Fourth Grade

Science Curriculum

Francis Howell School District

HOME SCHOOL COMMUNITY

LEARNING TOGETHER

Board Approved:

July 18, 2019

Francis Howell School District

Mission Statement

The mission of the Francis Howell School District is to prepare students today for success tomorrow.

Vision Statement

Every student will graduate with college and career readiness skills.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement
- Operating safe and well-maintained facilities
- Providing a safe learning environment for all students
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing responsible citizens
- Operating as a professional learning community
- Making appropriate use of technology

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

Upon completion of their Science study in the Francis Howell School District, students will be able to:

- Use Scientific and Engineering Practices to understand how scientific knowledge develops and the work of engineers, as well as the links between engineering and science. These practices include:
    - Asking questions (for science) and defining problems (for engineering)
    - Developing and using models
    - Planning and carrying out investigations
    - Analyzing and interpreting data
    - Using mathematics and computational thinking
    - Constructing explanations (for science) and designing solutions (for engineering)
    - Engaging in argument from evidence
    - Obtaining, evaluating, and communicating information
- Develop an understanding of, and be able to explain, concepts that bridge disciplinary boundaries, including:
    - Patterns
    - Cause and effect: Mechanism and explanation
    - Scale, proportion, and quantity
    - Systems and system models
    - Energy and matter: Flows, cycles, and conservation
    - Structure and function
    - Stability and change
- Use scientific knowledge to understand the world in four major domains:
    - Physical sciences (Matter and its interactions, Motion and Stability, Energy, Waves and Their Applications)
    - Life sciences (From Molecules to Organisms, Ecosystems, Heredity, Biological Evolution)
    - Earth and space sciences (Earth's Place in the Universe, Earth's Systems, Earth and Human Activity)
    - Engineering, technology, and the applications of science (Engineering Design, Links among Engineering, Technology, Science, and Society)

Rationale for Elementary Science

Science, engineering, and technology permeate nearly every facet of modern life, and they also hold the key to meeting many of humanity's most pressing current and future challenges. The overarching goal of science education is to ensure that all students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside of school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology. Elementary science in Francis Howell School District will develop student understandings and skills which are necessary for them to function productively as problem-solvers in a scientific and technological world, cultivate students' scientific and engineering habits of mind, develop their capability to engage in scientific and engineering practices, and teach them how to reason in the contexts of science, engineering, and technology.

Fourth Grade Science Course Description

Fourth Grade Science is designed to explore Energy, Waves and Information, Structure, Function, and Information Processing in Living Things, and Processes that Shape Earth. Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students will develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Fourth graders develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students will develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of patterns; cause and effect; energy and matter; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In fourth grade, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

4-5 Science Curriculum Team

Curriculum Committee

Christian Baez	Becky-David Elementary
Meredith Bates	Daniel Boone Elementary
Courtney Cole	Harvest Ridge Elementary
David Gentili	Fairmount Elementary
Andrea Hamp	Castlio Elementary
Elizabeth Nichols	John Weldon Elementary
Myka Niedringhaus	Warren Elementary
Laura Schmitz	Henderson Elementary
Jodi Wylde	Daniel Boone Elementary

Academics and Administration

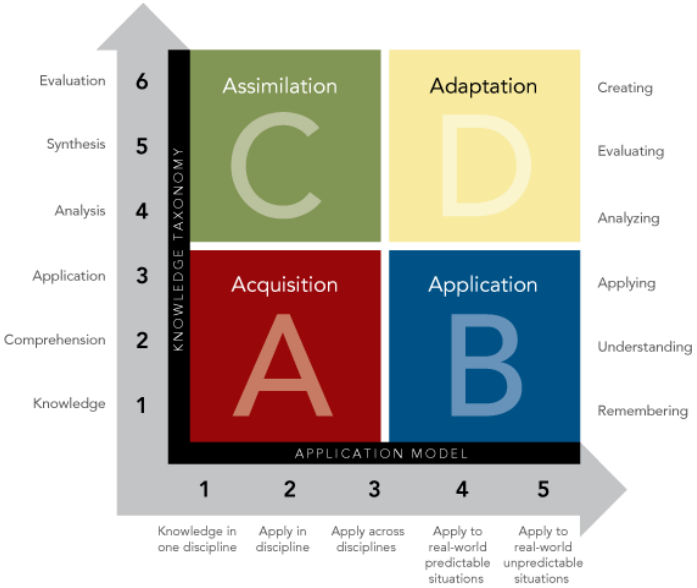
Science & Math Content Leader	Dr. Sherri Lorton
ELA, Social Studies, & Health Content Leader	Dr. Carrie Hepburn
Director of Student Learning	David Brothers
Chief Academic Officer	Dr. Nathan Hoven
Superintendent	Dr. Mary Hendricks-Harris

Curriculum Notes

All FHSD performance tasks and sample learning activities are aligned not only to understandings and standards, but also the Rigor and Relevance Framework and 21st Century Skills. Information on these two things is provided below or by clicking on the hyperlinks.

Rigor and Relevance Framework

The Rigor/Relevance Framework is a tool developed by the International Center to examine curriculum, instruction, and assessment along the two dimensions of higher standards and student achievement.



The Rigor/Relevance Framework has four quadrants.
Quadrant A represents simple recall and basic understanding of knowledge for its own sake. Examples of Quadrant A knowledge are knowing that the world is round and that Shakespeare wrote Hamlet.

Quadrant C represents more complex thinking but still knowledge for its own sake. Quadrant C embraces higher levels of knowledge, such as knowing how the U.S. political system works and analyzing the benefits and challenges of the cultural diversity of this nation versus other nations.

Quadrants B and D represent action or high degrees of application. Quadrant B would include knowing how to use math skills to make purchases and count change. The ability to access information in wide-area network systems and the ability to gather knowledge from a variety of sources to solve a complex problem in the workplace are types of Quadrant D knowledge.

A	B	C	D
Students gather and store bits of knowledge and information. Students are primarily expected to remember or understand this knowledge.	Students use acquired knowledge to solve problems, design solutions, and complete work. The highest level of application is to apply knowledge to new and unpredictable situations.	Students extend and refine their acquired knowledge to be able to use that knowledge automatically and routinely to analyze and solve problems and create solutions.	Students have the competence to think in complex ways.

21st Century Skills

These skills have been pared down from 18 skills to what are now called the 4Cs. The components include critical thinking, communication, collaboration, and creativity. Critical thinking is focused, careful analysis of something to better understand and includes skills such as arguing, classifying, comparing, and problem solving. Communication is the process of transferring a thought from one mind to others and receiving thoughts back and includes skills such as choosing a medium (and/or technology tool), speaking, listening, reading, writing, evaluating messages. Collaboration is working together with others to achieve a common goal and includes skills such as delegating, goal setting, resolving conflicts, team building, decision-making, and managing time. Creativity is expansive, open-ended invention and discovery of possibilities and includes skills such as brainstorming, creating, designing, imagining, improvising, and problem-solving.

