GUTTENBERG PUBLIC SCHOOLS
GUTTENBERG, NEW JERSEY

ANNA L. KLEIN SCHOOL

A Great Place to Work and Learn

SCIENCE GRADE 1

Curriculum Guide
Date: September 2021

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Approved by the Guttenberg Board of Education
at the regular meeting held on December, 2021

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VISION STATEMENT

The Guttenberg Science Curriculum aims to provide students with experiences in which they are making sense of a phenomenon or solving a problem. This curriculum is also based on the idea of a *science storyline* (Reiser, Novak & McGill, 2017). A storyline is a coherent sequence of lessons in which each step is driven by students' questions that arise from their interactions with phenomena. At each step, students make progress on the classroom's questions through science and engineering practices to figure out a piece of a science idea. Each piece they figure out adds to the developing explanation, model, or designed solution. Each step may also generate questions that lead to the next step in the storyline. Together, what students figure out helps explain a unit's phenomena or solve the problems they have identified. This approach highlights two key instructional shifts in the Next Generation Science Standards that are typically absent from traditional science instruction; phenomena-based teaching and the importance of coherence.

MISSION STATEMENT

First grade is a full year, required course at Anna L. Klein School and is intended to prepare students for upper-elementary science courses. The course is offered in two formats, a standard format and a small group/resource format. While the elementary school science progression spans all three disciplinary domains, the grade 1 course presents the students with a truly integrated approach to science. Throughout the year, students will construct ideas in each of the three disciplinary domains: physical science, life science, and earth science. In grade 1, students begin by examining air and weather. The students then shift their attention to an examination of sound and light in everyday life. The curriculum culminates with a module that examines plants and animals. The objective for students is to demonstrate mastery of the course standards by meeting the performance expectations.

SCOPE AND SEQUENCE

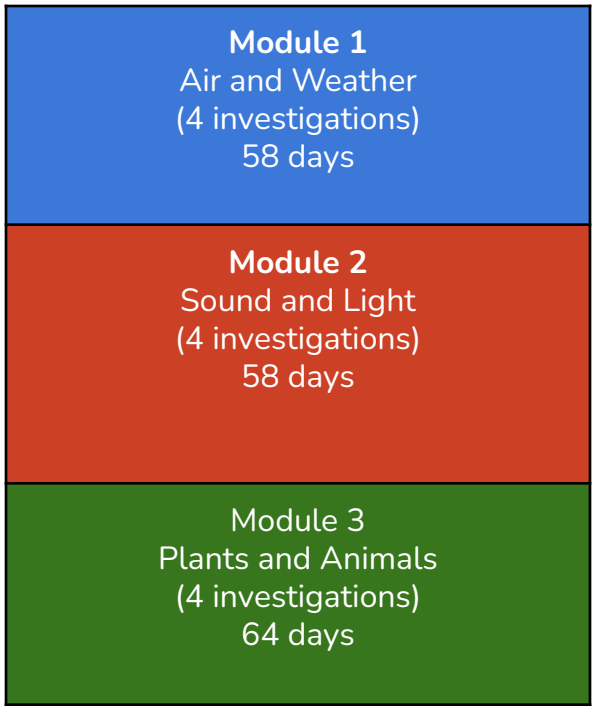
The Grade 1 Science Curriculum contains three modules adapted from FOSS (see below). Modules are broken down into smaller investigations. This is so that students can develop essential understandings in earth science, physical, and life science within a particular grade band and can continue to deepen these understandings across multiple grade bands.

Grade	Physical Science	Earth Science	Life Science
5	Mixtures and Solutions	Earth and Sun	Living Systems
4	Energy	Soils, Rocks, and Landforms	Environments
3	Motion and Matter	Water and Climate	Structures of Life
2	Solids and Liquids	Pebbles, Sand, and Silt	Insects and Plants
1	Sound and Light	Air and Weather	Plants and Animals
K	Materials and Motion	Trees and Weather	Animals Two by Two

Image: FOSS planning guide

PACING GUIDE

This curriculum is based on 180 days of school with each day being a 45 minute class period.



MODULE 1: AIR AND WEATHER

Grade 1

Trimester 1 - 58 days

Module Overview

In this module, students turn their focus upward to explore that objects in the sky change position in predictable ways. They explore the natural world by using simple instruments and calendars to observe and monitor change. They use new tools and methods to build on their understanding of the weather and to find out about properties of air by exploring how objects interact with air. They observe daily changes in air temperature and connect them to the daily movement of the Sun in the sky. They monitor changes in hours of daylight over seasons and changing weather conditions. And they find the Moon in the day and night skies and monitor its movement over the month.

Essential Questions

Investigation 1: Exploring Air

- Where is air and what can it do?
- What can air do?
- How does a parachute interact with air?
- What happens when air is pushed into a smaller space?
- How can water be used to show that air takes up space?
- How can compressed air be used to make a balloon rocket?

Investigation 2: Observing the Sky

- When you look up at the sky, what do you see, and how does it change?
- What is the weather today?
- What time of day is the air the warmest?
- What types of clouds are in the sky today?
- What time of day can we observe the Moon?

Investigation 3: Wind Explorations

- How do we observe and describe the wind?
- How can bubbles be used to observe the wind?
- How strong is the wind today?
- How can pinwheels be used to observe the wind?
- What does a wind vane tell us about the wind?
- What weather conditions are good for kite flying?

Investigation 4: HLooking for Change

- How do daylight and weather change through the seasons?
- How can we describe the weather over a month?
- What does the Moon look like at different times during a month?
- How does the amount of daylight change over the year?
- How does the temperature and weather change over the
- seasons?

MODULE 1: AIR AND WEATHER continued...

Instructional Strategies & Learning Activities

Some student activities include but are not limited to:

Investigation 1: Exploring Air

- Explore the phenomenon that air is matter and can push objects around.
- Explore vials, syringes, and tubing to experience air as matter, discovering that it takes up space and can be compressed, and that compressed air builds up pressure that can push objects around.
- Construct and compare parachutes and balloon rockets that use air.

Investigation 2: Observing the Sky

- Observe phenomena in the sky—weather and clouds, the Sun, and the Moon.
- Observe and record how the objects move, looking for patterns.
- Measure air temperature at different times of day, find out about sunrise and sunset, and record the number of daylight hours each day.
- Observe the movement of clouds in the sky.
- Find the Moon and begin to record its shape each day for a month.

Investigation 3: Wind Explorations

- Investigate the phenomenon of air in motion.
- Observe and describe wind speed using pinwheels, an anemometer, and a wind scale.
- Observe bubbles and construct wind vanes to find the wind's direction.
- Fly kites to feel the strength of the wind and the direction it is moving.

Investigation 4: Looking for Change

- Look for patterns in phenomena they observe over time—Moon phase, amount of daylight, and weather conditions.
- Organize monthly weather data, using graphs to describe weather trends.
- Continue to monitor weather throughout the year, comparing the seasons and looking for weather patterns.
- Use the observations they have recorded on the calendar to look for monthly patterns of the Moon and annual patterns of daylight hours.

Three Dimensional Learning

In this module, students build core understandings while using science and engineering practices and crosscutting concepts. The focal DCIs, SEPs, and CCCs include:

Disciplinary Core Ideas (DCIs)	ESS1.A; ESS1.B; ESS2.D; ESS3.A; PS1.A; ETS1.A; ETS1.B; ETS1.C; ETS2.A; ETS2.B
Science & Engineering Practices (SEPs)	Asking questions and defining problems; Developing and using models; Planning and carrying out investigations; Analyzing and interpreting data; Using mathematics and computational thinking; Constructing explanations and designing solutions; Obtaining, evaluating, and communicating information
Crosscutting Concepts (CCCs)	Patterns; Cause and Effect; Scale, Proportion, and Quantity; Systems & System Models; Structure and Function; Stability and Change

MODULE 1: AIR AND WEATHER continued...

Enduring Understandings

This unit expands students' understanding of Earth's landscapes. These grade K-2 DCI elements include:

ESS1.A: The universe and its stars

- What is the universe, and what goes on in stars? [Patterns of the motion of the Sun, Moon, and stars in the sky can be observed, described, and predicted. At night one can see the light coming from many stars with the naked eye, but telescopes make it possible to see many more and to observe them and the Moon and planets in greater detail.]

ESS1.B: Earth and the solar system

What are the predictable patterns caused by Earth's movement in the solar system? [Seasonal patterns of sunrise and sunset can be observed, described, and predicted.]

