Summative Assessments
● Describe physical quantities, such as weight and volume, in standard units. ● Describe and graph quantities such as area and volume to address scientific questions. ● Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. ● Describe a system in terms of its components and interactions. ● Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. ● Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. ● Describe a system in terms of its components and interactions. ● Develop a model using an example to describe a scientific principle. ● Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. ● Examples could include: ● The influence of oceans on ecosystems, landform shape, and climate. ● The influence of the atmosphere on landforms and ecosystems through weather and climate. ● The influence of mountain ranges on the wind and clouds in the atmosphere. ● Describe a system in terms of its components and interactions. ● Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. ● Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

Learning Activities

What it looks like in the classroom...

During this unit of study, students need to understand that Earth is a system made up of subsystems, all of which have multiple components that interact. Throughout this unit, students will consider scale and proportion when examining the amount of water on the Earth, and they will consider the impact that humans have on one of Earth's most valuable resources.

To begin the progression of learning in this unit, students conduct research, using informational texts and online resources, to determine the distribution of freshwater and saltwater among Earth's oceans, rivers, lakes, glaciers, groundwater, and polar ice caps. Students organize their data into graphs or charts, showing the allocation of freshwater and saltwater on Earth. (Amounts should be described in terms of volume, as well as in percentages.) After comparing and analyzing data, students should be able to conclude the following:

- Nearly all of Earth's available water is in the ocean.
- Fresh water makes up less than 3% of the total amount of water on the Earth.
- Most fresh water is found in glaciers or underground.
- Only a tiny fraction of the freshwater on Earth is in streams, lakes, wetlands, and the atmosphere.

Next, students conduct research in order to determine ways in which individuals and communities help to protect the Earth's resources and environments. Using books and other reliable media sources, as well as first-hand observations in the local community, students gather information about the ways in which humans affect the environment. They should look for examples of human activities in agriculture, industry, and in their everyday lives, and should describe, both orally and in writing, the ways in which these activities affect the land, oceans, streams, groundwater, air, and other organisms (both plants and animals). Students will need the opportunity to share their findings with the class, and then should conduct further research to find ways in which individual communities use science ideas to protect the Earth's resources and environments.

Working in pairs or small groups, students should gather relevant information from both observations and reliable resources to prepare a presentation that explains one way in which a community is minimizing the effects of human activities on Earth's resources and environment. The presentation should include both writing and speaking components, as well as a list of sources that were used to provide information. As a result of conducting research and creating a presentation, students should come to understand that the ecosystem is a system that includes both living and nonliving components that interact with one another. These interactions cause changes to the system and its components. Humans are just one of many components in an ecosystem, yet our activities affect all parts of the ecosystem, many times in adverse ways.

In the continuation of this unit of study, students develop models to describe the interactions that occur within and between major Earth systems and conduct research to learn how humans protect the Earth's resources. Foundational to this unit of study is the understanding of a system, its components, and the interactions that occur within the system. Initially, students may need opportunities to review familiar examples of systems, such as plants and animals, listing external and internal structures and processes and describing the interactions that occur within the system. Students can then begin to think about Earth's major systems, identifying the components and describing the interactions that occur within each. For example:

- The geosphere is composed of solid and molten rock, soil, and sediments. Some processes that occur between the components of the geosphere include erosion, weathering, deposition, sedimentation, compaction heating, cooling, and flow. These processes cause continual change to rock, soil, and sediments.
- The hydrosphere is composed of water in all its forms. Water, unlike the vast majority of earth materials, occurs naturally on the Earth as a solid, liquid, or gas, and it can be found on, above, and below the surface of the Earth. Some processes that occur in the hydrosphere include evaporation, condensation, precipitation, runoff, percolation, freezing, thawing, and flow. These processes cause water to change from one form to another in a continuous cycle.
- The atmosphere is a critical system made up of the gases that surround the Earth. The atmosphere helps to regulate Earth's climate and distribute heat around the globe, and it is composed of layers with specific properties and functions. This system, composed mainly of nitrogen, oxygen, argon, and carbon dioxide, also contains small amounts of other gases, including water vapor, which is found in the lowest level of the atmosphere where weather-related processes occur. In addition to weather processes, radiation, conduction, convection, carbon cycling, and the natural greenhouse effect are processes that occur in the atmosphere.
- The biosphere comprises living things, including humans. Living organisms can be found in each of the major systems of the Earth (the atmosphere, hydrosphere, and geosphere). Some processes that occur within the biosphere include transpiration, respiration, reproduction, photosynthesis, metabolism, growth, and decomposition.

