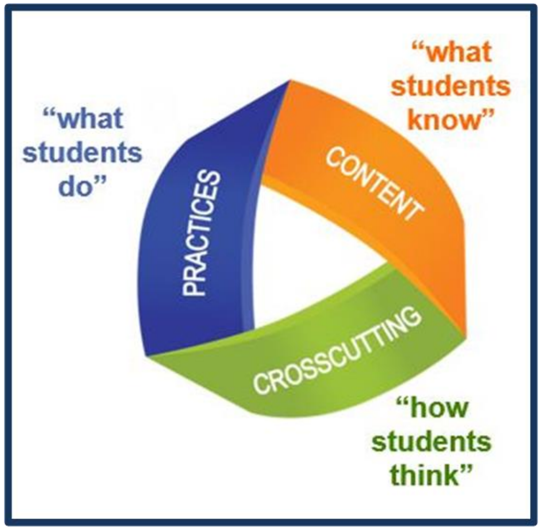
Ledyard Public Schools
Fourth Grade NGSS Curriculum



District Science Curriculum Committee	
Kim Pelletier	District Math and Science Consultant
Barbara Heaney, Ashley Zelinski, Gina Peluso	Kindergarten
Katherine McKelvey, Kathy Colosi, Janice Masse	First Grade
Johanne Wernquest, Deb Biondo, Kevin Rogers	Second Grade
Jennifer Pacheco, Matthew Hyatt, Lisa Silva	Third Grade
Santo Silva, Emily Reed, Ben Freiert	Fourth Grade
Lisa Tedder, Nikki Conger, Jeff Lewis	Sixth Grade
Sandy DeRosa, Dave Davino	Seventh Grade

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District Philosophy

Ledyard's vision for K-12 inquiry based science is to engage students in scientific and engineering practices as they apply crosscutting concepts to deepen their understanding of the core ideas in these fields.

A New Vision for Science Education

Implications of the Vision of the Framework for K-12 Science Education and the Next Generation Science Standards

SCIENCE EDUCATION WILL INVOLVE LESS:	SCIENCE EDUCATION WILL INVOLVE MORE:
Rote memorization of facts and terminology.	Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.
Learning of ideas disconnected from questions about phenomena.	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned.
Teachers providing information to the whole class.	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance.
Teachers posing questions with only one right answer.	Students discussing open-ended questions that focus on the strength of the evidence used to generate claims.
Students reading textbooks and answering questions at the end of the chapter.	Students reading multiple sources, including science-related magazine and journal articles and web-based resources; students developing summaries of information.
Pre-planned outcome for "cookbook" laboratories or hands-on activities.	Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas.
Worksheets.	Student writing of journals, reports, posters, and media presentations that explain and argue.
Oversimplification of activities for students who are perceived to be less able to do science and engineering	Provision of supports so that all students can engage in sophisticated science and engineering practices

Source: National Research Council. (2015). *Guide to Implementing the Next Generation Science Standards* (pp. 8-9). Washington, DC: National Academies Press. http://www.nap.edu/catalog/18802/guide-to-implementing-the-next-generation-science-standards

Three Dimensions of the *Next Generation Science Standards*:

SEP (appendix F), DCI (appendix E), CCC (appendix G)

Scientific and Engineering Practices Matrix

Asking Questions and Defining Problems
A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations
Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data
Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models
A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions
The products of science are explanations and the products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence
Argumentation is the process by which explanations and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.