ESS2.D: Weather and climate

- What regulates 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.]

• **ESS3.A: Natural resources**

- How do humans depend on Earth's resources? [Living things need water, air, and resources from the land, and they try to live in places that have the things they need. Humans use natural resources for everything they do: for example, they use soil and water to grow food, wood to burn to provide heat or to build shelters, and materials such as iron or copper extracted from Earth to make cooking pans.]

PS1.A: Structure and properties of matter

- How do particles combine to form the variety of matter one observes? [Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties, by its uses, and by whether it occurs naturally or is manufactured.]

ETS1.A: Defining and delimiting an engineering problem

- What is a design for? What are the criteria and constraints of a successful solution? [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. 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.]

ETS1.B: Developing possible solutions

- What is the process for developing potential design 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. To design something complicated, one may need to break the problem into parts and attend to each part separately but must then bring the parts together to test the overall plan.]

ETS1.C: Optimizing the design solution

- How can the various proposed design solutions be compared and improved? [Because there is always more than one possible solution to a problem, it is useful to compare designs, test them, and discuss their strengths and weaknesses.]

Assessments

Opportunities for **formative assessments** include but are not limited to:

- Science Notebook entries
- Answers to Focus Questions
- Performance Assessment Checklists (to track progress on SEPs, CCCs, and DCIs)
- I-Checks ("I check my own understanding..")

Opportunities for **summative assessment** include but are not limited to:

- I-Checks ("I check my own understanding..")

Opportunities to gather **benchmark data** (Fall/Winter/Spring)include but are not limited to:

- Specific I-Checks ("I check my own understanding..")
- Scientific Models
- Scientific explanations

Opportunities for **alternate assessments** include but are not limited to:

- Student Portfolios
- Teacher/student conference
- Keynote presentations made by student on a topic
- Storyboard of science processes
- Student created podcast or screencast in lieu of written explanations
- Student access to course materials and teacher guidance/prompting while completing assessment
- Collaborative assessment
- Student created summary sheets, concepts maps, or checklist of key science ideas

MODULE 1: AIR AND WEATHER continued...

New Jersey Student Learning Standards

Connections to NJSLS – Science

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 the year to relate the amount of daylight to the time of year.

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.

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.

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties**.**

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.

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.

Interdisciplinary Connections

Connections to NJSLS – Mathematics

MP.2 Reason abstractly and quantitatively. (1-ESS1-2), (K-ESS2-1)

MP.4 Model with mathematics. (1-ESS1-2), (K-ESS2-1), (2-PS1-1)

MP.5 Use appropriate tools strategically. (1-ESS1-2)

K.CC.A Know number names and the count sequence. (K-ESS2-1) • K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1)

K.MD.B.3 Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1)

1.OA.A.1 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.MD.C.4 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)

2.MD.D.10 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)

Connections to NJSLS – English Language Arts

W.1.7 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), (K-ESS2-1)

W.1.8 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.K.2 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-ESS3- 3)

W.2.6 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.2.7 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)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1), (K-2-ETS1-1), (K-2-ETS1-3)

RI.2.1 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)

SL.2.5 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)

Career Readiness, Life Literacies, and Key Skills

Connections to NJSLS –Career Readiness, Life Literacies, and Key Skills

9.4.2.CI.1: Demonstrate openness to new ideas and perspectives.

9.4.2.CI.2: Demonstrate originality and inventiveness in work.

9.4.2.CT.2: Identify possible approaches and resources to execute a plan.

9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).

9.4.2.IML.2: Represent data in a visual format to tell a story about the data

Technology

Connections to NJSLS –Technology

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

8.2.2.C.1 Brainstorm ideas on how to solve a problem or build a product.

8.2.2.C.2 Create a drawing of a product or device that communicates its function to peers and discuss.

8.2.2.A.3 Identify a system and the components that work together to accomplish its purpose.

8.2.2.A.4 Choose a product to make and plan the tools and materials needed

MODULE 1: AIR AND WEATHER continued...

SEL Competencies

Opportunities exist within the curricular unit to help students develop the following social and emotional competencies and sub-competencies. Examples include but are not limited to:

Self-awareness

- *Recognize one's own thoughts and feelings.* Allow students to capture their thoughts and feelings about the anchor phenomenon by asking questions, engaging in class discussion, and/or creating initial models. Allow students to brainstorm related phenomena as appropriate.

Self-management

- *Understand and practice strategies for managing one's own emotions, thoughts, and behaviors.* Allow students to use productive talk moves and sentence stems while engaging in class discussions.
- *Recognize the skills needed to establish and achieve personal and educational goals.* Allow students to review their science notebooks (specifically focus questions) and reflect upon what they have figured out and what still needs to be addressed to improve understanding.

Social awareness

- *Demonstrate an understanding of the need for mutual respect when viewpoints differ.* Encourage and model the use of productive talk moves when arguing from evidence with peers or when having class discussions. Allow students to practice providing constructive feedback when reviewing peers' work, creating consensus (class) models, or doing a gallery walk of models/explanations.
- *Demonstrate an awareness of the expectations for social interactions in a variety of settings.* Before beginning an investigation, determine the roles and responsibilities of each team member. Address and discuss behavioral expectations while working with science materials.

Responsible decision making

- *Develop, implement, and model effective problem-solving and critical thinking skills*. Have students reflect upon (in real time) the SEL skill they are using during an activity. Reflection prompts include: *What did you notice when...?, How did [SEL skill] contribute to your success with...?, How could [student]'s idea be incorporated?*

Relationship skills

- *Utilize positive communication and social skills to interact effectively with others*. Students should agree upon a set of class norms that can guide their daily activity. Have students periodically reflect upon how well they implement and use the norms when engaging in their daily work.

LGBTQIA+

In accordance with the Inclusive Curriculum Bill A1335, signed into law in NJ in 2020, this curriculum includes instruction, and instructional materials, that accurately portray political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people. This curricular document includes classroom materials that are in alignment with NJSLS and ensures that students receive diverse instruction in history, the social sciences, and other content areas, which cultivates respect towards minority groups, allows students to appreciate differences, and acquires the skills and knowledge needed to function effectively with people of various backgrounds.

Specifically, the FOSS lessons referenced in this curricular document make diversity visible in the following ways:

- Instructional materials acknowledge the specific contributions of members from multiple communities..
- Instructional materials include and highlight the efforts of scientists of all gender identities.
- Phenomena, settings, or examples are not solely centered on the activities/interests of the dominant U.S. culture, but incorporate other context and settings.
- Instructional materials recognize that all learners belong to multiple cultural communities that share different practices, purposes, ways of interacting, and approaches to conceptualizing and engaging with the world.
- Instructional materials avoid essentializing the activities and qualities of cultural groups and actively work against narrow and uniform (formulaic) ways that science is conducted (for example, by highlighting different forms of argumentation and explanation).

Accommodations

Special Education Students

Accommodations will be made in accordance with IEPs.

- Provide copy of class notes
- Color code important information
- Shorten assignments to focus on mastery
- Give alternatives to complete written assignments
- Keep workspaces clear of unrelated materials
- Provide a computer for written work
- Seat the student close to the teacher or role model
- Keep classroom materials (pencils, books) on hand
- Give directions in small steps and in as few words
- Number and sequence the steps of a task
- Show examples of end products
- Model and teach active reading strategies
- Repeat, clarify, and/or reword directions
- Ensure completion and accuracy of one part of a task before moving onto the next part
- Include brainstorm as a pre-activity before writing

Students with 504 Plans

- Use preferential seating as needed
- Allow frequent breaks
- Modify learning schedule and deadlines
- Extended time on assignments and/or assessments
- Reduce homework or classwork as needed
- Use verbal, visual, or technology
- Implement a behavior management support
- Excuse lateness, absence, or missed classwork
- Approve guidance/nurse's office visits
- Use refocus and redirect strategies as needed

Gifted and Talented Students

- Offer student choice for process, product, and/or product
- Employ curriculum compacting as appropriate
- Incorporate career based learning into lessons
- Allow for flexible grouping based on interest, inventory, and/or proficiency
- Incorporate tiered learning into lessons
- Encourage student-created rubrics & checklist to assess work
- Encourage risk taking
- Offer a variety of resources (text, audio, online) based on interest, inventory, and/or proficiency
- Allow for self-directed learning and for student creation of learning plan/goals
- Allow for exploration of related phenomena as appropriate
- Include opportunities for students to extend their thinking when writing or discussing content
- Offer alternative perspectives as appropriate