As students become more comfortable with describing each system in terms of its components and interactions, they should begin to think about and discuss the interactions that occur between systems. This should be a natural progression in their learning, since students will discover that any interactions that occur within a system affect components of other systems. Students should develop models that describe ways in which any two Earth systems interact and how these interactions affect the living and nonliving components of the Earth. Some examples include:

- The influence of oceans on ecosystems, landform shape, or climate.
- The impact of the atmosphere on landforms or ecosystems through weather and climate.
- The influence of mountain ranges on wind and clouds in the atmosphere.
- The role of living organisms (both plants and animals) in the creation of soils.

As a class, students can brainstorm additional examples. They can use any type of model, such as diagrams or physical replicas, to describe the interactions that occur between any two systems, and they can choose to enhance the model with multimedia components or visual displays. Once students have an understanding of the components and interactions that occur within and between Earth's major systems, they should gather information about the ways in which How human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. What individuals and communities are doing to help protect Earth's resources and the environment. Students can share their work in a variety of ways and should provide a list of sources for the information in their finished work.

Although engineering design is not explicitly called out in this unit, students could incorporate engineering design in a number of ways as they explore human impact on the environment.

- Students may design a way to promote local, sustainable agriculture, making healthy food available to more people in their communities while having minimizing the impact on the local environment.
- Students can design ways to capture and use rainwater throughout their community to lessen the impact on local freshwater reserves.
- Students can design and implement a variety of recycling projects that have a positive impact on the environment by increasing the reuse of materials that normally end up in landfills and decreasing our reliance on earth resources.
- Students can research and design ways to increase the use of environmentally friendly fertilizers and pesticides that do not harm the local environment. Students can create pamphlets, presentations, or even commercials that inform the local community of the impact that chemical fertilizers and pesticides have when used in and around homes and businesses and offer information on safer alternatives that are just as effective.

Students will need time to conduct research, determine criteria for success, consider constraints on available resources, and design solutions based on the information they gather. Students will need access to reliable sources of information that will help them as they work through the design process. Individual communities use science ideas to protect Earth's resources and environment. Students can work individually, in pairs, or in small groups to conduct research using books and other reliable media resources. They should paraphrase and summarize information as they take notes, then use their information to support their finished work.

Example Learning Activities

Global Water Distribution: In this lesson sequence, students predict and model the availability of water on Earth and discuss methods that can be used to purify and conserve this critical resource. They also assess how much water they and their families typically use, and think about ways to reduce their water usage. Finally, students explore different techniques being employed for water management around the world, including the use of dams to create reservoirs.

Simulating an Oil Spill to Understand Environmental Impact: This 8 minute instructional video provides a model for teachers to follow of a week long investigation of oil spills and the environmental impact they have on shorelines and creatures. Students take on the task of cleaning up a simulated oil spill. Educator uses the 5E curriculum model to engage students with fiction and non-fiction texts before exploring methods that simulate an oil spill and its cleanup. Video demonstrates the key portions of the activity and models appropriate teacher questioning and interactions with the students.

NOAA What-a-Cycle: Through role-playing as a particle of water, students gain an understanding of the complexity of the movement of water through earth's systems. Stations are set-up for nine different water reservoirs associated with the water cycle. On each turn, students roll the dice at each station and either stay in place or move to a different location. Students track their unique journey through the water cycle to later share and discuss the strengths and limitations of the game as a model for the movement of water through Earth's systems.

Shower Curtain Watershed: What is a watershed? How do our actions affect the health of a watershed? Students explore these questions by analyzing pictures and identifying watershed features. Students then make a watershed model using a plastic shower curtain, a spray bottle of water and themselves or classroom objects The objectives of the lesson are to: a) Identify nonliving and living features found in a watershed. b) Understand how human activities can affect watersheds.

Think It, Design It, Build It....Water Filtration Activity: This unit activity combines learning about ways individual communities use science ideas to protect the Earth's resources and environment along with the engineering design process to create a water filtration system.

Water cycle:
https://www3.epa.gov/safewater/kids/flash/flash_watercycle.html
http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/

Sphere interaction
http://www.cpalms.org/Public/PreviewResourceLesson/Preview/128958

Food chain/web
http://users.manchester.edu/Student/WKStarnes/ProfWeb/E3-FoodChainLesson.pdf
https://www.brainpop.com/science/ecologyandbehavior/foodchains/

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu

YouTube www.youtube.com

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students use print and digital sources to gather information and data that describe the amount of freshwater and saltwater on the Earth and where it is found. As students gather information, they should organize the information into graphs, analyze and interpret the information to answer questions, and summarize the information in order to describe the amounts and percentages of freshwater and saltwater on the Earth and to provide evidence about the distribution of water in oceans, lakes, streams, and reservoirs. Students also use several print and digital resources to find examples of:

- The effects of human activities in agriculture, industry, and everyday life on Earth's resources and environments
- Ways in which communities are using science ideas to protect Earth's resources and environments.