Standards

Standards aligned to this course can be found:

Science Standards

http://www.nextgenscience.org/overview-topics

https://dese.mo.gov/sites/default/files/curr-mls-standards-sci-k-5-sboe-2016.pdf

National Educational Technology Standards

http://www.iste.org/standards/standards/for-students-2016

Units & Standards Overview

Quarter 1 **Quarter 2** **Quarter 3** **Quarter 4**

Unit 1: What's Your Function?	**Unit 2: Earth Wind and Fire**	**Unit 3: Along for the Ride**	**Unit 4: Ride the Wave**
Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye.	Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps.	Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.	Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move.
Unit Standards:	**Unit Standards:**	**Unit Standards:**	**Unit Standards:**
4-LS1-1/MO 4.LS1.A.1 4-LS1-2/MO 4.LS1.D.1 4-PS4-2/MO 5.PS4.A.1 CCC2; **CCC4** SEP1; **SEP2**; **SEP7**	4-ESS1-1/MO 4.ESS1.C.1 4-ESS2-1/MO 4.ESS.2.A.1 **4-ESS2-2/MO 4.ESS2.B.1** 4-ESS3-2/MO 4.ESS3.A.1 3-5 ETS1-2/MO 4.ETS.1.B.1 **CCC1**; CCC2 SEP1; SEP3; **SEP4; SEP6**	4-PS3-1/MO 4.PS3.A.1 4-PS3-2/MO 4.PS3.B.2 **4-PS3-4/MO 4.PS3.B.2** MO 4.PS2.B.1 ; MO 4.PS2.B.2 4-ESS3-1 3-5 ETS1-1/MO 4.ETS.1.A.1 **CCC1**; CCC2; **CCC5** SEP1; **SEP2**; SEP3; **SEP6**; SEP8	**4-PS4-1/MO 4.PS4.A.1** 4-PS4-3 3-5 ETS1-3/MO 4.ETS.1.C.1 **CCC1** SEP1; **SEP2**; SEP3; **SEP6**
PE Assessment:	**PE Assessment:**	**PE Assessment:**	**PE Assessment:**
Venus Flytrap Assessment	Volcanoes Assessment	Energy Device Assessment	Waves Assessment
PE Standards:	**PE Standards:**	**PE Standards:**	**PE Standards:**
4-LS1-1/MO 4.LS1.A.1 **LS1.A** **CCC4** **SEP7**	**4-ESS2-2/MO 4.ESS.2.A.1** **ESS2.B** **CCC 1** **SEP 4**	**4-PS3-4/MO 4.PS3.B.2** **PS3.B** **PS3.D** **ETS1.A** **CCC5; SEP6**	**4-PS4-1/MO 4.PS4.A.1** **PS4.A** **CCC1** **SEP2**

Unit 1: *What's Your Function?*

Content Area: Science	**Course: Fourth Grade**	**UNIT: What's Your Function?** (Life Science: Structure, Function, and Information Processing)

Unit Description: Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. **Anchor Chart Examples:** Structures and Senses Structure and Functions	**Unit Timeline:** 4 weeks: 20 Days

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. **Asking Questions and Defining Problems:** Ask questions about what would happen if a variable is changed.
2. **Developing and Using Models:** Use a model to test interactions concerning the functioning of a natural system. Develop a model to describe and/or predict phenomena.
7. **Engaging in Argument from Evidence:** Construct an argument with evidence, data, and/or a model.

Understandings – *Students will understand that… (Big Ideas)*

2. (Cause and Effect) Cause and effect relationships are routinely identified. Events that occur together with regularity might or might not be a cause and effect relationship.
4. (Systems and System Models) A system can be described in terms of its components and their interactions.

➔ Plants and animals have structures that allow them to survive and respond to a changing environment.

➔ Animals take in different types of information through their senses to respond to their environment.

Essential Questions: *Students will keep considering…*

- How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals?
- How do organisms live, grow, respond to their environment and reproduce?
- How do organisms grow and develop?
- How do organisms obtain and use the matter and energy they need to live and grow?
- How do organisms detect, process and use information about the environment?

STANDARDS ADDRESSED		
Students who demonstrate understanding can: **4-LS1-1/MO 4.LS1.A.1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction**. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Tasks should not include any structures beyond macroscopic structures within plant and animal systems.] 4-LS1-2/MO 4.LS1.D.1 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Tasks should not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.] 4-PS4-2/MO 5.PS4.A.1 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]		
Disciplinary Core Ideas **Students will know...**	**Cross Cutting Concepts** **Students will understand…**	**Science and Engineering Practice** **Students will be able to...**
LS1.A: Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	**CCC 4: Systems and System Models** ● A system can be described in terms of its components and their interactions. (4-LS1-1)	SEP 1: Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships. ● Ask questions about what would happen if a variable is changed. **SEP 7: Engaging in Argument from Evidence** **Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).** ● Construct an argument with evidence, data, and/or a model. (4-LS1-1)
LS1.D: Information Processing Different sense receptors are specialized for	**CCC4: Systems and System Models** ● A system can be described in	**SEP 2: Developing and Using Models** **Modeling in 3–5 builds on K–2 experiences**

particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)	terms of its components and their interactions. (4-LS1-2)	**and progresses to building and revising simple models and using models to represent events and design solutions.** ● Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)
PS4.B: Electromagnetic Radiation An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)	CCC2: Cause and Effect ● Cause and effect relationships are routinely identified. (4-PS4-2) ● Events that occur together with regularity might or might not be a cause and effect relationship. (MO 5.PS4.A.1) **CCC4: Systems and System Model** ● A system can be described in terms of its components and their interactions. (MO 5.PS4.A.1)	**SEP2: Developing and Using Models** **Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.** ● Develop a model to describe and/or predict phenomena. (4-PS4-2)

Unit 1: Assessment

EVIDENCE of LEARNING			
Understandings 4	Standards **4-LS1-1/MO** **4.LS1.A.1** **LS1.A** **CCC4** **SEP7**	**Unit Performance Assessment**: **Description of Assessment Performance Task(s):** 4-LS1-1 Structures and Processes Assessment **Performance:** **Scoring Guide:**	**R/R Quadrant/ 21 Century** D Critical Thinking

Unit 1: Sample Activities

SAMPLE LEARNING PLAN
Pre-assessment: The teacher will review students' models made after Day 2. Formatively assess their application of the following model criteria: title, diagram with labels, explanation, color/color-coding, zoom-in bubbles, measurement/time, and questions.