Students at Risk of Failure

- Have students restate information
- Provide notes or outlines of key concepts
- Assistance in maintaining uncluttered space
- Use home-school communication tools (notebook, daily log, phone calls, or email messages)
- Peer or scribe note-taking
- Use of manipulatives
- Follow a routine/schedule
- Teach time management skills
- Verbal/visual cues regarding directions and staying on task
- Adjusted assignment timelines
- Visual daily schedule
- Immediate feedback
- Work-in-progress check
- Pace and/or chunk long-term projects
- Film or video supplements in place of reading text
- Cue/model expected behavior
- Use deescalating strategies
- Use peer supports and mentoring

Multilingual Learners

- Provide materials in student's native language
- Offer the use of a translator (as needed)
- Use word walls to develop science vocabulary
- Provide sentence starters for written and oral work
- Provide numerous opportunities to make ideas public through linguistic and non-linguistic modes of communication (i.e. explanations, scientist circle discussions, pictures, drawings, models, graphs)
- Intentionally group multilinguals with those peers who speak the same language or whose language is more developed
- Allow multilinguals to express their noticings through physical actions and/or by using representations
- Use cognates (words similar in spelling and meaning between languages) to make connections between science vocabulary and native language
- Preview/pause to discuss technical terms
- Allow representation of new terms in multiple ways: 1) write the term 2) draw the term 3) use one's own words to write the meaning of the term, or 4) use the new term in a sentence.
- Before whole-class discussions, provide multilinguals with the opportunity to work with others--either in pairs, triads, or small groups--on ideas related to their reasoning
- Use letter coding, number coding, and/or color coding when discussing parts of a model and/or system
- Encourage multilinguals to share experiences (related phenomena) when discussing the anchor phenomenon
- Use analogies to explain more complicated concepts

MODULE 1: AIR AND WEATHER continued...

Resources & Technology

The following is a list of some resources and technology to support and/or enhance the unit.

FOSS Materials

- https://www.fossweb.com/home - Use teacher login to access FOSS Dashboard and grade level materials.

Supplemental Instructional Materials

- http://phet.colorado.edu - This is a simulation site that includes lessons and resources that follows the NGSS framework.
- https://mysteryscience.com/ - Open and go lessons for K-5 that align to NGSS standards.
- https://www.brainpop.com/ - Access grade level videos on various science topics.
- https://www.sciencefriday.com/educate/ - Access STEM activities, lessons, and resources for K-12 learners in all science domains.
- https://thewonderofscience.com/ - The Wonder of Science was created to support the next generation of science teachers. The website aggregates resources developed by Paul Andersen and other science teachers implementing the Next Generation Science Standards.
- http://stemteachingtools.org/about - This site includes highly usable tools to support STEM teaching. The tools are authored and reviewed by teachers and researchers, so each one leverages knowledge from practice and from research to inform how to teach STEM subjects.
- https://www.generationgenius.com - Use this site for educational videos, lessons, and resources aligned to NGSS standards.
- https://ngss.nsta.org/ - NSTA provides classroom resources and a plethora of lesson ideas that can be incorporated into the curriculum
- https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/ - Nature Lab is the youth curriculum platform from Nature Conservancy
- https://sciencebob.com/category/experiments/ - Find science experiments to enhance or extend lessons.
- https://www.weareteachers.com/easy-science-experiments/ - Easy science experiments using household materials or as an at-home extension.
- https://www.teachengineering.org/ - STEM curriculum K-12
- https://www.sciencefun.org/kidszone/experiments/ - Find science experiments to enhance or extend lessons.
- https://www.exploratorium.edu/education/teaching-resources - Teaching and learning tools with lessons, activities, and more.
- https://scitoys.com/ - Make toys at home with common household materials, often in only a few minutes, that demonstrate fascinating scientific principles.

Supplemental Assessment Materials

- http://assessment.aaas.org/ - Use this resource for supplemental assessment questions and to consider misconceptions that students may have as it relates to particular content.
- https://snapgse.stanford.edu/ - The Stanford NGSS Assessment Project (SNAP) is focusing on ways that high-quality performance assessment can support the implementation process.
- https://thewonderofscience.com/draft-assessment/ - Use this site to find example performance assessments created by Paul Andersen and other science teachers implementing the NGSS.
- https://ngss-assessment.portal.concord.org/middle-school - Find middle grades performances tasks developed through a collaborative effort of University of Illinois at Chicago, Michigan State University, WestEd, and the Concord Consortium

MODULE 2: SOUND AND LIGHT

Grade 1

Trimester 2 - 58 days

Module Overview

In this module, students develop an understanding of how to observe and manipulate the phenomena of sound and light using simple tools and musical instruments. They learn that sound comes from vibrating objects, has volume and pitch, and develop simple models for how sound travels. With light, students find out what happens when materials with different properties are placed in a beam of light, and explore how to create and change shadows and reflections. Students explore how to use sound and light devices to communicate information and compare the ways that animals use their senses (ears and eyes) to gather information about their environment.

Essential Questions

Investigation 1: Sound and Vibrations

- What is sound?
- What causes sound?
- What kinds of sounds are easy to identify?
- What information does sound give us?

Investigation 2: Changing Sound

- How can we change the properties of sound?
- How can we make loud and soft sounds?
- How can we make low-pitched and high-pitched sounds?
- How does sound travel from the source to the receiver?
- How can we use sound to communicate over long distances?

Investigation 3: Light and Shadows

- What is shadow?
- What makes a shadow?
- How can we use the Sun to create shadows?
- What happens when different materials block light?

Investigation 4: Light and Mirrors

- How does light travel and change direction?
- How do animals (including humans) use light?
- How can we redirect a light beam?
- What can we see with a mirror?
- What can be seen with no light?
- How can we communicate with light?

MODULE 2: SOUND AND LIGHT continued...

Instructional Strategies & Learning Activities

Some student activities include but are not limited to:

Investigation 1: Sound and Vibrations

- Observe the phenomenon of sound using a table fiddle, tuning forks, a tone generator, cups, sticks, and rubber bands.
- Look for vibrations at the sound source and come up with words to describe different sounds.
- Explore how to discriminate between different kinds of sounds and what information sounds convey.
- Find out about sounds that different animals make.

Investigation 2: Changing Sound

- Use simple instruments (xylophone, one-string guitar) to investigate how to change the volume of sound (loud and soft) and the pitch of sound (high and low).
- Develop a model to explain the phenomenon of sound traveling from a source to a receiver.
- Redesign the spoon gong to make a device to both send and receive sound.
- Gain knowledge about sound receivers used by different animals.

Investigation 3: Light and Shadows

- Use flashlights, sunlight, and solid materials that block light to explore the phenomena of light and shadows.
- Create and change shadows and investigate how light interacts with objects that are transparent, translucent, and opaque.

Investigation 4: Light and Mirrors

- Explore the phenomenon of light travel by positioning mirrors to reflect images so they can see their own eyes and view objects behind them.
- Investigate how to use one and two mirrors to direct light to different locations.
- Experience the phenomenon that objects can be seen only when light is available.
- Explore the shapes and location of eyes on different animals.
- Read about devices that use light to communicate information.

Three Dimensional Learning

In this module, students build core understandings while using science and engineering practices and crosscutting concepts. The focal DCIs, SEPs, and CCCs include:

Disciplinary Core Ideas (DCIs)	PS4.A; PS4.B; PS4.C; LS1.D; ETS1.A; ETS1.B; ETS1.C; ETS2.A; ETS2.B
Science & Engineering Practices (SEPs)	Asking questions and defining problems; Developing and using models; Planning and carrying out investigations; Analyzing and interpreting data; Using mathematics and computational thinking; Constructing explanations and designing solutions; Obtaining, evaluating, and communicating information
Crosscutting Concepts (CCCs)	Patterns; Cause and Effect; Scale, Systems & System Models

MODULE 2: SOUND AND LIGHT continued...

Enduring Understandings

This unit expands students' understanding of energy. These grade K-2 DCI elements include:

PS4.A: Wave properties

- What are the characteristic properties and behaviors of waves? [Sound can make matter vibrate, and vibrating matter can make sound.]

PS4.B: Electromagnetic radiation What is light?