Students summarize and paraphrase the information and use it when creating presentations that describe ways in which communities are using science ideas to protect Earth's resources and environments. The presentation should include both oral and written components, and a list of sources should be included with the presentation.

In this unit, students can use information from print and digital sources to build their understanding of Earth's major systems and the interactions that occur within and between them. As students read and gather information from multiple print or digital sources, they should use the information to make inferences, answer questions, participate in discussions, solve problems, and support their thinking about the interactions that occur among Earth's systems and the impact that humans have on Earth's resources and environments. As students build models to explain the interactions between the systems and research ways in which individual communities use science ideas to protect the Earth's resources and environments, they can enhance their work with multimedia components, such as graphics and sound and visual displays.

- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1) RI.5.1
- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-2), (5-ESS3-1) RI.5.7
- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2), (5-ESS3-1) W.5.8
- Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1) RI.5.9
- Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-

ESS2-1),(5-ESS3-1) RI.5.7 (5-ESS3-1) W.5.9 (5-ESS3-1) W.5.9

- Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-2) SL.5.5 (5-ESS2-2),(5-ESS2-1) SL.5.5

Mathematics

Students model with mathematics by using tables, charts, and/or graphs to organize data and information they collect. This includes the amount of fresh and salt water on Earth, the locations of both fresh and salt water on Earth, how human activities affect Earth's resources, and ways in which communities protect the Earth's resources and environments. Students also reason abstractly and quantitatively when analyzing these data to use as evidence to support their thinking. Reason abstractly and quantitatively when analyzing data used as evidence to explain how Earth's major systems interact and how human activities affect Earth's resources. Model with mathematics by using tables, charts, or graphs to organize data and information they collect to support explanations about the interactions that occur within and between Earth's systems. Represent real-world and mathematical relationships through graphing. For example, students can graph data to show the relationship between the amount of rainfall that occurs and changes in air temperature or pressure or the relationship between the types or number of organisms living at various altitudes.

- Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2), (5-ESS3-1) MP.2
- Model with mathematics. (5-ESS2-1),(5-ESS2-2), (5-ESS3-1) MP.4
- Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1) 5.G.A.2

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:
- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

Course Title: 5th Grade Science

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Integration of Technology

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September - November	9 Weeks	1	Structure, Properties, and Interactions of Matter
November – January	9 Weeks	2	Matter and Energy in Organisms and Ecosystems
February – April	9 Weeks	3	Earth's Systems
April - June	9 Weeks	4	Space Systems: Stars and the Solar System

Unit Title	Ecosystems
Length of Unit	Marking Period 3
Summary/Overview	***What happens to the matter and energy that are part of each organism?***

	In this unit of study, students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment, and they can explain that energy in animals' food was once energy from the sun. The crosscutting concepts of *energy and matter* and *systems and system models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *developing and using models* and *engaging in argument from evidence.* Students are also expected to use these practices to demonstrate understanding of the core ideas.

Desired Outcomes	
Standards	
5-LS1-1	**Support an argument that plants get the materials they need for growth chiefly from air and water.**
5-LS2-1	**Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.**
5-PS3-1	**Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.**
Focus Standards	
LS1.C:	Organization for Matter and Energy Flow in Organisms ● Plants acquire their material for growth chiefly from air and water. (5-LS1-1)
LS2.A	Interdependent Relationships in Ecosystems ● The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced

	species can damage the balance of an ecosystem. (5-LS2-1)
LS2.B	Cycles of Matter and Energy Transfer in Ecosystems ● Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)
PS3.D	Energy in Chemical Processes and Everyday Life ● The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1)
LS1.C	Organization for Matter and Energy Flow in Organisms ● Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)

Learning Objectives
(Students will be able to…)

- Identify a given claim to be supported about a given phenomenon. The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.
- Describe the given evidence, data, and/or models that support the claim, including evidence of:
    - Plant growth over time.
    - Changes in the weight of soil and water within a closed system with a plant, indicating:
    - Soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants).
    - Plants' inability to grow without water.
    - Plants' inability to grow without air.
    - Air is matter (e.g., empty object vs. air filled object).
- Determine whether the evidence supports the claim, including:
    - Whether a particular material (e.g., air, soil) is required for growth of plants.
    - Whether a particular material (e.g., air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth.
- Use reasoning to connect the evidence to support the claim with argumentation. Students describe a chain of reasoning that includes:
    - During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
    - Because some plants don't need soil to grow, and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil

must not enter the plant in sufficient quantities to be the chief contributor to plant growth. Therefore, plants do not acquire most of the material for growth from soil.
    - A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
    - Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth, plant growth must come chiefly from water and air.
- Use models to describe a phenomenon that includes the idea that energy in animals' food was once energy from the sun.
- Students identify and describe the components of the model that are relevant for describing* the phenomenon, including:
    - Energy
    - Sun
    - Plants
    - Animals, including their bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
- Students identify and describe* the relevant relationships between components, including:
    - The relationship between plants and the energy they get from sunlight to produce food.
    - The relationship between food and the energy and materials that animals require for bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
    - The relationship between animals and the food they eat, which is either other animals or plants (or both), to obtain energy for bodily functions and materials for growth and repair.
- Students use the models to describe* causal accounts of the relationships between energy from the sun and animals' needs for energy, including that:
    - Since all food can eventually be traced back to plants, all of the energy that animals use for body repair, growth, motion, and body warmth maintenance is energy that once came from the sun.
    - Energy from the sun is transferred to animals through a chain of events that begins with plants producing food then being eaten by animals.

Understandings (Students will understand or know...)	**Essential Questions**
● **Matter is transported into, out of, and within systems.** ● **Plants acquire their material for growth chiefly from air and water.** ● **Science explanations describe the mechanisms for natural events.** ● **A system can be described in terms of its components and their interactions.** ● **The food of almost any kind of animal can be traced back to plants.**	1. *Where do plants get the materials they need for growth?* 2. *How does matter move among plants, animals, decomposers, and the environment?* 3. *How can energy in animals' food be traced to the sun?*

• **Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants.** • **Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as *decomposers*.** • **Decomposition eventually restores (recycles) some materials back to the soil.** • **Organisms can survive only in environments in which their particular needs are met.** • **Energy can be transferred in various ways and between objects.** • **The energy released from food was once energy from the sun, which was captured by plants in the chemical process that forms plant matter (from air and water).** • **Food provides animals with the materials they need for body repair and growth and the energy they need for motion and to maintain body warmth.**	

Assessment Evidence	
Formative Assessments • Describe how matter is transported into, out of, and within systems. • Support an argument with evidence, data, or a model. • Support an argument that plants get the materials they need for growth chiefly from air and water. • Describe a system in terms of its components and interactions. • Develop a model to describe phenomena. • Develop a model to describe the	**Summative Assessments** • Labs • Projects • Tests **Alternative Assessments** • Oral Presentations • Teacher Observations • Making Models

movement of matter among plants, animals, decomposers, and the environment. ● Emphasis is on the idea that matter that is not food—such as air, water, decomposed materials in soil—is changed into matter that is food. Examples of systems could include: ● Organisms ● Ecosystems ● Earth ● Describe how energy can be transferred in various ways and between objects. ● Use models to describe phenomena. ● Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. ○ Examples of models could include: ● Diagrams ● Flowcharts	

Learning Activities

What it looks like in the classroom...

In every habitat and ecosystem on Earth, plants and animals survive, grow, reproduce, die, and decay. What happens to the matter and energy that are part of each organism? Where does it come from and where does it go? In this unit of study, students make observations and use models to understand how energy flows and matter cycles through organisms and ecosystems.

Students should first understand that plants acquire their material for growth chiefly from air and water. Students will need opportunities to observe a variety of plants over time. As students document plants' continual need for water and air in order to grow, they recognize that this evidence supports the argument that plants acquire their material for growth chiefly from air and water (not from soil). In addition, as students observe that plants also need sunlight, they begin to recognize that plants use energy from the sun to transform air and water into plant matter.

Once students understand that plants acquire material for growth from air and water, they need opportunities to observe animals and plants interacting within an ecosystem. Terrariums, such as those built in 3-liter bottles, are ideal for this because they are large enough for small plants and animals to survive and grow, yet easy to build and maintain. In these terrariums, students should observe plants growing and providing a source of food for small herbivores, carnivores consuming other animals, and decomposers consuming dead plant material.

All of these interactions may not be observable within a single terrarium; however, a class could use a number of 3-liter bottles to set up different ecosystems, each with a few carefully chosen plants and animals. This will give students opportunities to observe different types of interactions within a variety of enclosed systems.

When students record their observations of these small systems, it is important that students be able to:

- Identify the living and nonliving components of a system.
- Describe the interactions that occur between the living and nonliving components of each system.
- Develop models (such as food chains or food webs) that describe the movement of matter among plants, animals, decomposers, and the environment.

As students continue to observe each terrarium, they learn that:

- The food of almost any kind of animal can be traced back to plants.
- Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants.
- Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as decomposers.
- Decomposition eventually restores (recycles) some materials back to the soil.
- A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life.
- Organisms can survive only in environments in which their particular needs are met.
- Matter cycles between the air and soil and among plants and animals as these organisms live and die.
- Organisms obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment.

Furthermore, students can conduct research to determine the effects of newly introduced species to an ecosystem.