Using Mathematics and Computational Thinking
In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information
Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

NGSS@ NSTA STEM STARTS HERE

www.nsta.org/ngss

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

Disciplinary Core Ideas Matrix Grade 4 Disciplinary Core Ideas are highlighted yellow			
Physical Science	**Life Science**	**Earth and Space Science**	**Engineering, Technology, and the Application of Science**
PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale Systems ESS2.C: The Role of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

Crosscutting Concepts Matrix		
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. Cause and Effect: Mechanism and Explanation Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.	Scale, Proportion, and Quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. Systems and System Models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.	Energy and Matter: Flows, Cycles, and Conservation Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. Structure and Function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. Stability and Change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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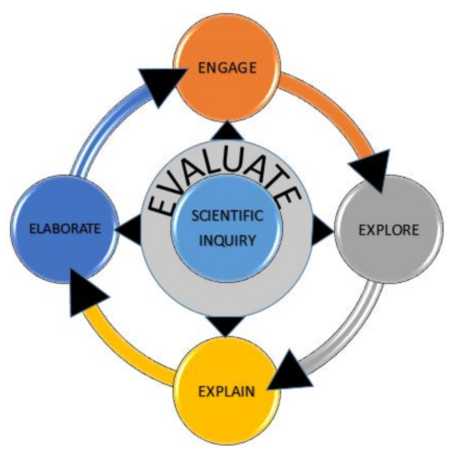
Connections to the Nature of Science

Nature of Science Practices	Nature of Science Crosscutting Concepts
These understandings about the nature of science are closely associated with the science and engineering practices, and are found in that section of the foundation box on a standards page. More information about the Connections to Engineering, Technology and Applications of Science can be found in Appendix H.	These understandings about the nature of science are closely associated with the crosscutting concepts, and are found in that section of the foundation box on a standards page. More information about the Connections to Engineering, Technology and Applications of Science can be found in Appendix H.
Scientific Investigations Use a Variety of Methods	Science is a Way of Knowing
Science Knowledge is Based on Empirical Evidence	Scientific Knowledge Assumes and Order and Consistency in Natural Systems
Scientific Knowledge is Open to Revision in Light of New Evidence	Science is a Human Endeavor
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena.	Science Addresses Questions About the Natural and Material World

How does Ledyard Define Inquiry?

Inquiry is defined as a way of seeking information, knowledge, or truth through questioning. Inquiry is a way for a learner to acquire new information and data and turn it into useful knowledge. Inquiry involves asking good questions and developing robust investigations from them. Inquiry also involves considering possible solutions and consequences. A third component of inquiry is separating evidence based claims from common opinion, and communicating claims with others, and acting upon these claims when appropriate. Questions lead to gathering information through research, study, experimentation, observation, or interviews. During this time, the original question may be revised, a line of research refined, or an entirely new path may be pursued. As more information is gathered, it becomes possible to make connections and allows individuals to construct their own understanding to form new knowledge. Sharing this knowledge with others develops the relevance of the learning for both the student and a greater community. Sharing is followed by reflection and potentially more questions, bringing the inquiry process full circle.

Inquiry 5 Science Teaching Model



Engagement	Object, event or question used to engage students. Connections facilitated between what students know and can do.
Exploration	Objects and phenomena are explored. Hands-on activities, with guidance.
Explanation	Students explain their understanding of concepts and processes. New concepts and skills are introduced as conceptual clarity and cohesion are sought.
Elaboration	Activities allow students to apply concepts in contexts, and build on or extend understanding and skill.
Evaluation	Students assess their knowledge, skills and abilities. Activities permit evaluation of student development and lesson effectiveness.

Ledyard Next Generation Science Standards Grade 4

Unit 1: The Study of Organism Structures and Survival

(21 days in First Trimester August-November)

Anchoring Phenomenon	
Humpback whales communicate through sound Firefly communication	
Compelling Questions	**Supporting Questions**
How are animal structures used for communication and sensing the environment? How are plant structures used for support and growth? Why is energy transfer important?	• What animal and plant structures use energy transfer for support and growth? • What are the types of energy transfer? • How is energy transferred? • Why is sensing the environment important for animals? • Why do animals need camouflage?
Storyline	**Possible Student Misconceptions:**
Fourth graders will investigate animal structures, functions and patterns in communication.	*Animals do not communicate.* *Waves are just in the ocean.* *Energy is only electric.*