- How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there? [Objects can be seen only when light is available to illuminate them. Very hot objects give off light (e.g., a fire, the Sun). 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 (i.e., on the other side from the light source), where the light cannot reach. Mirrors and prisms can be used to redirect a light beam. Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.]

PS4.C: Information technologies and instrumentation

- How are instruments that transmit and detect waves used to extend human senses? [People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch. People also use a variety of devices to communicate (send and receive information) over long distances.]

LS1.D: Information processing

- How do organisms detect, process, and use information about the environment? [Animals have body parts that capture and convey different kinds of information needed for growth and survival—for example, eyes for light, ears for sounds, and skin for temperature or touch. Animals respond to these inputs with behaviors that help them survive (e.g., find food, run from a predator).]

ETS1.A: Defining and delimiting an engineering problem

- What is a design for? What are the criteria and constraints of a successful solution? [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. 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.]

ETS1.B: Developing possible solutions

- What is the process for developing potential design 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. To design something complicated, one may need to break the problem into parts and attend to each part separately but must then bring the parts together to test the overall plan.]

ETS1.C: Optimizing the design solution

- How can the various proposed design solutions be compared and improved? [Because there is always more than one possible solution to a problem, it is useful to compare designs, test them, and discuss their strengths and weaknesses.]

ETS2.A: Interdependence of science, engineering, and technology

- What are the relationships among science, engineering, and technology? [People encounter questions about the natural world every day. There are many types of tools produced by engineering that can be used in science to help answer these questions through observation or measurement. Observations and measurements are also used in engineering to help test and refine design ideas.]

ETS2.B: Influence of engineering, technology, and science on society and the natural world

- How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world? [People depend on various technologies in their lives; human life would be very different without technology. Every human-made product is designed by applying some knowledge of the natural world and is built by using materials derived from the natural world, even when the materials are not themselves natural—for example, spoons made from refined metals. Thus, developing and using technology has impacts on the natural world.]

Assessments

Opportunities for **formative assessments** include but are not limited to:

- Science Notebook entries
- Answers to Focus Questions
- Performance Assessment Checklists (to track progress on SEPs, CCCs, and DCIs)
- I-Checks (“I check my own understanding..”)

Opportunities for **summative assessment** include but are not limited to:

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Opportunities to gather **benchmark data** (Fall/Winter/Spring)include but are not limited to:

- Specific I-Checks (“I check my own understanding..”)
- Scientific Models
- Scientific explanations

Opportunities for **alternate assessments** include but are not limited to:

- Student Portfolios
- Teacher/student conference
- Keynote presentations made by student on a topic
- Storyboard of science processes
- Student created podcast or screencast in lieu of written explanations
- Student access to course materials and teacher guidance/prompting while completing assessment
- Collaborative assessment
- Student created summary sheets, concepts maps, or checklist of key science ideas

MODULE 2: SOUND AND LIGHT continued...

New Jersey Student Learning Standards

Connections to NJSLS – Science

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.

1-PS4-3. Plan and conduct an investigation 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.

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-ETS1-1: 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.

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.

Interdisciplinary Connections

Connections to NJSLS – Mathematics

MP.2 Reason abstractly and quantitatively. (K-2-ETS1-1), (K-2-ETS1-3)

MP.4 Model with mathematics. (K-2-ETS1-1), (K-2-ETS1-3)

MP.5 Use appropriate tools strategically. (K-2-ETS1-1), (K-2-ETS1-3)

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1- PS4-4)

1.MD.A.2 Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. (1-PS4-4)

2.MD.D.10 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)

Connections to NJSLS – English Language Arts

W.1.2 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.1.7 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), (1-PS4- 4), (1-LS1-1)

W.1.8 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)

SL.1.1 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)

RI.2.1 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)

W.2.6 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.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1), (K-2-ETS1-3)

SL.2.5 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)

Career Readiness, Life Literacies, and Key Skills

Connections to NJSLS –Career Readiness, Life Literacies, and Key Skills

9.4.2.CI.1: Demonstrate openness to new ideas and perspectives.

9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a)

9.4.2.CT.2: Identify possible approaches and resources to execute a plan.

9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).

9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10)

9.4.2.TL.1: Identify the basic features of a digital tool and explain the purpose of the tool.

Technology

Connections to NJSLS –Technology

8.2.2.D.1 Collaborate and apply a design process to solve a simple problem from everyday experiences.

8.2.2.C.5 Describe how the parts of a common toy or tool interact and work as part of a system.

8.2.2.D.4 Identify the resources needed to create technological products or systems.

MODULE 2: SOUND AND LIGHT continued...

SEL Competencies

Opportunities exist within the curricular unit to help students develop the following social and emotional competencies and sub-competencies. Examples include but are not limited to:

Self-awareness

- *Recognize one's own thoughts and feelings.* Allow students to capture their thoughts and feelings about the anchor phenomenon by asking questions, engaging in class discussion, and/or creating initial models. Allow students to brainstorm related phenomena as appropriate.

Self-management

- *Understand and practice strategies for managing one's own emotions, thoughts, and behaviors.* Allow students to use productive talk moves and sentence stems while engaging in class discussions.
- *Recognize the skills needed to establish and achieve personal and educational goals.* Allow students to review their science notebooks (specifically focus questions) and reflect upon what they have figured out and what still needs to be addressed to improve understanding.

Social awareness

- *Demonstrate an understanding of the need for mutual respect when viewpoints differ.* Encourage and model the use of productive talk moves when arguing from evidence with peers or when having class discussions. Allow students to practice providing constructive feedback when reviewing peers' work, creating consensus (class) models, or doing a gallery walk of models/explanations.
- *Demonstrate an awareness of the expectations for social interactions in a variety of settings.* Before beginning an investigation, determine the roles and responsibilities of each team member. Address and discuss behavioral expectations while working with science materials.

Responsible decision making

- *Develop, implement, and model effective problem-solving and critical thinking skills*. Have students reflect upon (in real time) the SEL skill they are using during an activity. Reflection prompts include: *What did you notice when...?, How did [SEL skill] contribute to your success with...?, How could [student]'s idea be incorporated?*

Relationship skills

- *Utilize positive communication and social skills to interact effectively with others*. Students should agree upon a set of class norms that can guide their daily activity. Have students periodically reflect upon how well they implement and use the norms when engaging in their daily work.

LGBTQIA+

In accordance with the Inclusive Curriculum Bill A1335, signed into law in NJ in 2020, this curriculum includes instruction, and instructional materials, that accurately portray political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people. This curricular document includes classroom materials that are in alignment with NJSLS and ensures that students receive diverse instruction in history, the social sciences, and other content areas, which cultivates respect towards minority groups, allows students to appreciate differences, and acquires the skills and knowledge needed to function effectively with people of various backgrounds.

Specifically, the FOSS lessons referenced in this curricular document make diversity visible in the following ways:

- Instructional materials acknowledge the specific contributions of members from multiple communities..
- Instructional materials include and highlight the efforts of scientists of all gender identities.
- Phenomena, settings, or examples are not solely centered on the activities/interests of the dominant U.S. culture, but incorporate other context and settings.
- Instructional materials recognize that all learners belong to multiple cultural communities that share different practices, purposes, ways of interacting, and approaches to conceptualizing and engaging with the world.
- Instructional materials avoid essentializing the activities and qualities of cultural groups and actively work against narrow and uniform (formulaic) ways that science is conducted (for example, by highlighting different forms of argumentation and explanation).

MODULE 2: SOUND AND LIGHT continued...

Accommodations

Special Education Students

Accommodations will be made in accordance with IEPs.