After investigating the movement of matter in ecosystems, students revisit the concept of energy flow in systems. At the beginning of this unit of study, students learned that energy from the sun is transferred to plants, which then use that energy to change air and water into plant matter. After observing the interactions between the living and nonliving components of small ecosystems, students recognize that energy, like matter, is transferred from plants to animals. When animals consume plants, that food provides animals with the materials they need for body repair and growth and with the energy they need to maintain body warmth and for motion. Students can use diagrams or flowcharts to describe the flow of energy within an ecosystem, tracing the energy in animals' food back to the energy from the sun that was captured by plants.

Example Activities

Bottle Biology Terrarium: Students will create a terrarium, make observations of the terrarium, then develop a model to explain how matter transfers within the ecosystem. This resource describes the process of creating a terrarium (which will serve as the phenomena that the students observe), but does not include specific lesson details or instructional strategies.
Biodomes Engineering Design Project: This activity is a culmination of a 16 day unit of study where students explore the biosphere's environments and ecosystems. In this final activity, students apply what they learned about plants, animals, and decomposers to design and create a model biodome. Engaging in the engineering design process, students construct a closed (system) environment containing plants and animals existing in equilibrium. Provided with a variety of materials (constraints), teams of students will use their imagination and culminating knowledge to design a biodome structure following the criteria of the activity that models how plants, insects, and decomposers work together in a system. (The activity can be conducted as a structured or open-ended design. It is recommended to allow students the opportunity to be true engineers and follow the opened-ended design.)

Beginning Plants Unit: This Concord Consortium unit utilizes Science, Math, and ELA lessons to teach students about plants' need for sunlight, air and water.

Soil Biosolarization: Sustainable Weed Killer: Students will be acting as agricultural engineers as they conduct a scientific experiment to test the effectiveness of a sustainable pest-control technique called *soil biosolarization* that uses organic waste.

Water Movement Through Plants: Students explore differences in the amount of water taken up by different types of plants through student designed investigations.

Experiment with Ecosystems: Students use an ecosystem simulator to test their hypotheses about producer/consumer and predator/prey relationships. The simulation includes grass, rabbits, hawks and foxes interacting together in one ecosystem.

Dissecting an Owl Pellet: Students identify an owl pellet's contents and practice recording and analyzing the data.

Wetlands Are Wonderlands: This resource consists of five activities for students to explore food webs and food pyramids within the context of a wetlands ecosystem. The example ecosystem is based in Ohio but would work as an ecosystem introduction in any state.

Weaving the Web: In this lesson students participate in a classroom model of a food web. During the creation of the model, students discuss types or organisms, relationships between organisms in an ecosystem, energy, and matter.

Resources

Next Generation Science Standards **https://www.nextgenscience.org**
Learning Center NSTA **http://learningcenter.nsta.org**
National Science Teacher Association **http://nsta.org**
Better Lesson **www.betterlesson.com**
Mosa Mack **www.mosamack.com**
PBS Learning **https://nj.pbslearningmedia.org**
PhET **https://phet.colorado.edu**
YouTube **www.youtube.com**

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students should use information from print and digital sources to build their understanding of energy and matter in ecosystems. As students read, they should use the information to answer questions, participate in discussions, solve problems, and support their thinking about movement of matter and the flow of energy through the organisms in an ecosystem. In this unit of study, students are also required to build models to describe the cycling of matter and the flow of energy in ecosystems. They can enhance their models using multimedia components, such as graphics and sound, and visual displays.

- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1) RI.5.1
- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-LS2-1), (5-PS3-1) RI.5.7
- Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1) RI.5.9
- Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1) W.5.1
- Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-LS2-1), (5-PS3-1) SL.5.5

Mathematics

In this unit students should use appropriate tools in strategic ways when making and recording observations of the living and nonliving components of an ecosystem. Model with mathematics when using tables, charts, or graphs to organize observational data. Reason abstractly and quantitatively when analyzing data that can be used as evidence for explaining how matter cycles and energy flows in systems. Convert among different-sized standard measurement units within a given measurement system and use these conversions to help explain what happens to matter and energy in ecosystems.

- Reason abstractly and quantitatively. (5-LS1-1), (5-LS2-1) MP.2
- Model with mathematics. (5-LS1-1), (5-LS2-1) MP.4
- Use appropriate tools strategically. (5-LS1-1) MP.5
- Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-LS1-1) 5.MD.A.1

Modifications

Gifted and Talented

- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners

- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504

- Review student individual educational plan and/or 504 plan
- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education

9.2B3, 9.2B4

https://www.state.nj.us/education/cccs/2014/career/

CRP (2,3,4,5,7,8)

https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Course Title: 5th Grade Science

Integration of Technology (*How will students integrate technology throughout the unit? How will students achieve the NJSLS*)
8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1 https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide			
Month	**Estimated Time of Unit**	**Unit #**	**Theme/Content**
September - November	9 Weeks	1	Structure, Properties, and Interactions of Matter
November – January	9 Weeks	2	Matter and Energy in Organisms and Ecosystems
February – April	9 Weeks	3	Earth's Systems
April - June	9 Weeks	4	Space Systems: Stars and the Solar System