Anchoring Phenomena for this Unit:
Owl Regurgitating Pellets

Understanding	Standards	Major Learning Activities:	Instructional Strategy:	R/R Quadrant: 21C:
4	**4-LS1-1/MO** **4.LS1.A.1** **LS1A** **CCC4** **SEP1**	**Day One: Questioning** **Objective:** Students will ask questions about how an owl's digestive system helps support its survival. a. Show video of an owl hunting and regurgitating an owl pellet. (linked in the anchoring phenomena) b. Distribute pellets to the students. Provide them time to dissect and explore. c. *In small groups, with one person as recorder, write down questions about what you are observing* i. Rules for Producing Questions: 1. Ask as many questions as you can. 2. Do not stop to discuss, judge or answer the questions. 3. Write down every question exactly as it is stated. 4. Change any statement into a question. d. *In your list, you might have the two types of questions: closed-ended and open-ended.* i. Review your list of questions and identify closed and open-ended questions. ii. Mark the open-ended questions with an O and the closed-ended questions with a C. iii. THEN, change questions from one type to another. Go back to your list of questions and change one closed-ended question into an open-ended, and change one open-ended question into a closed-ended one. Make the changes right on the list. e. Choose the three most important questions from your list. Mark them with an "X" and discuss your reasons for selecting those three.	Setting Objectives Cues and Questions Non-Linguistic Representation Graphic Organizer Identifying Similarities and Differences Cooperative Learning Generating and Testing Hypothesis	A Collaboration Communication
4	**4-LS1-1/MO** **4.LS1.A.1** **LS1A** **CCC4** SEP2	**Day Two: Modeling** **Objective:** Students will make a model to show how an owl's digestive system helps support its survival. Class discussion a. In your table/group review questions from the previous day's activity. b. Select one person to share your top 3 questions with the class.	Setting Objectives Cues and Questions	C Collaboration Communication

		c. Individually, sketch a model of how you think an owl regurgitates pellets. i. Important aspects of creating a model. Examples: 1. Title 2. Diagram with labels 3. Explanation 4. Color/color-coding 5. Zoom-in bubbles 6. Measurement/Time 7. Questions d. Have students share their model with their table/group and explain their thinking (and hear others' thinking). e. When finished, tell students to revise their model to include some (or more than they had before) of the elements described above and write an explanation of what they think is happening when the owl regurgitates pellets. f. Lastly, have students participate in a gallery walk to view other student's models and explanations. (When creating models, a tech option--to allow for a virtual gallery walk and peer feedback--could be to use Google Drawings on Chromebooks or a drawing app on iPads like Paper.)	Non-Linguistic Representation Cooperative Learning	
4	**4-LS1-1/MO 4.LS1.A.1 LS1A CCC4 SEP6**	**Day Three: Investigating and Explaining** **Objective:** Students will construct an explanation to tell how an owl's digestive system helps support its survival. RESOURCES: Owl Pellet Diagram Owl Pellet article and video from Carolina Supply Co a. Provide students time to research how the internal structures of the owl's digestive system allow it to eat and produce an owl pellet. b. Students can use bone identification charts to learn what specific animals their owl ate. c. Revise models to reflect new learning. Have students share their revised models with their Day One small groups. d. As a class, construct an explanation as to how the owl's digestive system helps it to survive.	Setting Objectives Graphic Organizer Identifying Similarities and Differences	C Collaboration Communication Critical Thinking
4	**4-LS1-1/MO 4.LS1.A.1 LS1A CCC4** SEP8	**Day Four: Research** **Objective:** Students will research to obtain, evaluate, and communicate information about an animal and how its structures help it survive. 1. Choose from the list of animals below to investigate an adaptation and explain how the structure or function of that animal allows it to survive or	Setting Objectives Cues and Questions	B Collaboration Communicat

<table>
<tr>
<td></td>
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<td>grow OR allow students to use books or World Book online to choose their animal and structure/function.
a. Octopus
b. Tropical Pitcher *Assessment is on Venus Flytrap
c. Puffer fish
d. Cheetah
e. Whale
f. Zebra
g. Elephant
h. Butterfly
2. Have students create a 3-column chart to organize research.
<table>
<tr><th>Animal/Plant</th><th>Structure</th><th>Function</th></tr>
<tr><td></td><td></td><td></td></tr>
</table>
3. Some topics to have students consider during their research include:
a. The group of animals it belongs to
b. The types of food it eats, and whether this makes it an herbivore, omnivore, or carnivore
c. The habitat and location(s) throughout the world in which it can be found
d. The external structures it has to help it survive in the wild.
e. The internal structures it has to help it survive in the wild.
f. Its potential predators.
4. Use a cooperative learning structure to have students share their research and learn about a variety of plants/animals and their structures.</td>
<td>Graphic Organizer

Identifying Similarities and Differences

Cooperative Learning</td>
<td>ion

Critical Thinking</td>
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<td>4</td>
<td>4-LS1-1/MO 4.LS1.A.1 LS1A CCC4 SEP7</td>
<td>Day Five: Engage in Argument
Objective: Students will develop and support a claim (using evidence) about how animal structures help them survive.
a. Have students use their revised model and notes from the investigation to create a claim about how the animal/plants structure allows them to survive. Use the Argumentation Template to construct their response.
Argumentation Template (A simpler version can be found here: Simple Argumentation Template but it is important to note that scientists, and your students, find or provide evidence BEFORE making a claim, then link the claim and evidence with terms and reasoning.)</td>
<td>Setting Objectives

Identifying Similarities and Differences

Cooperative Learning</td>
<td>D

Communication

Collaboration

Critical Thinking</td>
</tr>
</table>

UNIT RESOURCES
Teacher Resources: ● Owl Pellets ● Youtube videos - linked above in sample lessons ● Student Articles - linked above in sample lessons
Student Resources: ● Graphic Organizer shown above ● Nat'l Geographic Windows on Literacy ● *Strange Animals* by O'sullivan ● *Strange Plants* by Halpern ● *Where in the Wild?: Camouflaged Creatures Concealed…and Revealed* by Schwartz ● *Where Else in the Wild?: More Camouflage Creatures Concealed…and Revealed* by Schwartz ● *Plants in Different Habitats* by Bobbie Kalman ● *Octopuses* by Michele Spirn (ebook) ● *Blue-Ringed Octopus Small But Deadly* by Natalie Lunis (ebook) ● *The Amazing Octopus* by Bobbie Kalman ● *Animal Adaptations* by Peter Winkler ● Bobbie Kalman – The Science of Living Things series ● *How do Animals Eat Food?* (Crabtree Pub) ● *How do Animals Move?* ● *How do Animals Adapt?* ● *What are Camouflage and Mimicry?*
Vocabulary: **Structure**- the arrangement of and relations between the parts or elements of something complex. **Function**- an activity or purpose natural to or intended for a person or thing. **Survival**- the state or fact of continuing to live or exist, typically in spite of an accident, ordeal, or difficult circumstances. **Growth**- the process of increasing in physical size **Behavior**- the way in which one acts or conducts oneself, especially towards others. **Reproduction**- the action or process of making a copy of something.