- Provide copy of class notes
- Color code important information
- Shorten assignments to focus on mastery
- Give alternatives to complete written assignments
- Keep workspaces clear of unrelated materials
- Provide a computer for written work
- Seat the student close to the teacher or role model
- Keep classroom materials (pencils, books) on hand
- Give directions in small steps and in as few words
- Number and sequence the steps of a task
- Show examples of end products
- Model and teach active reading strategies
- Repeat, clarify, and/or reword directions
- Ensure completion and accuracy of one part of a task before moving onto the next part
- Include brainstorm as a pre-activity before writing

Students with 504 Plans

- Use preferential seating as needed
- Allow frequent breaks
- Modify learning schedule and deadlines
- Extended time on assignments and/or assessments
- Reduce homework or classwork as needed
- Use verbal, visual, or technology
- Implement a behavior management support
- Excuse lateness, absence, or missed classwork
- Approve guidance/nurse's office visits
- Use refocus and redirect strategies as needed

Gifted and Talented Students

- Offer student choice for process, product, and/or product
- Employ curriculum compacting as appropriate
- Incorporate career based learning into lessons
- Allow for flexible grouping based on interest, inventory, and/or proficiency
- Incorporate tiered learning into lessons
- Encourage student-created rubrics & checklist to assess work
- Encourage risk taking
- Offer a variety of resources (text, audio, online) based on interest, inventory, and/or proficiency
- Allow for self-directed learning and for student creation of learning plan/goals
- Allow for exploration of related phenomena as appropriate
- Include opportunities for students to extend their thinking when writing or discussing content
- Offer alternative perspectives as appropriate

Students at Risk of Failure

- Have students restate information
- Provide notes or outlines of key concepts
- Assistance in maintaining uncluttered space
- Use home-school communication tools (notebook, daily log, phone calls, or email messages)
- Peer or scribe note-taking
- Use of manipulatives
- Follow a routine/schedule
- Teach time management skills
- Verbal/visual cues regarding directions and staying on task
- Adjusted assignment timelines
- Visual daily schedule
- Immediate feedback
- Work-in-progress check
- Pace and/or chunk long-term projects
- Film or video supplements in place of reading text
- Cue/model expected behavior
- Use deescalating strategies
- Use peer supports and mentoring

Multilingual Learners

- Provide materials in student's native language
- Offer the use of a translator (as needed)
- Use word walls to develop science vocabulary
- Provide sentence starters for written and oral work
- Provide numerous opportunities to make ideas public through linguistic and non-linguistic modes of communication (i.e. explanations, scientist circle discussions, pictures, drawings, models, graphs)
- Intentionally group multilinguals with those peers who speak the same language or whose language is more developed
- Allow multilinguals to express their noticings through physical actions and/or by using representations
- Use cognates (words similar in spelling and meaning between languages) to make connections between science vocabulary and native language
- Preview/pause to discuss technical terms
- Allow representation of new terms in multiple ways: 1) write the term 2) draw the term 3) use one's own words to write the meaning of the term, or 4) use the new term in a sentence.
- Before whole-class discussions, provide multilinguals with the opportunity to work with others--either in pairs, triads, or small groups--on ideas related to their reasoning
- Use letter coding, number coding, and/or color coding when discussing parts of a model and/or system
- Encourage multilinguals to share experiences (related phenomena) when discussing the anchor phenomenon
- Use analogies to explain more complicated concepts

MODULE 2: SOUND AND LIGHT continued...

Resources & Technology

The following is a list of some resources and technology to support and/or enhance the unit.

FOSS Materials

- https://www.fossweb.com/home - Use teacher login to access FOSS Dashboard and grade level materials.

Supplemental Instructional Materials

- http://phet.colorado.edu - This is a simulation site that includes lessons and resources that follows the NGSS framework.
- https://mysteryscience.com/ - Open and go lessons for K-5 that align to NGSS standards.
- https://www.brainpop.com/ - Access grade level videos on various science topics.
- https://www.sciencefriday.com/educate/ - Access STEM activities, lessons, and resources for K-12 learners in all science domains.
- https://thewonderofscience.com/ - The Wonder of Science was created to support the next generation of science teachers. The website aggregates resources developed by Paul Andersen and other science teachers implementing the Next Generation Science Standards.
- http://stemteachingtools.org/about - This site includes highly usable tools to support STEM teaching. The tools are authored and reviewed by teachers and researchers, so each one leverages knowledge from practice and from research to inform how to teach STEM subjects.
- https://www.generationgenius.com - Use this site for educational videos, lessons, and resources aligned to NGSS standards.
- https://ngss.nsta.org/ - NSTA provides classroom resources and a plethora of lesson ideas that can be incorporated into the curriculum
- https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/ - Nature Lab is the youth curriculum platform from Nature Conservancy
- https://sciencebob.com/category/experiments/ - Find science experiments to enhance or extend lessons.
- https://www.weareteachers.com/easy-science-experiments/ - Easy science experiments using household materials or as an at-home extension.
- https://www.teachengineering.org/ - STEM curriculum K-12
- https://www.sciencefun.org/kidszone/experiments/ - Find science experiments to enhance or extend lessons.
- https://www.exploratorium.edu/education/teaching-resources - Teaching and learning tools with lessons, activities, and more.
- https://scitoys.com/ - Make toys at home with common household materials, often in only a few minutes, that demonstrate fascinating scientific principles.

Supplemental Assessment Materials

- http://assessment.aaas.org/ - Use this resource for supplemental assessment questions and to consider misconceptions that students may have as it relates to particular content.
- https://snapgse.stanford.edu/ - The Stanford NGSS Assessment Project (SNAP) is focusing on ways that high-quality performance assessment can support the implementation process.
- https://thewonderofscience.com/draft-assessment/ - Use this site to find example performance assessments created by Paul Andersen and other science teachers implementing the NGSS.
- https://ngss-assessment.portal.concord.org/middle-school - Find middle grades performances tasks developed through a collaborative effort of University of Illinois at Chicago, Michigan State University, WestEd, and the Concord Consortium

MODULE 3: PLANTS AND ANIMALS

Grade 1

Trimester 3 - 65 days

Module Overview

In this module, students observe firsthand the structures of plants and discover ways to propagate new plants from mature plants (from seeds, bulbs, roots, and stem cuttings). They observe and describe changes that occur as young plants grow, and compare classroom plants to those in the schoolyard. They design terrariums (habitat systems) and provide for the needs of both plants and animals living together in the classroom. They explore variation in the same kind of organism, including variation between young and adults, and find out about the behaviors of parents to help their offspring survive. They explore structure and function relationships as they sort different kinds of animal and plant structures, including animal sensory structures.

Essential Questions

Investigation 1: Grass and Grain Seeds

- What are the structures of a young plant growing from a seed?
- What happens to ryegrass and alfalfa seeds in moist soil?
- What happens to the grass and alfalfa plants after we mow them?
- How does a wheat seed grow?
- How many different kinds of plants live in an area of the schoolyard?

Investigation 2: Stems

- Where can new plants come from besides seeds?
- How can we make a new plant from an old one?
- What grows from the nodes of a potato?
- How do we keep our cuttings alive?

Investigation 3: Terrariums

- How do plants and animals survive in their habitat?
- What do plants need to live and grow in a terrarium?
- What do animals need to live in a terrarium?
- What structures or behaviors do plants or animals have that help them live in their habitat?
- How do the behaviors of squirrels help them survive the winter?

Investigation 4: Growth and Change

- What do offspring get from their parents that help young survive?
- How does a bulb grow?
- What parts of the parent plant can grow new plants?
- How do the plants in the schoolyard compare to the plants studied in class?
- What do animal parents do to help their young survive?

MODULE 3: PLANTS AND ANIMALS continued...

Instructional Strategies & Learning Activities

Some student activities include but are not limited to:

Investigation 1: Grass and Grain Seeds

- Engage with the phenomenon of plant growth from seeds.
- Plant miniature lawns with ryegrass and alfalfa.
- Mow the lawns and observe the phenomenon of how grass and alfalfa respond to cutting.
- Plant individual wheat seeds in clear straws and observe early growth of plants, as well as variation in the growth of the same kind of seed.
- Conduct a schoolyard plant hunt and continue to look for variation.
- Observe variation in kinds of animals and individuals of the same kind.

Investigation 2: Stems

- Observe and describe the phenomenon of making new plants from stems of houseplants.
- Look for evidence that a new plant is forming.
- Plant pieces of potatoes (modified stems) and observe them grow.

Investigation 3: Terrariums

- Set up terrariums using seeds and plants from Investigations 1 and 2.
- Add local animals such as snails and isopods, provide for the needs of the organisms, and observe the phenomena of interactions.
- Gain knowledge about other organisms through media and compare and sort structures and functions.
- Engage with and describe the phenomena of variations in how squirrels store food for winter survival.
- Engage with ways that engineers learn from nature to solve human problems.

Investigation 4: Growth and Change

- Students plant bulbs in moist cotton and observe and describe the phenomenon of young plant development.
- Plant parts of roots—carrots and radishes—to discover which parts will develop into new plants and compare young to parent plants.
- Adopt a schoolyard plant and compare it to other plants.
- Use media to learn about how behaviors of animals help their young to survive.
- Describe the phenomenon of how young organisms resemble their parents.