Unit Title	Space Systems: Stars and the Solar System
Length of Unit	Marking Period 4
Summary/Overview	***What patterns do we notice when observing the sky?*** In this unit of study, students develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. The crosscutting concepts of *patterns, cause and effect*, and *scale, proportion, and quantity* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate

	proficiency in *analyzing and interpreting data* and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

Desired Outcomes	
Standards	
5-PS2-1	**Support an argument that the gravitational force exerted by Earth on objects is directed down.**
5-ESS1-1	**Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.**
5-ESS1-2	**Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.**
Focus Standards	
PS2.B	Types of Interactions ● The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)
ESS1.A:	The Universe and its Stars ● The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)
ESS1.B	Earth and the Solar System ● The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)
Learning Objectives	

(Students will be able to…)
● Identify a given claim to be supported about a phenomenon. The claim includes the idea that the gravitational force exerted by Earth on objects is directed down toward the center of Earth. ● Students identify and describe* the given evidence, data, and/or models that support the claim, including: ○ Multiple lines of evidence that indicate that the Earth's shape is spherical (e.g., observation of ships sailing beyond the horizon, the shape of the Earth's shadow on the moon during an eclipse, the changing height of the North Star above the horizon as people travel north and south). ○ That objects dropped appear to fall straight down. ○ That people live all around the spherical Earth, and they all observe that objects appear to fall straight down. ● Evaluate the evidence to determine whether it is sufficient and relevant to supporting the claim. ● Use reasoning to connect the relevant and appropriate evidence to support the claim with argumentation. Students describe a chain of reasoning that includes: ○ If Earth is spherical, and all observers see objects near them falling directly "down" to the Earth's surface, then all observers would agree that objects fall toward the Earth's center. ○ Since an object that is initially stationary when held moves downward when it is released, there must be a force (gravity) acting on the object that pulls the object toward the center of Earth. ● identify a given claim to be supported about a given phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth. ● Describe the evidence, data, and/or models that support the claim, including: ○ The sun and other stars are natural bodies in the sky that give off their own light. ○ The apparent brightness of a variety of stars, including the sun. ○ A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights). ○ The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars). ● Evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe* the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth. ● Use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe a chain of reasoning that includes: ○ Because stars are defined as natural bodies that give off their own light, the sun is a star. ○ The sun is many times larger than Earth but appears small because it is very far away. ○ Even though the sun is very far from Earth, it is much closer than other stars. ○ Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky. ○ Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away. ○ Although stars are immensely large compared to Earth, they appear small and dim because they are so far away. ○ Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

- Using graphical displays (e.g., bar graphs, pictographs), students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that include:
  - The length and direction of shadows observed several times during one day.
  - duration of daylight throughout the year, as determined by sunrise and sunset times.
  - Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
- Use the organized data to find and describe* relationships within the datasets, including:
  - The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
  - The length of the day gradually changes throughout the year as Earth orbits the sun, with longer days in the summer and shorter days in the winter.
  - Some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
- Use the organized data to find and describe* relationships among the datasets, including:
  - Similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).

Understandings (Students will understand or know...)	Essential Questions
● **Cause-and-effect relationships are routinely identified and used to explain change.** ● **The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.** ● **Natural objects exist from the very small to the immensely large.** ● **The sun is a star that appears larger and brighter than other stars because it is closer.** ● **Stars range greatly in their distance from Earth.** ● **Natural objects exist from the very small to the immensely large.** ● **The sun is a star that appears larger and brighter than other stars because it is closer.** ● **Stars range greatly in their distance**	1. *What effect does Earth's gravitational force have on objects?* 2. *What effect does the relative distance from Earth have on the apparent brightness of the sun and other stars?* 3. *What patterns do we notice when observing the sky?*

from Earth. ● **Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.** ● **The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its north and south poles, cause observable patterns. These include:** ● **Day and night** ● **Daily changes in the length and direction of shadows** ● **Different positions of the sun, moon, and stars at different times of the day, month, and year.**	

Assessment Evidence	
Formative Assessments ● Identify cause-and-effect relationships in order to explain change. ● Support an argument with evidence, data, or a model. ● Support an argument that the gravitational force exerted by Earth on objects is directed down. ("Down" is a local description of the direction that points toward the center of the spherical Earth.) ● Support an argument with evidence, data, or a model. ● Support an argument that differences in the apparent brightness of the sun compared to that of other stars is due to their relative distances from Earth. ● Sort, classify, communicate, and analyze simple rates of change for natural	**Summative Assessments** ● Labs ● Projects ● Tests **Alternative Assessments** ● Oral Presentations ● Teacher Observations ● Making Models

phenomena using similarities and differences in patterns. ● Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. ● Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. ○ Examples of patterns could include: ● The position and motion of Earth with respect to the sun. ● Selected stars that are visible only in particular months.	