Unit 2: Earth, Wind, and Fire

Content Area: Science	Course: Fourth Grade	UNIT: Earth, Wind, and Fire (Earth Systems: Processes that Shape the Earth)

Unit Description:	Unit Timeline:
Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. **Anchor Chart Examples:** Earth Features and Processes Earth Features and Processes 2	4 weeks: 20 Days

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. **Asking Questions and Defining Problems:** Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
2. **Developing and Using Models:** Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
3. **Planning and Carrying Out Investigations:** Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
4. **Analyzing and Interpreting Data:** Analyze and interpret data to make sense of phenomena using logical reasoning.
6. **Constructing Explanations and Designing Solutions:** Identify the evidence that supports particular points in an explanation. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Understandings – *Students will understand that… (Big Ideas)*

1. (Patterns) Patterns can be used as evidence to support an explanation.
2. (Cause and Effect) Cause and effect relationships are routinely identified, tested, and used to explain change.

Essential Questions: ***Students will keep considering…***

- How can water, ice, wind and vegetation change the land?
- How do people reconstruct and date events in Earth's planetary history?
- How and why is Earth constantly changing?
- How do Earth's major systems interact?
- Why do the continents move, and what causes earthquakes and volcanoes?
- How do the properties and movements of water shape Earth's surface and affect its systems?
- How do the Earth's surface processes and human activities affect each other?
- How do natural hazards affect individuals and societies?

STANDARDS ADDRESSED
Students who demonstrate understanding can: 4-ESS1-1/MO 4.ESS1.C.1 Identify evidence from patterns in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.[Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers.] 4-ESS2-1/MO 4.ESS.2.A.1 (NGSS/MO combined standards) Plan and conduct investigations, including making observations and/or measurements, to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. Assessment Boundary: Tasks should not include more than one variable to test for weathering and erosion. Items should not assess a specific sequence in a procedure.] **4-ESS2-2/MO 4.ESS.2.B.1 Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes. Assessment Boundary: Topographic maps at this grade level should only include simple mountains, valleys and hills.] 4-ESS3-2/MO 4.ESS.3.A.1 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity. Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, volcanic eruptions, landslides, and hurricanes.] 3-5 ETS1-2/MO 4.ETS.1.B.1 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Disciplinary Core Ideas **Students will know...**	**Cross Cutting Concepts** **Students will understand…**	**Science and Engineering Practice** **Students will be able to...**
ESS1.C: The History of Planet Earth Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were	**CCC1: Patterns** ● Patterns can be used as evidence to support an explanation. (4-ESS1-1)	**SEP 6: Constructing Explanations and Designing Solutions** **Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify**

formed. (4-ESS1-1)		**variables that describe and predict phenomena and in designing multiple solutions to design problems.** ● Identify the evidence that supports particular points in an explanation. (4-ESS1-1)
ESS2.A: Earth Materials and Systems Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) ESS2.E: Biogeology Living things affect the physical characteristics of their regions. (4-ESS2-1)	CCC2: Cause and Effect ● Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1)	SEP 3: Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ● Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)
ESS2.B: Plate Tectonics and Large-Scale System Interactions The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)	**CCC1: Patterns** ● Patterns can be used as evidence to support an explanation. (4-ESS2-2)	**SEP 4: Analyzing and Interpreting Data** **Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.** ● Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)
ESS3.B: Natural Hazards A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (4-ESS3-2)	CCC2: Cause and Effect ● Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2)	SEP 1: Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying

ETS1.B: Developing Possible Solutions ● Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2) ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)		qualitative relationships. ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **SEP2: Developing and Using Models** **Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.** ● Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. **SEP 6: Constructing Explanations and Designing Solutions** **Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.** ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

Unit 2: Assessment

EVIDENCE of LEARNING

Understandings	Standards	**Unit Performance Assessment**: **Mapping Earth's Features Assessment**	**R/R Quadrant 21 Century**
4	**4-ESS2-2/MO** **4.ESS.2.A.1** **ESS2.B** **CCC 1** **SEP 4**	**Description of Assessment Performance Task(s):** 4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features. **Scoring Guide:**	D critical thinking

SAMPLE LEARNING PLAN
Pre-assessment: The teacher will review students' models made after Day 2. Formatively assess their application of the following model criteria: title, diagram with labels, explanation, color/color-coding, zoom-in bubbles, measurement/time, and questions.
Anchoring Phenomena for this Unit: **Volcano Paricutin Documentary**

Understandings	**Standards**	**Major Learning Activities:**	**Instructional Strategy:**	**R/R Quadrant: 21C:**
2	**4-ESS2-2/MO** **4.ESS2.B.1** **ESS2.B** **CCC1** **SEP 4**	**Day One: Questioning** **Objective:** Students will ask questions about the patterns they notice when a volcano is formed. a. Show the **Volcano Paricutin Documentary** b. *In small groups, with one person as recorder, write down questions about what you are observing.* Rules for Producing Questions: 1. Ask as many questions as you can. 2. Do not stop to discuss, judge or answer the questions. 3. Write down every question exactly as it is stated. 4. Change any statement into a question. c. *In your list, you might have the two types of questions: closed-ended and open-ended.* i. Review your list of questions and identify closed and open-ended questions. ii. Mark the open-ended questions with an O and the closed-ended questions with a C. iii. THEN, change questions from one type to another. Go back to your list of questions and change one closed-ended question into an open-ended, and change one open-ended question into a closed-ended one. Make the changes right on the list. d. Choose the three most important questions from your list. Mark them with an "X" and discuss your reasons for selecting those three. [Alternately, teachers could create a collaborative doc with a table (2 columns) with heading for open-ended and closed. Students would add their question to the correct column of the doc, and then across from it write their changed question. This visual representation might help them to see the differences of question types.]	Setting Objectives Cues and Questions Non-Linguistic Representation Cooperative Learning Generating and Testing Hypothesis	A Critical Thinking Collaboration Communication