Three Dimensional Learning

In this module, students build core understandings while using science and engineering practices and crosscutting concepts. The focal DCIs, SEPs, and CCCs include:

Disciplinary Core Ideas (DCIs)	LS1.A; LS1.B; LS1.D; LS3.A; LS3.B; ETS1.A; ETS1.B; ETS1.C; ETS2.A; ETS2.B
Science & Engineering Practices (SEPs)	Asking questions and defining problems; Developing and using models; Planning and carrying out investigations; Analyzing and interpreting data; Using mathematics and computational thinking; Constructing explanations and designing solutions; Engaging in argument from evidence; Obtaining, evaluating, and communicating information
Crosscutting Concepts (CCCs)	Patterns; Cause and Effect; Systems & System Models; Structure and Function

MODULE 3: PLANTS AND ANIMALS continued...

Enduring Understandings

This unit expands students' understanding of energy. These grade K-2 DCI elements include:

LS1.A: Structure and function

- How do the structures of organisms enable life's functions? [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 see, find, and take in food, water, and air. Plants also have different parts that help them survive, grow, and produce more plants.]

LS1.B: Growth and development of organisms

- How do organisms grow and develop? [Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. 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.]

LS1.D: Information processing

- How do organisms detect, process, and use information about the environment? [Animals have body parts that capture and convey different kinds of information needed for growth and survival—for example, eyes for light, ears for sounds, and skin for temperature or touch. Animals respond to these inputs with behaviors that help them survive (e.g., find food, run from a predator). Plants also respond to some external inputs (e.g., turn leaves toward the Sun).]

LS3.A: Inheritance of traits

- How are the characteristics of one generation related to the previous generations? [Organisms have characteristics that can be similar or different. Young animals are very much, but not exactly, like their parents and also resemble other animals of the same kind. Plants also are very much, but not exactly, like their parents and resemble other plants of the same kind.]

LS3.B: Variation of traits

- Why do individuals of the same species vary in how they look, function, and behave? [Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.]

ETS1.A: Defining and delimiting an engineering problem

- What is a design for? What are the criteria and constraints of a successful solution? [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. 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.]

ETS1.B: Developing possible solutions

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ETS1.C: Optimizing the design solution

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ETS2.A: Interdependence of science, engineering, and technology

- What are the relationships among science, engineering, and technology? [People encounter questions about the natural world every day. There are many types of tools produced by engineering that can be used in science to help answer these questions through observation or measurement. Observations and measurements are also used in engineering to help test and refine design ideas.]

ETS2.B: Influence of engineering, technology, and science on society and the natural world

- How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world? [People depend on various technologies in their lives; human life would be very different without technology. Every human-made product is designed by applying some knowledge of the natural world and is built by using materials derived from the natural world, even when the materials are not themselves natural—for example, spoons made from refined metals. Thus, developing and using technology has impacts on the natural world.]

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- Collaborative assessment
- Student created summary sheets, concepts maps, or checklist of key science ideas

MODULE 3: PLANTS AND ANIMALS continued...

New Jersey Student Learning Standards

Connections to NJSLS – Science

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.

1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly, like their parents.

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.

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.

Interdisciplinary Connections

Connections to NJSLS – Mathematics

1.NBT.B.3 Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols >, =, and <. (1-LS1-2)

1.NBT.C.4 Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning uses. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. (1-LS1-2)

1.NBT.C.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. (1-LS1-2)

1.NBT.C.6 Subtract multiples of 10 in the range 10–90 from multiples of 10 in the range 10–90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. (1-LS1-2)

MP.2 Reason abstractly and quantitatively. (1-LS3-1), (K-2-ETS1-1), (K-2-ETS1-3)

MP.4 Model with mathematics. (K-2-ETS1-1), (K-2-ETS1-3)

MP.5 Use appropriate tools strategically. (1-LS3-1), (K-2-ETS1-1), (K-2-ETS1-3)

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1- LS3-1)

2.MD.D.10 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)

Connections to NJSLS – English Language Arts

RL.1.1 Ask and answer questions about key details in a text. (1-LS1-2), (1-LS3-1

RL.1.2 Identify the main topic and retell key details of a text. (1-LS1-2)

RL.1.10 With prompting and support, read and comprehend stories and poetry at grade level text complexity or above. (1-LS1-2)

RI.2.1 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)

W.1.7 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), 1-LS3-1)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-LS3-1)

W.2.6 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.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1), (K-2-ETS1-3)

SL.2.5 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)

Career Readiness, Life Literacies, and Key Skills

Connections to NJSLS –Career Readiness, Life Literacies, and Key Skills

9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.

9.4.2.CT.1: Gather information about an issue, such as climate change, and collaboratively brainstorm ways to solve the problem (e.g., K-2-ETS1-1, 6.3.2.GeoGI.2).

9.4.2.CT.2: Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3)

Technology

Connections to NJSLS –Technology

8.2.2.C.1 Brainstorm ideas on how to solve a problem or build a product

8.2.2.C.4 Identify designed products and brainstorm how to improve one used in the classroom.

8.2.2.C.5 Describe how the parts of a common toy or tool interact and work as part of a system.

MODULE 3: PLANTS AND ANIMALS continued...

SEL Competencies

Opportunities exist within the curricular unit to help students develop the following social and emotional competencies and sub-competencies. Examples include but are not limited to:

Self-awareness

- *Recognize one's own thoughts and feelings.* Allow students to capture their thoughts and feelings about the anchor phenomenon by asking questions, engaging in class discussion, and/or creating initial models. Allow students to brainstorm related phenomena as appropriate.

Self-management

- *Understand and practice strategies for managing one's own emotions, thoughts, and behaviors.* Allow students to use productive talk moves and sentence stems while engaging in class discussions.
- *Recognize the skills needed to establish and achieve personal and educational goals.* Allow students to review their science notebooks (specifically focus questions) and reflect upon what they have figured out and what still needs to be addressed to improve understanding.

Social awareness

- *Demonstrate an understanding of the need for mutual respect when viewpoints differ.* Encourage and model the use of productive talk moves when arguing from evidence with peers or when having class discussions. Allow students to practice providing constructive feedback when reviewing peers' work, creating consensus (class) models, or doing a gallery walk of models/explanations.
- *Demonstrate an awareness of the expectations for social interactions in a variety of settings.* Before beginning an investigation, determine the roles and responsibilities of each team member. Address and discuss behavioral expectations while working with science materials.

Responsible decision making

- *Develop, implement, and model effective problem-solving and critical thinking skills*. Have students reflect upon (in real time) the SEL skill they are using during an activity. Reflection prompts include: *What did you notice when...?, How did [SEL skill] contribute to your success with...?, How could [student]'s idea be incorporated?*

Relationship skills

- *Utilize positive communication and social skills to interact effectively with others*. Students should agree upon a set of class norms that can guide their daily activity. Have students periodically reflect upon how well they implement and use the norms when engaging in their daily work.

LGBTQIA+

In accordance with the Inclusive Curriculum Bill A1335, signed into law in NJ in 2020, this curriculum includes instruction, and instructional materials, that accurately portray political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people. This curricular document includes classroom materials that are in alignment with NJSLS and ensures that students receive diverse instruction in history, the social sciences, and other content areas, which cultivates respect towards minority groups, allows students to appreciate differences, and acquires the skills and knowledge needed to function effectively with people of various backgrounds.

Specifically, the FOSS lessons referenced in this curricular document make diversity visible in the following ways:

- Instructional materials acknowledge the specific contributions of members from multiple communities..
- Instructional materials include and highlight the efforts of scientists of all gender identities.
- Phenomena, settings, or examples are not solely centered on the activities/interests of the dominant U.S. culture, but incorporate other context and settings.
- Instructional materials recognize that all learners belong to multiple cultural communities that share different practices, purposes, ways of interacting, and approaches to conceptualizing and engaging with the world.
- Instructional materials avoid essentializing the activities and qualities of cultural groups and actively work against narrow and uniform (formulaic) ways that science is conducted (for example, by highlighting different forms of argumentation and explanation).

MODULE 3: PLANTS AND ANIMALS continued...

Accommodations

Special Education Students

Accommodations will be made in accordance with IEPs.