Unit 1: The Study of Organism Structures and Survival Overview

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• **4-PS4-2** • **4-PS4-3** • **4-LS1-1** • **4-LS1-2** • **3-5 ETS1-2** *Teacher Note: : All the <u>Performance Expectations</u> above will be covered this unit and can be worked on concurrently. All <u>Science and Engineering Practices</u> and <u>Crosscutting Concepts</u> in bold are written in the Performance Expectations above. The italicized practices and crosscutting concepts, although not mentioned specifically, may be incorporated additionally in any science lesson at any time.*	• *1: Asking Questions and Defining Problems* • *2: Developing and Using* Models • 3: Planning and Carrying Out Investigations • 4: Analyzing and Interpreting Data • 5: Using Mathematical Computational Thinking • 6: Constructing Explanations and Designing Solutions • 7: Engaging in Argument from Evidence • *8: Obtaining, Evaluating, and Communicating Information*	**<u>ENGINEERING, TECHNOLOGY AND THE APPLICATION OF SCIENCE</u>** • **ETS1 Engineering Design** -ETS1.C: Optimizing the Design Solution **<u>LIFE SCIENCE</u>** • **LS1 From Molecules to Organisms: Structure and Processes** -LS1.A: Structure and Function -LS1.D: Information Processing • **<u>PS4 Waves and Their Applications in Technologies for Information Transfer</u>** -PS4.B: Electromagnetic Radiation -PS4.C: Information Technologies and Instrumentation	• 1: Patterns • 2: Cause and Effect • *3: Scale, Proportion and Quantity* • *4: Systems and System Models* • *5: Energy and Matter* • *6: Structure and Function* • *7: Stability and Change*

Performance Expectation
4-PS4-2 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:
Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
Clarification Statement: *N/A*
Assessment Boundary: *Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*

Lesson Level Photo Analysis: What animal structures are used for sensing the environment?
Lesson Level Phenomenon Video: **Owls have huge eyes.**
note: all photo and video above links to suggested activities below

4-PS4-2 Suggested Activities	4-PS4-2 Recommended Formative Assessments
What Animal Structures Are Used For Sensing the Environment? (*TCI: Unit 1, Lesson 8*) Students will create a pinhole camera, which is used as a model for how the human eye works. They develop an explanation for how the camera works based on their observations and apply this explanation to a diagram of a human eye. (115 minutes) *Teachers will have used this lesson already to investigate Performance Expectation LS1-2	• Use the model of the eye and the pinhole camera to write an explanation how the pinhole camera works. Link to Resources

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to describe phenomena. ***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.***	**PS4.B Electromagnetic Radiation** • An object can be seen when light reflected from its surface enters the eyes.	**Cause and Effect** • Cause and effect relationships are routinely identified.

Performance Expectation
4-PS4-2 Waves and Their Applications in Technologies for Information Transfer

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
1.PS4.B ; 1.PS4.C ; MS.PS4.B ; MS.LS1.D

Common Core State Standards Connections:
ELA /Literacy -
SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-PS4-2)*

Mathematics —
MP.4 Model with mathematics. *(4-PS4-2)*

4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. *(4-PS4-2)*

Lesson Level Vocabulary: *sense receptor, ear drum, eye, antenna, ear, taste bud*

DCI Domain Vocabulary:
Domains are bold:
- **Waves and Their Applications in Technologies for Information Transfer→Electromagnetic Radiation (PS4)**
  flow, surface, x-ray, absorb, electric, properties of light, convert, particle, wave, wave-length

Performance Expectation
4-PS4-3 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:
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.*
Assessment Boundary: *N/A.*

Lesson Level Photo Analysis: How can patterns be used to send messages?
Lesson Level Phenomenon Video: You can send messages to and receive messages from people who are far away.
note: all photo and video above links to suggested activities below