3	**4-ESS2-2/MO** **4.ESS2.B.1** **ESS2.B** **CCC1** **SEP 4**	**Day Two: Modeling** **Objective:** Students will use their understanding of patterns to make a model to show how a volcano is formed. Class discussion a. In your table/group review questions from the previous day's activity. b. Select one person to share your top 3 questions with the class. c. Individually, sketch a model of how you think the mountain appeared in the farmer's field. Important aspects of creating a model. Examples: a. Title b. Diagram with labels c. Explanation d. Color/color-coding e. Zoom-in bubbles f. Measurement/Time g. Questions ii. Have students share their model with their table/group and explain their thinking (and hear others' thinking). iii. When finished, tell students to revise their model to include some (or more than they had before) of the elements described above and write an explanation of how and why they think the volcano is formed. iv. Lastly, have students participate in a gallery walk to view other student's models and explanations. (When creating models, a tech option--to allow for a virtual gallery walk and peer feedback--could be to use Google Drawings on Chromebooks or a drawing app on iPads like Paper.)	Setting Objectives Cues and Questions Non-Linguistic Representation Cooperative Learning Generating and Testing Hypothesis	C Critical Thinking Collaboration Communication Creativity
4	**4-ESS2-2/MO** **4.ESS2.B.1** **ESS2.B** **CCC1** SEP 8	**Day Three: Investigating and Explaining** **Objective:** Students will obtain information and create a map of the patterns that create the Ring of Fire. Prep for "Mapping Volcanoes" a. Step 1: Print materials. i. For each group of 8 students, print one set of Volcano Mapping Sheets . 1. For 8 students, print 1 set. 2. For 9 to 16 students, print 2 sets. 3. For 17 to 24 students, print 3 sets. 4. For 25 to 32 students, print 4 sets.	Setting Objectives Cues and Questions Graphic Organizer Identifying Similarities and	B Collaboration Communication Creativity

		ii. For each pair of students, print: 1. one Volcano Discoveries sheet . Each page should be cut in two to make two worksheets. iii. For yourself, print: 1. one Volcano Discoveries Answer Key 2. one Volcano Mapping Sheets Answer Key b. Step 2: Other supplies. i. Each pair of students will need: ● a red pencil to mark volcanoes on the map ● pencils to write with **Directions:** Mystery Science Volcanoes 1. As a class, watch the video (Explorations 1, 2 and 3) from the link above and have students discuss the question prompted in the video with their shoulder partner. a. Do you think it's possible for a volcano to pop up where you live? Why or why not? 2. Next, as a class, watch the video/directions for "Mapping Activity" using the link above (it is on the next slide after Exploration 3 of 16). 3. Directions for "Mapping Activity" (students may use the Mystery Science link to work through the steps 1-8 of mapping volcanoes): a. Students will work with a partner. b. Each partnership needs one of the four maps & the volcano list that goes with it. Also needed is a pencil and a colored pencil. c. Look at the volcano list - notice that each location is written as a number and a letter. On the map there are also numbers and letters. d. Have partners decide who will be the mapper and the announcer. e. The Announcer will read each location, then the Mapper will find and draw a small triangle on the map to mark the spot. As you check your work, the Announcer can mark the volcano off the list. f. After mapping all the volcanoes, complete the Volcanoes Discovery worksheet.	Differences Cooperative Learning Generating and Testing Hypothesis	
4	**4-ESS2-2/MO 4.ESS2.B.1 ESS2.B**	**Day Four: Research** **Objective:** Students will use their understanding of patterns to explain why the there are so many volcanoes in the Ring of Fire.	Setting Objectives	C Critical

	CCC1 SEP 8	1. Teacher will begin the lesson by collecting the 4 maps and putting them together (may do this ahead of time). 2. As a class, discuss the questions below: a. If you had to describe where volcanoes are, what would you say? b. Can you draw a path that connects most of the volcanoes on the map? Where would you draw it? Next, watch the video together from Mystery Science (Exploration 4 of 16): Mystery Science Volcanoes 3. After that, continue to use the Mystery Science link above and have students discuss the question below with their should partner (Exploration 5 of 16): a. This map shows the other volcanoes in the world. Are there any close to where you live? b. As a class, watch Exploration 6 of 16 together. 4. Students will use the remainder of time to research about volcanoes to gather information to create a claim tomorrow about how the volcano appeared in the farmer's field. **Research Links:** Video: https://safeyoutube.net/w/TDm Article: Newsela Nasa Volcano article Article: Stunning Volcanoes article - Pandotrip Article: Top 10 Famous Volcanoes - Time Magazine Article: Top 10 Active Volcanoes article Article & video: Plate Tectonics for Kids video Article: Plate Tectonics - National Geo Article: Tectonic Plates Photos: Ring of Fire Photos - National Geo	Cues and Questions Non-Linguistic Representation Identifying Similarities and Differences	Thinking Communication Collaboration
3	**4-ESS2-2/MO** **4.ESS2.B.1** **ESS2.B** **CCC1** **SEP 7**	**Day Five: Engage in Argument** **Objective:** Students will use their understanding of patterns to construct an argument to tell how a volcano can appear in a farmer's field. a. Students will revisit model from Day One and revise based on new learning. b. Have students use their revised model and maps of the Ring of Fire to create a claim about how the volcano appeared in the farmer's field. Use the Argumentation Template to construct their response. i. **Argumentation Template**	Cues and Questions Non-Linguistic Representation Graphic Organizer Generating	D Critical Thinking Collaboration Communication

		c. Provide map and article to show that Paricutin is in the Ring of Fire 1. Map 2. Article	and Testing Hypothesis	Creativity

Unit 2: Resources

UNIT RESOURCES
Teacher Resources: ● Mystery Science ● Plate Tectonics Simulation ● Youtube videos linked above ● Articles linked above ● To allow students to see volcanic terrain in 3D, see 360 images of these locations, and gain an understanding of the proximity of these locations to oceans, as well as where they are, try Google Earth. Here is a link to Bromo Tengger Semeru National Park, East Java, Indonesia: https://earth.app.goo.gl/ihxVQ and one to Mount Saint Helen's: https://earth.app.goo.gl/WU73WB to get you started.
Student Resources: ● *Earthquakes by* Kea Than 890 L ● *Mudflows and Landslides* by Michael and Mary Woods Reading Level 5.6 ● *Missouri Hello USA* by Rita C. LaDoux 920 L ● *Volcanoes* by Monica Halpern ● *Everything Volcanoes and Earthquakes* by Kathy Furgang 1040 L
Vocabulary: **Maps**-a diagram of an area of land or sea **Mountains**- a large natural elevation of the earth's surface rising abruptly from the surrounding level **Ocean Trenches**- a long, narrow ditch in the ocean **Patterns**- a repeated model **Volcano**- a mountain or hill, having a crater or vent through which lava, rock fragments, hot vapor, and gas are erupted

Unit 3: Along For the Ride

Content Area: Science	Course: Fourth Grade	UNIT: Along for the Ride (Energy)

Unit Description: Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. **Anchor Chart Example:** Energy	**Unit Timeline:** 7 weeks: 30 Days

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. **Asking Questions and Defining Problems:** Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
2. **Developing and Using Models:** Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
3. **Planning and Carrying Out Investigations:** Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. Make predictions about what would happen if a variable changes,
6. **Constructing Explanations and Designing Solutions:** Apply scientific ideas to solve design problems. Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
8. **Obtaining, Evaluating, and Communicating Information:** Obtain and combine information from books and other reliable media to explain phenomena.