- Provide copy of class notes
- Color code important information
- Shorten assignments to focus on mastery
- Give alternatives to complete written assignments
- Keep workspaces clear of unrelated materials
- Provide a computer for written work
- Seat the student close to the teacher or role model
- Keep classroom materials (pencils, books) on hand
- Give directions in small steps and in as few words
- Number and sequence the steps of a task
- Show examples of end products
- Model and teach active reading strategies
- Repeat, clarify, and/or reword directions
- Ensure completion and accuracy of one part of a task before moving onto the next part
- Include brainstorm as a pre-activity before writing

Students with 504 Plans

- Use preferential seating as needed
- Allow frequent breaks
- Modify learning schedule and deadlines
- Extended time on assignments and/or assessments
- Reduce homework or classwork as needed
- Use verbal, visual, or technology
- Implement a behavior management support
- Excuse lateness, absence, or missed classwork
- Approve guidance/nurse's office visits
- Use refocus and redirect strategies as needed

Gifted and Talented Students

- Offer student choice for process, product, and/or product
- Employ curriculum compacting as appropriate
- Incorporate career based learning into lessons
- Allow for flexible grouping based on interest, inventory, and/or proficiency
- Incorporate tiered learning into lessons
- Encourage student-created rubrics & checklist to assess work
- Encourage risk taking
- Offer a variety of resources (text, audio, online) based on interest, inventory, and/or proficiency
- Allow for self-directed learning and for student creation of learning plan/goals
- Allow for exploration of related phenomena as appropriate
- Include opportunities for students to extend their thinking when writing or discussing content
- Offer alternative perspectives as appropriate

Students at Risk of Failure

- Have students restate information
- Provide notes or outlines of key concepts
- Assistance in maintaining uncluttered space
- Use home-school communication tools (notebook, daily log, phone calls, or email messages)
- Peer or scribe note-taking
- Use of manipulatives
- Follow a routine/schedule
- Teach time management skills
- Verbal/visual cues regarding directions and staying on task
- Adjusted assignment timelines
- Visual daily schedule
- Immediate feedback
- Work-in-progress check
- Pace and/or chunk long-term projects
- Film or video supplements in place of reading text
- Cue/model expected behavior
- Use deescalating strategies
- Use peer supports and mentoring

Multilingual Learners

- Provide materials in student's native language
- Offer the use of a translator (as needed)
- Use word walls to develop science vocabulary
- Provide sentence starters for written and oral work
- Provide numerous opportunities to make ideas public through linguistic and non-linguistic modes of communication (i.e. explanations, scientist circle discussions, pictures, drawings, models, graphs)
- Intentionally group multilinguals with those peers who speak the same language or whose language is more developed
- Allow multilinguals to express their noticings through physical actions and/or by using representations
- Use cognates (words similar in spelling and meaning between languages) to make connections between science vocabulary and native language
- Preview/pause to discuss technical terms
- Allow representation of new terms in multiple ways: 1) write the term 2) draw the term 3) use one's own words to write the meaning of the term, or 4) use the new term in a sentence.
- Before whole-class discussions, provide multilinguals with the opportunity to work with others--either in pairs, triads, or small groups--on ideas related to their reasoning
- Use letter coding, number coding, and/or color coding when discussing parts of a model and/or system
- Encourage multilinguals to share experiences (related phenomena) when discussing the anchor phenomenon
- Use analogies to explain more complicated concepts

MODULE 3: PLANTS AND ANIMALS continued...

Resources & Technology

The following is a list of some resources and technology to support and/or enhance the unit.

FOSS Materials

- https://www.fossweb.com/home - Use teacher login to access FOSS Dashboard and grade level materials.

Supplemental Instructional Materials

- http://phet.colorado.edu - This is a simulation site that includes lessons and resources that follows the NGSS framework.
- https://mysteryscience.com/ - Open and go lessons for K-5 that align to NGSS standards.
- https://www.brainpop.com/ - Access grade level videos on various science topics.
- https://www.sciencefriday.com/educate/ - Access STEM activities, lessons, and resources for K-12 learners in all science domains.
- https://thewonderofscience.com/ - The Wonder of Science was created to support the next generation of science teachers. The website aggregates resources developed by Paul Andersen and other science teachers implementing the Next Generation Science Standards.
- http://stemteachingtools.org/about - This site includes highly usable tools to support STEM teaching. The tools are authored and reviewed by teachers and researchers, so each one leverages knowledge from practice and from research to inform how to teach STEM subjects.
- https://www.generationgenius.com - Use this site for educational videos, lessons, and resources aligned to NGSS standards.
- https://ngss.nsta.org/ - NSTA provides classroom resources and a plethora of lesson ideas that can be incorporated into the curriculum
- https://www.nature.org/en-us/about-us/who-we-are/how-we-work/youth-engagement/nature-lab/ - Nature Lab is the youth curriculum platform from Nature Conservancy
- https://sciencebob.com/category/experiments/ - Find science experiments to enhance or extend lessons.
- https://www.weareteachers.com/easy-science-experiments/ - Easy science experiments using household materials or as an at-home extension.
- https://www.teachengineering.org/ - STEM curriculum K-12
- https://www.sciencefun.org/kidszone/experiments/ - Find science experiments to enhance or extend lessons.
- https://www.exploratorium.edu/education/teaching-resources - Teaching and learning tools with lessons, activities, and more.
- https://scitoys.com/ - Make toys at home with common household materials, often in only a few minutes, that demonstrate fascinating scientific principles.

Supplemental Assessment Materials

- http://assessment.aaas.org/ - Use this resource for supplemental assessment questions and to consider misconceptions that students may have as it relates to particular content.
- https://snapgse.stanford.edu/ - The Stanford NGSS Assessment Project (SNAP) is focusing on ways that high-quality performance assessment can support the implementation process.
- https://thewonderofscience.com/draft-assessment/ - Use this site to find example performance assessments created by Paul Andersen and other science teachers implementing the NGSS.
- https://ngss-assessment.portal.concord.org/middle-school - Find middle grades performances tasks developed through a collaborative effort of University of Illinois at Chicago, Michigan State University, WestEd, and the Concord Consortium

SUPPORTING THREE DIMENSIONAL LEARNING

SCIENCE PRACTICES

As students engage with the curriculum, they will be "doing science" and may require support as they use different science practices. This section contains suggestions (adapted from OpenSciEd) for how teachers can support students as they engage with the eight science practices.

Asking Questions/Defining Problems

- Develop a safe and supportive space for students' uncertainty.
- Focus on the need to ask and answer questions in order to address the uncertainty that may require the entire unit to resolve.
- Listen, look for, and encourage students to ask open-ended questions (e.g., why, how).
- When you notice close-ended questions, encourage students to rephrase the question so that it cannot be answered with a simple yes/no response.
- Revisit the Driving Question Board periodically throughout the unit and at the end of the unit. This helps students to see the progress they have made toward answering the questions that were important to them at the onset of the unit.
- Give students the opportunity to elaborate on their rationale for asking the questions in the first place.
- When multiple related questions are asked, prompt students to consider how these questions are similar or different.

Planning and Carrying Out Investigations

- Involve students in deciding the kinds of evidence that need to be collected to support or refute a claim ("*What do we need to know?*")
- Involve students in defining the strategies and/or methods used for collecting observations or data ("*How will we come to get the information we need?*")
- Have students identify independent, dependent, and control variables as appropriate.
- Allow students to brainstorm and think about how changing one factor will change another.
- When preparing for an investigation, encourage students to revise their questions so that they are investigable or testable.

Developing and Using Models

- As appropriate, encourage students to identify the limitations of models they use and/or develop.
- Have students identify the parts of the system and how those parts interact with each other.
- Facilitate students in organizing the parts of the system and their interactions in a visual display to facilitate making sense of the phenomenon. This can be done by creating a class model (consensus model).
- When doing an investigation, it may be necessary to map the elements of the investigation setup to the elements in the phenomenon so that students can see the connection between the two.
- Help students understand that models do more than just show what we can see, they should also try to represent any unobservable mechanisms and interactions that we think might be at work in the system to explain a phenomenon.
- As students create models, encourage them to put any ideas they are thinking down on paper. They can use labels, pictures, symbols, and/or words.