4-PS4-3 Suggested Activities	4-PS4-3 Recommended Formative Assessments
How Far Can A Whisper Travel? (Mystery Science Grade 4 Waves of Sound, Mystery 1) Students will build a paper cup telephone using different materials (different cup sizes, yarn, string, fishing line, etc,) and investigate the connection between sound and vibration. (50 minutes) *Students could also investigate using drums to send coded information through sound waves, using a flashlight to convey information using a pattern of on and off, or using Morse code to send information. Build an instrument with a box and rubber bands of varying sizes that can be plucked in a pattern to communicate information. Use musical patterns on a xylophone or tuning forks to convey information.* How Can Patterns Be Used to Send Messages? (TCI Unit 4, lesson 6) Students will design and test digital devices that send secret messages. Students will determine which design/device works best. (135 minutes)	• Create a short opinion presentation explaining why their design model is the best for sound travel. Students will also write a reflection piece at the end of all the presentations supporting their opinion (and revisions) why their design model would be the best for sound travel.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ***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.***	**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. **ETSI.C Optimizing the Design Solution** • Different solutions need to be tested to determine which of them best solves the problem, given the criteria and the constraints.	**Patterns** • Similarities and differences in patterns can be used to sort and classify designed products. -- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Knowledge of relevant scientific concepts and research findings is important in engineering.

Performance Expectation
4-PS4-3 Waves and Their Applications in Technologies for Information Transfer

Connections to other DCIs in Fourth Grade:
4.ETS1.A

Articulation of DCIs across grade-levels:
K.ETS1.A ; 2.ETS1.B ; 2.ETS1.C ; 3.PS2.A ; MS.PS4.C ; MS.ETS1.B

Common Core State Standards Connections:
ELA /Literacy -
RI.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. *(4-PS4-3)*

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)
Mathematics —
N/A

Lesson Level Vocabulary: *digital device, telegraph*

DCI Domain Vocabulary:
Domains are bold:
- **Waves and Their Applications in Technologies for Information Transfer→Information Technologies and Instrumentation (PS4)**
  communicate, communication, electricity, form, cost, device, advantage, coded, cycle, decoded, display, electrical, exploration, medical, Morse code, product, properties of light, digital, high-tech, sound wave, application, conversion, convert, digitize, memory, solar, store, transfer, transmit, wave

Performance Expectation
4-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:
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: *Assessment is limited to macroscopic structures within plant and animal systems.*

Lesson Level Photo Analysis: What plant structures are used for support and growth?
Lesson Level Phenomenon Video: Palm trees can remain standing during strong winds.
note: all photo and video above links to suggested activities below

4-LS1-1 Suggested Activities	4-LS1-1 Recommended Formative Assessments
What Plant Structures Are Used For Support and Growth? (*TCI: Unit 1, Lesson 1*) Students will watch a series of videos on plant structures and ask questions based on their observations. Students will draw of model of a plant's system, explaining how a plant structure helps to support it, and to help it grow. (105 minutes)	• Complete the following claims correctly: "I know plants have structures for growth because…", and "I know plants have structures for support because…" • Write a short opinion piece defending their claim in which structure of the plant is most important to its survival. • Compare and contrast the leaves of a deciduous tree to the needles of a conifer.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Construct an argument with evidence, data, and/or a model. **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).**	**LS1.A: Structure and Function** • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Performance Expectation
4-LS1-1 From Molecules to Organisms: Structures and Processes

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
1.LS1.A ; 1.LS1.D ; 3.LS3.B ; MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy

W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)

Mathematics

4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. *(4-LS1-1)*

Lesson Level Vocabulary: *chlorophyll, leaf, photosynthesis, root, stem, vascular system*

DCI Domain Vocabulary:
Domains are bold:

- **Biological Evolution: Unity and Diversity→Biodiversity in Humans (LS4)**
  Earth, ecosystem, environment, environmental, erosion, habitat, health, human, living, material, medicine, pollution, recycle, recycling, safety, species, survival