Understandings – *Students will understand that… (Big Ideas)*

1. (Patterns) Observed patterns of forms and events guide organizational classification, and they prompt questions about relationships and the factors that influence them.
2. (Cause and Effect) Cause and effect relationships are routinely identified. Cause and effect relationships are routinely identified and used to explain change.
5. (Energy and Matter) Energy can be transferred in various ways and between objects.

Essential Questions: ***Students will keep considering…***

- What is energy and how is it related to motion?
- How can energy be used to solve a problem?
- How is energy transferred and conserved?
- How are forces related to energy?
- How do food and fuel provide energy?

STANDARDS ADDRESSED

Students who demonstrate understanding can:

4-PS3-1/MO 4.PS3.A.1 Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

4-PS3-2/MO 4.PS3.B.2 (NGSS/MO combined standards) Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, electric currents, motion, and magnetic force. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-4/MO 4.PS3.B.2 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

MO 4.PS2.B.1 Plan and conduct fair tests to compare and contrast the forces required to overcome friction when an object moves over different surfaces. [Assessment Boundaries: Tasks should not include anything more complex than written or pictorial descriptions. Items should not assess a specific sequence in a procedure.]

MO 4.PS2.B.2 Predict how changes in either the amount of force applied to an object or the mass of the object affects the motion of the object. [Assessment Boundary: Tasks should not include anything more complex than written or pictorial descriptions.]

4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

3-5 ETS1-1/MO 4.ETS.1.A.1 Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.

Disciplinary Core Ideas **Students will know...**	**Cross Cutting Concepts** **Students will understand…**	**Science and Engineering Practice** **Students will be able to...**
PS3.A: Definitions of Energy The faster a given object is moving, the more energy it possesses. (4-PS3-1)	**CCC5: Energy and Matter** ● Energy can be transferred in various ways and between objects. (4-PS3-1)	**SEP 6: Constructing Explanations and Designing Solutions** **Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.** ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)
PS3.A: Definitions of Energy ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2) ● Light also transfers energy from place to place. (4-PS3-2) ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2)	**CCC5: Energy and Matter** ● Energy can be transferred in various ways and between objects. (4-PS3-2)	SEP 3: Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ● Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)
PS3.A: Definitions of Energy	**CCC5: Energy and Matter**	SEP 1: Asking Questions and Defining

● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-3) **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-3) PS3.C: Relationship Between Energy and Forces ● When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)	● Energy can be transferred in various ways and between objects. (4-PS3-3)	Problems Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships. ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)
PS3.B: Conservation of Energy and Energy Transfer ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4) **PS3.D: Energy in Chemical Processes and Everyday Life** ● The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) **ETS1.A: Defining and Delimiting Engineering Problems** ● Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints	**CCC5: Energy and Matter** ● Energy can be transferred in various ways and between objects. (4-PS3-4)	**SEP 2: Developing and Using Models** **Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.** ● Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. ● Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system. **SEP 6: Constructing Explanations and Designing Solutions** **Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.**

into account. (secondary to 4-PS3-4)		● Apply scientific ideas to solve design problems. (4-PS3-4)
PS2.B: Types of Interactions ● The effect of the unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion. Some forces act through contact; some forces act even when the objects are not in contact; The gravitational force of Earth acting on an object near Earth's surface pulls that object toward Earth's center (MO PS2.B.1; MO PS2.B.2)	**CCC1: Patterns** ● Observed patterns of forms and events guide organizational classification, and they prompt questions about relationships and the factors that influence them. (MO PS2.B.1) CCC2: Cause and Effect ● Cause and effect relationships are routinely identified. (MO PS2.B.1, MO PS2.B.2)	**SEP 3: Planning and Carrying out Investigations** **Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.** ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (MO PS2.B.1) ● Make predictions about what would happen if a variable changes (MO PS2.B.2)
ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)	CCC2: Cause and Effect ● Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)	SEP 8: Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. ● Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

Unit 3: Assessment

EVIDENCE of LEARNING			
Understandings 1, 2, 5	Standards **4-PS3-4/MO** **4.PS3.B.2** **PS3.B** **PS3.D** **ETS1.A** **CCC5** **SEP6**	**Unit Performance Assessment**: Along for the Ride **Scoring Guide:** *Located at the bottom of the assessment*	**R/R Quadrant/ 21 Century** D Critical Thinking Communication Creativity

SAMPLE LEARNING PLAN
Pre-assessment: The teacher will review students' models made after Day 2. Formatively assess their application of the following model criteria: title, diagram with labels, explanation, color/color-coding, zoom-in bubbles, measurement/time, and questions.
Anchoring Phenomena for this Unit: Roller Coaster Links Below **Roller Coaster Links:** Coaster 1 Coaster 2 Coaster 3 Coaster 4 Coaster 5

Understandings	Standards	Major Learning Activities:	Instructional Strategy:	R/R Quadrant: 21C:
1, 2, 5	4-PS3-4/MO 4.PS3.B.2 CCC5 SEP 1	**Day One: Questioning** **Objective:** Students will ask questions about how energy moves an object. a. Show a variety of roller coaster videos. They should see that roller coasters have a variety of ways to start (chain up the hill, electromagnetic, starting at the top of a hill, etc.) b. *In small groups, with one person as recorder, write down questions about what you are observing.* i. Rules for Producing Questions: 1. Ask as many questions as you can. 2. Do not stop to discuss, judge or answer the questions. 3. Write down every question exactly as it is stated. 4. Change any statement into a question. c. *In your list, you might have the two types of questions: closed-ended and open-ended.* i. Review your list of questions and identify closed and open-ended questions. ii. Mark the open-ended questions with an O and the closed-ended questions with a C. iii. THEN, change questions from one type to another. Go back to your list of questions and change one closed-ended question into an open-ended, and change one open-ended question into a	Setting Objectives Cues and Questions Non-Linguistic Representation Cooperative Learning Generating and Testing Hypothesis	A Critical Thinking Collaboration Communication