Arguing from Evidence

- During discussions, encourage as many students as possible to share their initial ideas, so that the class can consider differing perspectives to work toward agreement.
- Encourage students to use sentence stems for productive and respectful talk (*i.e. I respectfully disagree because…, Have you considered…?, What do you mean when you say…?*).
- When arguing from evidence, It is not important that students come to the "one correct answer," but rather that they sort through and weigh the evidence and reasoning from their data and their peers, to consider why certain ideas or solutions hold more or less promise versus another.
- As groups engage in discussion, center their focus on how their evidence can be useful for evaluating claims and persuading others about the validity of their ideas.
- Use "Evidence Sorting Activities" to help students determine which pieces of evidence best support or refute a claim

Using Mathematical and Computational Thinking

- Have students consider how different ways of setting up the data (parameters) can reveal different patterns in the data.
- Look for opportunities to point out and have students apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra).

Analyzing and Interpreting Data

- If students struggle with interpreting a data set, prompt them with questions so that they can none in on a particular aspect of the data set.
- Support students in thinking about how using multiple sets of data in concert with one another helps to uncover information and patterns that may be less clear when examining only one data set alone.
- Encourage students to consider how they could use technological tools to more precisely describe the differences they observe in data sets.

Obtaining, Evaluating, and Communicating Information

- Have students critically consider the source of information and whether or not it is reliable
- Have students distinguish resource as qualitative or quantitative evidence
- When having students extract key pieces of information from text, ask questions like: *What is the main idea about …..? Or, What are the three most critical pieces of information to help us figure out…?*
- Assigned readings of grade-level complexity
- Provide students different strategies to use while reading text (active reading strategies).
- Provide students with different strategies to annotate text and the images found in text.

Constructing Explanations/Designing Solutions

- Use prompts to encourage students to support their predictions and ideas with evidence from previous lessons
- Push students to make explicit connections between model ideas and observations as they construct an explanation.
- Sentence frames support students to construct an explanation by breaking it into components including developing a **claim** and providing **evidence** and **reasoning** to support that claim

SUPPORTING THREE DIMENSIONAL LEARNING

CROSSCUTTING CONCEPTS

Many educators already incorporate crosscutting concepts into their teaching, but may still be looking for ways to amplify these concepts or to make them more explicit for their students, including in their classroom assessments. This section contains prompts (adapted from STEM Teaching Tools) to help teachers elicit student understanding of CCCs in the context of investigating phenomena or solving problems.

PATTERNS

*Ask after presenting students with data from an **experimental study** focused on isolating causal variables as part of the scenario:*

- *What patterns do you observe in the data presented above in the [table, chart, graph, model output]?*
- *What does the pattern of data you see allow you to conclude from the experiment?*

*Ask after presenting students with **observational data** as part of the scenario*:

- *Does the pattern in the data support the conclusion that is related to... ? Why or why not?*
- *What do you predict will happen to [variable] in the future? Use the pattern you see in the data to justify your answer.*

*When asking students to **classify** (e.g., physical objects or organisms) presented as part of the scenario:*

- *What are some similarities and differences among the above?*
- *What is one way you could classify or group these_____ , to create groups of_____ that are similar to each other? Describe the attributes (characteristics) you are using to classify the _____.*

CAUSE and EFFECT

When drawing conclusions from a simple investigation, ask students:

- *What caused the patterns you observed?*
- *Follow up question: How do you know that caused _____ ?*
- *Follow up question: How can you test whether_____ caused_____ to happen?*
- *What do you predict would happen if [extrapolate to new, related situation]?*

SCALE, PROPORTION, and QUANTITY

*When eliciting understanding of **quantity and proportion** presented as data in the scenario, ask students:*

- *How long is_____?*
- *How much does____ weigh?*
- *What is the temperature of___ ?*
- *What is the volume of _____?*
- *What is the ratio of ____ and ____ in the data presented?*
- *What is the proportion of _____ that are ?*
- *What equation could be written to express the relationship between quantities of and quantities of _?*

*When eliciting students' understanding of **scale**, ask students:*

- *Is the model presented at a [smaller/larger/the same] scale than the phenomenon as you might observe it directly?*
- *Does the model describe processes that are [faster/slower/the same speed] than the phenomenon as you might observe it directly?*

SYSTEMS and SYSTEM MODELS

*When eliciting information about the **components and interactions of systems** and system models, ask students:*

- *What are the key parts of [a natural object, designed object, or organism described in the scenario]?*
- *Draw the parts of the system described in the scenario.*
- *How do the parts of [a natural object, designed object, or organism described in the scenario] work together?*
- *Draw a picture that shows how the parts of the system described in the scenario work together.*
- *What can the parts of [a natural object, designed object, or organism described in the scenario] do together that the individual parts cannot do alone?*
- *How do the different components of the system interact?*

*When eliciting information about the **boundaries of systems** and system models, ask students:*

- *What is the boundary of the system described in [the scenario]?*
- *What are the consequences of drawing the boundary of the system around as opposed to in a model?*
- *Draw a boundary to indicate what is inside and outside of the system*

ENERGY and MATTER

*When eliciting understanding of the **cycling of matter**, ask students: (Scale: The movement question can be answered at the atomic-molecular, cellular, or macroscopic scale.)*

- *Where are the molecules moving?*
- *How do molecules move to the location of the chemical change in [a system]?*
- *How do molecules move away from the location of the chemical change [a system]?*
- *What evidence is there that matter is conserved in this cycle?*

*When eliciting understanding of **changes to matter**, ask students: (Scale: The chemical change question is always answered at the atomic-molecular scale.)*

- *How are atoms in molecules being rearranged into different molecules?*
- *What molecules are carbon atoms in before and after the chemical change?*

*When eliciting understanding of **energy change**, ask students: (Scale: These energy questions can be answered at the atomic-molecular, cellular, or macroscopic scales.)*

- *Where in this system are energy changes occurring?*
- *What is happening to energy in this system?*
- *What forms of energy are involved in this system?*
- *What energy transformations take place during the chemical change?*
- *How much energy is needed to [make something happen]?*
- *What energy is entering, staying, and leaving [the system]?*
- *Where does the _____ get its energy?*

STRUCTURE and FUNCTION

*After presenting students with **observational data** as part of the scenario:*

- *What structures are present in ? What function does each structure have in (scenario)? How do you think each structure behaves?*
- *What is the relationship between the structure and its function?*
- *Why does the shape of matter for its function? What other properties of the structure might allow it to have certain behaviors?*

*Ask after presenting students **with a model** as part of the scenario:*

- *What are the substructures shown in the model? For each substructure, how does it behave in the model? What properties does it have? What is its function in the model?*
- *Describe the organization of substructures and how the spatial relationship matters for behavior and function.*
- *For the model, describe the behaviors by which the structures accomplish their functions.*

*After asking students to **design a solution** (e.g., a mechanical system):*

- *Describe the structures in your solution. Describe the function of your solution. What is important about the relationship between structure and function in your solution that make it a successful design?*

*When asking students about **structure and function in natural environments**:*

- *Identify the properties of the environment that constrain behavior of organisms. What about the structures of an organism allow them to survive within the environment? What is the behavior of the organism and the function of the structures it has?*

STABILITY and CHANGE

- *What things stay the same in [the system presented in the scenario]?*
- *What things change in [the system presented in the scenario]?*
- *What things are changing slowly in [the system presented in the scenario]?*
- *Is the system described in the scenario stable or unstable? Present evidence to support your claim.*
- *How was this system affected by [sudden event described in the scenario]?*
- *How might this system be affected by [sudden event not described in the scenario]?*
- *How was this system affected in the long term by [gradual changes described in the scenario]?*
- *How might this system be affected in the long term by [gradual changes not described in the scenario]?*
- *Especially for systems in dynamic equilibrium: What are the factors causing this system to be stable?*
- *What are the factors causing this system to be unstable?*
- *What is happening at the [specify scale, such as atomic] scale to make this system stable?*
- *What is happening at the [specify scale, such as atomic] scale to make this system unstable?*
- *For designed systems: How can you design this system to be more stable?*

SUPPORTING THREE DIMENSIONAL LEARNING

DISCIPLINARY CORE IDEAS

Disciplinary Core Ideas provide a scope and sequence for learning about the most important scientific concepts in one of four domains: *the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science*. This section provides the criteria used to classify an understanding as a "core idea."

Disciplinary core ideas should meet the following criteria:

1. Have a broad importance across multiple science or engineering disciplines or be a key organizing concept within a single discipline

2. Provide a key tool for understanding or investigating more complex ideas and solving problems

3. Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge

4. Be teachable and learnable over multiple grade bands at an increasing level of depth and sophistication (NRC Framework 2012, p. 31)