Performance Expectation
4-LS1-2 From Molecules to Organisms: Structure and Processes

Students who demonstrate understanding can:
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: *Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.*

Lesson Level Photo Analysis: What animal structures are used for sensing the environment?
Lesson Level Phenomenon Video: Owls have huge eyes.
note: all photo and video above links to suggested activities below

4-LS1-2 Suggested Activities	4-LS1-2 Recommended Formative Assessments
What Animal Structures are Used for Sensing the Environment? (*TCI: Unit 1, Lesson 8*) Students will create a pinhole camera, which is used as a model for how the human eye works. They develop an explanation for how the camera works based on their observations and apply this explanation to an animal. (115 minutes) Camouflage, Countershading and Adaptations (NSTA) Students will investigate penguins and how they adapt to their environment.	• Use a model of the eye to label how light enters the eye. • Model countershading on an animal to camouflage it in its environment. Include an explanation of how the camouflage affects the interaction between predator and prey. (Model could include simple drawings or be created using technology.)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Use a model to test interactions concerning the functioning of a natural system. ***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.***	**LS1.D: Information Processing** • Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Performance Expectation
4-LS1-2 From Molecules to Organisms: Structure and Processes

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
MS.LS1.A ; MS.LS1.D

Common Core State Standards Connections:
ELA/Literacy

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-LS1-2)*

Mathematics

N/A

Lesson Level Vocabulary: *sense receptor, ear drum, eye, antenna, ear, taste bud*

DCI Domain Vocabulary:
Domains are bold:

- **From Molecules to Organisms: Structure and Processes→Information Processing (LS1)**
  brain, senses, chemical, mechanical, memory, perception, process, storage, transfer, transmit, accuracy

Performance Expectation
3-5-ETS1-2 Engineering Design

Students who demonstrate understanding can:
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.
Clarification Statement: N/A
Assessment Boundary: N/A

Lesson Level Photo Analysis: How can patterns be used to send messages?
Lesson Level Phenomenon Video: You can send messages to and receive messages from people who are far away.
note: all photo and video above links to suggested activities below

3-5-ETS1-2 Suggested Activities	3-5-ETS1-2 Recommended Formative Assessments
How Far Can A Whisper Travel? (Mystery Science Grade 4 Waves of Sound, Mystery 1) Students will build a paper cup telephone using different materials (different cup sizes, yarn, string, fishing line, etc,) and investigate the connection between sound and vibration. (50 minutes) Students could also investigate using drums to send coded information through sound waves, using a flashlight to convey information using a pattern of on and off, or using Morse code to send information. Build an instrument with a box and rubber bands of varying sizes that can be plucked in a pattern to communicate information. Use musical patterns on a xylophone or tuning forks to convey information How Can Patterns Be Used to Send Messages? (TCI Unit 4, lesson 6) Students will design and test digital devices that send secret messages. Students will determine which design/device works best. (135 minutes)	• Create a short opinion presentation explaining why their design model is the best for sound travel. Write a reflection piece at the end of all the presentations supporting their opinion (and revisions) why their design model would be the best for sound travel.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 problem. **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.**	**ETS1.B: Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • 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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Performance Expectation
3-5-ETS1-2 Engineering Design

Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-ESS3-2

Articulation of DCIs across grade-levels:
K-2.ETS1.A ; K-2.ETS1.B ; K-2.ETS1.C ; MS.ETS1.B ; MS.ETS1.C

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(3-5-ETS1-2)*
RI.5.1	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-ETS1-2)*
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2)

Mathematics -

MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-2)*
MP.4	Model with mathematics. *(3-5-ETS1-2)*
MP.5	Use appropriate tools strategically. *(3-5-ETS1-2)*
3-5.OA	Operations and Algebraic Thinking *(3-ETS1-2)*

Lesson Level Vocabulary: *digital device, telegraph*

DCI Domain Vocabulary:

Domains are bold:

- **Waves and Their Applications in Technologies for Information Transfer→Information Technologies and Intrumentation (PS4)**
  communicate, communication, electricity, form, cost, device, advantage, coded, cycle, decoded, display, electrical, exploration, medical, Morse code, product, properties of light, digital, high-tech, sound wave, application, conversion, convert, digitize, memory, solar, store, transfer, transmit, wave
- **Engineering Design→Developing Possible Solutions (ETS1)**
  diorama, existing, design problem, design process, design solution, designed, operate, peers, replicable experiment, reproducible result, independent, societal

Ledyard Next Generation Science Standards Grade 4

Unit 2: THE STUDY OF ENERGY AND EROSION

(34 days in Second Trimester December-March)

Anchoring Phenomenon	
Why aren't the oldest mountain ranges in the world the tallest mountain ranges in the world?	
Essential Questions	**Compelling Questions**
What evidence of patterns and systems do we see in motion, weathering, fossils, rocks, and rock formation?	• *What are some clues that Earth's surface changes?* • *How do fossils form and what do they show?* • *How is energy transferred between colliding objects?* • *How are energy and motion related?*
Storyline	**Possible Student Misconceptions:**
Students will build an understanding of systems and energy related to motion, weathering, fossils, and rock formation.	*Fossils are rocks.* *All mountains are the same age.*

Unit 2: The Study of Energy and Erosion Overview

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• **4-ESS2-1** • **4-PS3-3** • **4-ESS1-1** • **4-PS3-1** • **4-PS3-2** • **3-5-ETS1-3** *Teacher Note: All the <u>Performance Expectations</u> above will be covered this unit and can be worked on concurrently. All <u>Science and Engineering Practices</u> and <u>Crosscutting Concepts</u> in bold are written in the Performance Expectations above. The italicized practices and crosscutting concepts, although not mentioned specifically, may be incorporated additionally in any science lesson at any time.*	• **1: Asking Questions and Defining Problems** • *2: Developing and Using Models* • **3: Planning and Carrying Out Investigations** • *4: Analyzing and Interpreting Data* • *5: Using Mathematical Computational Thinking* • **6: Constructing Explanations and Designing Solutions** • *7: Engaging in Argument from Evidence* • *8: Obtaining, Evaluating, and Communicating Information*	**<u>EARTH AND SPACE SCIENCE</u>** • **ESS1 Earth's Place in the Universe** -ESS1.C: The History of Planet Earth • **ESS2 Earth's Systems** **-**ESS2.A: Earth Materials and Systems -ESS2.E: Biogeology **<u>ENGINEERING, TECHNOLOGY AND THE APPLICATION OF SCIENCE</u>** • **ETS1 Engineering Design** -ETS1.B :Developing Possible Solutions -ETS1.C: Optimizing the Design Solution **<u>PHYSICAL SCIENCE</u>** • **PS3 Energy** -PS3.A: Definitions of Energy -PS3.B: Conservation of Energy and Energy Transfer -PS3.C: Relationship Between Energy and Forces	• **1: Patterns** • **2: Cause and Effect** • *3: Scale, Proportion and Quantity* • *4: Systems and System Models* • **5: Energy and Matter** • *6: Structure and Function* • *7: Stability and Change*

Performance Expectation
4-ESS2-1 Earth's Systems

Students who demonstrate understanding can:
Make 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: *Assessment is limited to a single form of weathering or erosion.*

Lesson Level Photo Analysis: What evidence do you see that Earth's surface has changed?
Lesson Level Phenomenon Video: Parts of this coastline seem to have broken off.
note: all photo and video above links to suggested activities below

4-ESS2-1 Suggested Activities	4-ESS2-1 Recommended Formative Assessments
What Are Some Clues That Earth's Surface Changes? (TCI: Unit 3, Lesson 1) Students analyze clues and use evidence to explain whether water, wind, or living things are changing Earth's surface. (100 minutes)	• Use graphic to identify the type of erosion as wind, water or living things and explain how it changed the Earth's surface. Link to Resources

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **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.**	**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. **ESS2.E: Biogeology** • Living things affect the physical characteristics of their regions.	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change.