		closed-ended one. Make the changes right on the list. d. Choose the three most important questions from your list. Mark them with an "X" and discuss your reasons for selecting those three.		
1, 2, 5	4-PS3-4/MO 4.PS3.B.2 CCC5 SEP 2	**Day Two: Modeling** **Objective:** Students will create a model to show how energy is transferred. a. Class discussion i. In your table/group review questions from the previous day's activity. ii. Select one person to share your top 3 questions with the class. iii. Individually, sketch a model of how you think a roller coaster gets from beginning to end. 1. Important aspects of creating a model. Examples: a. Title b. Diagram with labels c. Explanation d. Color/color-coding e. Zoom-in bubbles f. Measurement/Time g. Questions iv. Have students share their model with their table/group and explain their thinking (and hear others' thinking). v. When finished, tell students to revise their model to include some (or more than they had before) of the elements described above and write an explanation of how and why they think the roller coaster makes it from start to finish. vi. Lastly, have students participate in a gallery walk to view other student's models and explanations. (When creating models, a tech option--to allow for a virtual gallery walk and peer feedback--could be to use Google Drawings on Chromebooks or a drawing app on iPads like Paper.)	Setting Objectives Cues and Questions Non-Linguistic Representation Cooperative Learning Generating and Testing Hypothesis	C Critical Thinking Collaboration Communication Creativity
1, 2, 5	4-PS3-2/MO 4.PS3.B.2 4-PS3-4/MO 4.PS3.B.2 CCC5	**Day Three: Investigation** **Objective:** Students will investigate how energy is transferred. DIRECTIONS: a. Have students work in groups of 3 or 4. b. Gather supplies. Each group needs: Masking tape, ruler, paper cup, a foam track, 2 marbles c. Teams need to build a track that begins at an elevated point and has 2	Cues and Questions Identifying Similarities and Differences Cooperative	B Collaboration Communication

	SEP 3	additional hills. The cup is placed at the end of the track to catch the marbles. Students place one marble (**S**) at the elevated starting point and the other target marble (**T**) at some point along the track. The objective is to get both marbles to end up in the cup. Masking tape can be used to secure the track to it's starting location and along the floor. Hill heights can be adjusted as needed to facilitate success. Use this data collection sheet .	Learning Generating and Testing Hypothesis	Creativity
1, 2, 5	4-PS3-4/MO 4.PS3.B.2 CCC5 SEP 8	**Day Four: Research** **Objective:** Students will research and understand how energy is transferred. 1. Students will read the given articles about how roller coasters work. 2. Have students research and take notes over how energy is transferred from the starting point to the end point of the rollercoaster. **Research Links:** Article: How do Roller Coasters Work? Article: How Roller Coasters Work Article: Best Roller Coaster Ride Ever Simulation	Setting Objectives Cues and Questions Non-Linguistic Representation Identifying Similarities and Differences	C Critical Thinking Communication Collaboration
1, 2, 5	4-PS3-4/MO 4.PS3.B.2 CCC5 SEP 6	**Day Five: Construct an Explanation** **Objective:** Students will construct an explanation to show how energy is transferred. 1. Students will revisit model from Day One and revise based on new learning. 2. Have students use their revised model to create a claim about how the energy is transferred on roller coaster ride from beginning to end. Use the Constructing Explanations Template to construct their response. Constructing Explanations Template	Cues and Questions Non-Linguistic Representation Graphic Organizer Identifying Similarities and Differences	D Critical Thinking Collaboration Communication Creativity

UNIT RESOURCES

Teacher Resources:

- Video: How Roller Coasters Work
- Data Collection Sheet
- Argumentation Template
- Energy Skate Park Simulation
- Circuit Construction Simulation
- Energy Power Sleuth
- Speedometry: Speedometry

Roller Coaster Links:

- Coaster 1
- Coaster 2
- Coaster 3
- Coaster 4
- Coaster 5

Student Resources:

Article: How do Roller Coasters Work?
Article: How Roller Coasters Work
Article: Best Roller Coaster Ride Ever
Simulation

Vocabulary:

Analyze - separate something into its parts in order to examine them; to study or examine carefully
Conduct - to do, manage or lead
Construct - to make or form by combining or arranging parts or elements
Investigation - a detailed inquiry or systematic examination
Kinetic Energy - the energy of a body or a system with respect to the motion of the body or of the particles in the system
Observe - to watch carefully especially with attention to details or behavior for the purpose of arriving at a judgement
Potential Energy - the energy of a body or a system with respect to the position of the body or the arrangement of the particles of the system
Procedure - a series of steps taken to accomplish an end
Scientific Inquiry - process of formulating scientifically-oriented questions, giving priority to evidence, formulating explanations, evaluating explanations in light of alternative explanations, and communicating and justifying proposed explanations

Unit 4: Ride the Wave

Content Area: Science	Course: Fourth Grade	UNIT: Ride the Wave (Waves: Waves and Information)

Unit Description: Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. **Anchor Chart Example:** **Patterns of Waves** **Waves and Info**	**Unit Timeline:** 2 weeks: 10 days

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. **Asking Questions and Defining Problems:** Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
2. **Developing and Using Models:** Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
3. **Planning and Carrying Out Investigations:** Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
6. **Constructing Explanations and Designing Solutions:** Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Understandings – *Students will understand that… (Big Ideas)*

1. (Patterns) Similarities and differences in patterns can be used to sort and classify natural phenomena. Similarities and differences in patterns can be used to sort and classify designed products.

Essential Questions: ***Students will keep considering…***

- What are waves and what are some things they can do?
- How are waves used to transfer energy and information?
- What are the characteristic properties and behaviors of waves?
- How are instruments that transmit and detect waves used to expand human senses?

STANDARDS ADDRESSED		
Students who demonstrate understanding can: **4-PS4-1/MO 4.PS4.A.1 Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength. The terms *amplitude* and *wavelength* should not be assessed.] 4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information. [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.] 3-5 ETS1-3/MO 4.ETS.1.C.1 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		
Disciplinary Core Ideas **Students will know...**	**Cross Cutting Concepts** **Students will understand…**	**Science and Engineering Practice** **Students will be able to...**
PS4.A: Wave Properties ● **Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (4-PS4-1)** ● **Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)**	**CCC1: Patterns** ● **Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)**	SEP1: Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships. ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. **SEP 2: Developing and Using Models** **Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.** ● **Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)**

PS4.C: Information Technologies and Instrumentation ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) ETS1.C: Optimizing the Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS-3)	**CCC1: Patterns** ● **Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)**	SEP 3: Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3) SEP 6: Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