Learning Activities

What it looks like in the classroom…

In this unit of study, students explore the effects of gravity and determine the effect that relative distance has on the apparent brightness of stars. They also collect and analyze data in order to describe patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

To begin the progression of learning in this unit, students explore the effects of gravity by holding up and releasing a variety of objects from a variety of heights and locations. Students should record and use their observations to describe the interaction that occurs between each object and the Earth. In addition, students should use their observations as evidence to support an argument that the gravitational force exerted by the Earth on objects is directed "down" (towards the center of the Earth), no matter the height or location from which an object is released.

Next, students investigate the effect of distance on the apparent brightness of stars. Using information from a variety of print or digital sources, students learn that natural objects vary in size, from very small to immensely large. Stars, which vary in size, also range greatly in their distance from the Earth. The sun, which is also a star, is much, much closer to the Earth than any other star in the universe. Once students understand these concepts, they should explore the effect of distance on the apparent brightness of the sun in relation to other stars. This can be accomplished by modeling the effect using a light source, such as a bright flashlight. As students vary the distance of the light from their eyes, they should notice that the farther away the light is, the less bright it appears. Observations should again be recorded and used as evidence to support the argument that the differences in the apparent brightness of the sun compared to that of other stars is due to their relative distances from the Earth.

To continue the progression of learning, students investigate the following observable patterns of change that occur due to the position and motion of the Earth, sun, moon, and stars.

- Day and night: This pattern of change is a daily, cyclical pattern that occurs due to the rotation of the Earth every 24 hours. Students can observe model simulations using online or digital resources, or they can create models in class of the day/night pattern caused by the daily rotation of the Earth.
- The length and direction of shadows: These two interrelated patterns of change are daily, cyclical patterns that can be observed and described through direct observation. Students need the opportunity to observe a stationary object at chosen intervals throughout the day and across a few days. They should measure and record the length of the shadow and record the direction of the shadow (using drawings and cardinal directions), then use the data to describe the patterns observed.
- The position of the sun in the daytime sky: This daily, cyclical pattern of change can also be directly observed. Students will need the opportunity to make and record observations of the position of the sun in the sky at chosen intervals throughout the day and across a few days. Data should then be analyzed in order to describe the pattern observed.

The appearance of the moon in the night sky: This cyclical pattern of change repeats approximately every 28 days. Students can use media and online

- resources to find data that can be displayed graphically (pictures in a calendar, for example), which will allow them to describe the pattern of change that occurs in the appearance of the moon every four weeks.
- The position of the moon in the night sky: This daily, cyclical pattern of change can be directly observed, but students would have to make observations of the position of the moon in the sky at chosen intervals throughout the night, which is not recommended. Instead, students can use media and online resources to learn that the moon, like the sun, appears to rise in the eastern sky and set in the western sky every night.
- The position of the stars in the night sky: Because the position of the stars changes across the seasons, students will need to use media and online resources to learn about this pattern of change.

Whether students gather information and data from direct observations or from media and online sources, they should organize all data in graphical displays so that the data can be used to describe the patterns of change.

Example Activities

Gravity and Falling Objects: PBS Learning Media lesson where students investigate the force of gravity and how all objects, regardless of mass, fall to the ground at the same rate.

NASA's Solar System Exploration website contains several resources that educators and students can use to make sense of the night sky.

Our Super Star: PBS Learning Media lesson that guides students to understand the basic facts about the Sun, model the mechanics of day and night, and use solar energy to make a tasty treat.

Como Planetarium: Night and Day*:* *A third grade student finishes eating dinner, and then gets a phone call. The person on the phone says, "I just finished my breakfast, how was your dinner?" How can this be?*

Como Planetarium: The Sun's Path: The lesson begins with the guiding question: How far does the sun move between the time your bus arrives at school, and the time you eat your lunch? Using a panorama photo, students make predictions and then collect data about the position.

Emmy's Moon and Stars and Where Are The Stars?: This is a formative assessment probe designed to elicit student ideas about the relative positions of objects seen in the sky. Students observe a picture of a person viewing the night sky and wonder about the distance of the moon and stars.

How Big, How Far, How Hot, How Old?: Participants use provided images of earth and space objects to arrange them in order of their size, their distance from Earth, their temperature, and/or their age. Through this work students represent and confront their mental models of space.

Motion of the Sun Simulator: This interactive simulation provides a model of the sun's apparent motion from two different perspectives on a single applet: (1) a space based view, and (2) how a stick figure's shadow changes on Earth using a horizon diagram.