Unit 4: Assessment

EVIDENCE of LEARNING			
Understandings 1	Standards **4-PS4-1/MO** **4.PS4.A.1** **PS4.A** **CCC1** **SEP2**	**Unit Performance Assessment**: Ride the Wave **Scoring Guide:** *Located at the bottom of the assessment*	**R/R Quadrant 21 Century** D Critical Thinking Communication Creativity

Unit 4: Sample Activities

SAMPLE LEARNING PLAN
Pre-assessment: The teacher will review students' models made after Day 2. Formatively assess their application of the following model criteria: title, diagram with labels, explanation, color/color-coding, zoom-in bubbles, measurement/time, and questions.
Anchoring Phenomena for this Unit: How are bats able to navigate at night? How bats navigate at night

Understanding	Standards	Major Learning Activities:	Instructional Strategy:	R/R Quadrant: 21C:
1, 2, 5	4-PS4-1/MO 4.PS4.A.1 CCC1 SEP1	**Day One: Questioning** **Objective:** Students will ask questions about the patterns of sound. Show a video on bats navigating at night: How bats navigate at night a. *In small groups, with one person as recorder, write down questions about what you are observing.* i. Rules for Producing Questions: 1. Ask as many questions as you can. 2. Do not stop to discuss, judge or answer the questions. 3. Write down every question exactly as it is stated.	Cues and Questions Non-Linguistic Representation Cooperative Learning	A Critical Thinking Collaboration Communicat

		4. Change any statement into a question. b. *In your list, you might have the two types of questions: closed-ended and open-ended.* i. Review your list of questions and identify closed and open-ended questions. ii. Mark the open-ended questions with an O and the closed-ended questions with a C. iii. THEN, change questions from one type to another. Go back to your list of questions and change one closed-ended question into an open-ended, and change one open-ended question into a closed-ended one. Make the changes right on the list. *c.* Choose the three most important questions from your list. Mark them with an "X" and discuss your reasons for selecting those three.	Generating and Testing Hypothesis	ion
1, 2, 5	4-PS4-1/MO 4.PS4.A.1 CCC1 SEP1 SEP2	**Day Two: Modeling** **Objective:** Students will create a model to show the patterns of sound. Class discussion i. In your table/group review questions from the previous day's activity. ii. Select one person to share your top 3 questions with the class. iii. Individually, sketch a model of how you think a bat flies at night. 1. Important aspects of creating a model. Examples: a. Title b. Diagram with labels c. Explanation d. Color/color-coding e. Zoom-in bubbles f. Measurement/Time g. Questions iv. Have students share their model with their table/group and explain their thinking (and hear others' thinking). v. When finished, tell students to revise their model to include some (or more than they had before) of the elements described above and write an explanation of how and why they think the roller coaster makes it from start to finish. vi. Lastly, have students participate in a gallery walk to view other student's models and explanations. (When creating models, a tech option--to allow for a virtual gallery walk and peer feedback--could be to use Google Drawings on Chromebooks or a drawing app on iPads like Paper.)	Setting Objectives Cues and Questions Non-Linguistic Representation Cooperative Learning Generating and Testing Hypothesis	C Critical Thinking Collaboration Communication Creativity

1, 2, 5	4-PS4-1/MO 4.PS4.A.1 CCC1 SEP3	**Day 3: Investigation** **Objective:** Students will investigate the patterns of waves moving through space. DIRECTIONS - Making Waves with a Rope: 1. Two group members kneel on the floor on opposite ends of the rope and stretch the rope all the way out so it is straight. 2. One group member holds an end of the rope on the floor. The other group member repeatedly lifts the other end of the rope up and then flicks her wrist down to make even, steady wave patterns in the rope. 3. Group members who are not holding the rope should record their observations. 4. Group members holding the rope switch roles with group members recording observations. DIRECTIONS - Making Waves with a Spring Toy: 1. Two group members kneel on the floor on opposite ends of the spring toy and stretch the spring toy almost all the way out along the floor. 2. One group member holds an end of the spring toy steady, and the other group member pushes the other end of the spring toy forward (toward the other group member). Leave the spring toy on the floor and keep holding on to the ends. 3. Wait until the spring toy has stopped moving before pushing it again. Focus on pushing the spring toy forward rather than moving it side to side. 4. Group members who are not holding the spring toy should record their observations. 5. Group members holding the spring toy switch roles with group members recording observations. Lab Sheet	Setting Objectives Cues and Questions Graphic Organizer Identifying Similarities and Differences Cooperative Learning Generating and Testing Hypothesis	B Collaboration Communication Creativity
1, 2, 5	4-PS4-1/MO 4.PS4.A.1 CCC1 SEP2 SEP8	**Day Four: Research** **Objective:** Students will research and understand the motion and patterns of waves. **1. Setting a Purpose for Reading** Students are introduced to the book *Warning: Tsunami* and the teacher models visualization after the class has read a few pages together. This serves as an introduction to the visualization reading strategy, which students will employ throughout the unit. **2. Partner Reading** Students read the book *Warning: Tsunami.* Students apply the reading strategy of visualization by recording what they visualize when they think of various measurements in the book. **3. Reflection**	Setting Objectives Cues and Questions Non-Linguistic Representation Identifying Similarities and	C Critical Thinking Communication Collaboration

		Students discuss what they have learned thus far about the patterns of motion in waves as preparation for applying that knowledge to sound waves in a future lesson.	Differences	
1, 2, 5	4-PS4-1/MO 4.PS4.A.1 CCC1 SEP2 SEP6	**Day Five: Construct an Explanation** **Objective:** Students will construct an explanation to make a claim based on patterns about how bats move at night. 1. Students will revisit model from Day One and revise based on new learning. 2. Have students use their revised model to create a claim about how bats are able to navigate at night. Use the Constructing Explanations Template to construct their response.	Cues and Questions Non-Linguistic Representation Graphic Organizer	D Critical Thinking Communication

Unit 4: Resources

UNIT RESOURCES
Teacher Resources: ● Lab Sheet ● Warning: Tsunami Sheet ● Argumentation Template ● Sound Simulation ● Waves on a String Simulation
Student Resources: ● Lab Sheet ● Warning: Tsunami Sheet ● Argumentation Template
Vocabulary: **Amplitude** - the absolute value of the maximum displacement from a zero value during one period of an oscillation. **Analyze** - to separate something into its parts in order to examine them; to study or examine something carefully **Describe** - to represent or give an account of in words; to give an account of something by giving details of its characteristics **Energy** - the capacity for vigorous activity; available power **Explanation** - Something that explains; a statement made to clarify something and makes it understandable **Wave** - a disturbance on the surface of a liquid body, as the sea or a lake, in the form of a moving ridge or swell **Wavelength** - the distance, measured in the direction of propagation of a wave, between two successive points in the wave that are characterized by the same phase of oscillation