All About the Sun: Sun and Stars: This resource is a packet of supplementary curriculum materials for grades 2-4 developed by the Stanford SOLAR (Solar On-Line Activity Resources) Center in conjunction with NASA and the Learning Technologies Channel.

Journey North Mystery Class – Photoperiod: This resource provides methods for teaching students to calculate and graph photoperiod (amount of daylight) over time.

Journey North Mystery Class – What Makes Day and Night: This resource provides teaching suggestions with a slideshow and photo gallery (showing hourly movement) as well as an animation of Earth's rotation to develop understanding of day and night.

Kinesthetic Astronomy - Sky Time Lesson: Students construct a size-distance scale model for the sun, Earth, moon and stars. In addition, they use their bodies and movements to model the relationship between time and astronomical motions of Earth.

Resources

Next Generation Science Standards https://www.nextgenscience.org
Learning Center NSTA http://learningcenter.nsta.org
National Science Teacher Association http://nsta.org
Better Lesson www.betterlesson.com
Mosa Mack www.mosamack.com
PBS Learning https://nj.pbslearningmedia.org
PhET https://phet.colorado.edu
YouTube www.youtube.com

GRAVITY https://nj.pbslearningmedia.org/resource/phy03.sci.phys.mfe.lp_gravity/gravity-and-falling-objects/#.WOaK0IjytEZ

https://educators.brainpop.com/bp-jr-topic/gravity/

Connecting with English Language Arts/literacy and Mathematics

English Language Arts

Students should use information from print and digital sources to build their understanding of:

The Earth's gravitational force on objects.

The differences in the apparent brightness of the sun compared to that of other stars due to their relative distances from Earth.

Patterns of change that occur due to the position and motion of the Earth, sun, moon, and stars.

As students read and gather information from multiple sources, they should integrate and use the information to answer questions and support their thinking during discussions and in their writing.

- Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-PS2-1), (5-ESS1-1) RI.5.1
- Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1) RI.5.7
- Explain how an author uses reasons and evidence to support particular points in a text, identifying

which reasons and evidence support which point(s). (5-ESS1-1) RI.5.8
- Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1), (5-ESS1-1) RI.5.9
- Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1), (5-ESS1-1) W.5.1
- Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2) SL.5.5

Mathematics

Students reason abstractly and quantitatively when analyzing and using data as evidence to describe phenomena, including:

The Earth's gravitational force pulls objects "down" (toward the center of the Earth).

The differences in the apparent brightness of the stars are due to their relative distances from Earth.

Patterns of change, such as the day/night cycle, the change in length and direction of shadows during the day, the apparent motion of the sun across the daytime sky and the moon across the nighttime sky, the changes in the appearance of the moon over a period of four weeks, and the seasonal changes in the position of the stars in the night sky.

Students will model with mathematics as they graphically represent data collected from direct observations and from multiple resources throughout the unit, and as they describe relative distances of the sun and other stars from the Earth. Students might also express relative distances between the Earth and stars using numbers that can be expressed using powers of 10.
- Reason abstractly and quantitatively. (5-ESS1-1),(5-ESS1-2) MP.2
- Model with mathematics. (5-ESS1-1,(5-ESS1-2)) MP.4
- Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1) 5.NBT.A.2
- Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS1-2) 5.G.A.2

Modifications

Gifted and Talented
- Provide appropriate challenge for wide ranging skills and development areas.
- Participate in inquiry and project-based learning units of study.

English Language Learners
- Pair visual prompts with verbal presentations
- Provide students with visual models, sentence stems, concrete objects, and hands on materials.

Students with IEPs/504
- Review student individual educational plan and/or 504 plan

- Establish procedures for accommodations and modifications for assessments as per IEP/504
- Modify classroom environment to support academic and physical needs of the students as per IEP/504

At Risk Learners:

- Differentiated instruction
- Basic Skills
- Provide instructional interventions in the general education classroom

21st Century Skills and Career Education

9.2B3, 9.2B4
https://www.state.nj.us/education/cccs/2014/career/
CRP (2,3,4,5,7,8)
https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

Integration of Technology (*How will students integrate technology throughout the unit? How will students achieve the NJSLS*)

8.1.8.A.1,8.1.8.A.4,8.1.8.B.1,8.1.8.D.4,8.1.8.E.1,8.1.8.F.1
https://www.state.nj.us/education/cccs/2014/tech/

Pacing guide

Month	Estimated Time of Unit	Unit #	Theme/Content
September - November	9 Weeks	1	Structure, Properties, and Interactions of Matter
November – January	9 Weeks	2	Matter and Energy in Organisms and Ecosystems
February – April	9 Weeks	3	Earth's Systems
April - June	9 Weeks	4	Space Systems: Stars and the Solar System

Course Title: 5th Grade Science