Performance Expectation
4-ESS2-1 Earth's Systems

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
2.ESS1.C ; 2.ESS2.A ; 5.ESS2.A

Common Core State Standards Connections:

ELA/Literacy -

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1)

Mathematics

MP.2 Reason abstractly and quantitatively. (4-ESS2-1)

MP.4 Model with mathematics. (4-ESS2-1)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *(4-ESS2-1)*

4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. *(4-ESS2-1)*

Lesson Level Vocabulary: *deposition, erosion, weathering*

DCI Domain Vocabulary:

Domains are bold:

- **Earth's Systems→Earth Materials and Systems; Biogeology (ESS2)**
  earthquake, ecosystem, erosion, mountain, ocean, period(time), planet, surface, valley, volcano, dam, movement, atmosphere, changes in Earth's surface, climate, Earth's surface, feature, force, gases of the atmosphere, glacial, surface feature, weathering, wind patterns, global, landform, local, mountain range, ocean floor, organism, plate, plateau, sediment, transport, vegetation, continental, microscopic, ocean trench, plate tectonics, wetlands, form, habitat, coral reef, organism, biosphere

Performance Expectation
4-PS3-3 Energy

Students who demonstrate understanding can:
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.*

Lesson Level Photo Analysis: How can you tell that energy transferred when a soccer ball is kicked?
Lesson Level Phenomenon Video: When the ball on one end is released, the ball on the other end moves.
note: all photo and video above links to suggested activities below

4-PS3-3 Suggested Activities	4-PS3-3 Recommended Formative Assessments
How is Energy Transferred by Colliding Objects? (TCI: Unit 2, Lesson 2) Students investigate collisions to identify how energy transfers between objects when they collide, and how the speed and weight of the objects affect these collisions. (115 minutes)	• Write and discuss predictions about collisions between balls of different mass (tennis ball to tennis ball vs. basketball to tennis ball)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. **Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.**	**PS3.A: Definitions of Energy** • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **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. **PS3.C: Relationship Between Energy and Forces** • When objects collide, the contact forces transfer energy so as to change the objects' motions.	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Performance Expectation
4-PS3-3 Energy

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
K.PS2.B ; 3.PS2.A ; MS.PS2.A ; MS.PS3.A ; MS.PS3.B ; MS.PS3.C

Common Core State Standards Connections:

ELA/Literacy –

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-3)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-3)

Mathematics -
N/A

Lesson Level Vocabulary: *collide, collision, touch, energy, conserved, transfers, motion*

DCI Domain Vocabulary:

Domains are bold:

- **Energy→Definitions of Energy; Conservation of Energy and Energy Transfer; Relationship Between Energy and Forces (PS3)**
  flow, form, universe, electrical, properties, spring (coil), forms of energy, independent, possess, transport, conservation, conversion, convert, microscopic scale, particle, renewable energy, store, transfer, liquid, melt, sound, speed, flow, form, state, region, surrounding, volume, collide, collision, Earth's surface, electrical, heat conduction, light absorption, properties, resource, sample, transform, vehicle, available, transport, chemical, conservation, conversion, current, electric current, lever arm, magnet, pulley, force, exert, store, transfer

Performance Expectation
4-ESS1-1 Earth's Place in the Universe

Students who demonstrate understanding can:

Identify evidence from patterns in rock formations and fossils in rock layers 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. Assessment is limited to relative time.*

Lesson Level Photo Analysis: What do fossils that organisms leave reveal about what Earth was like long ago?

Lesson Level Phenomenon Video: Fossil shell from an aquatic animal was found on land.

note: all photo and video above links to suggested activities below

4-ESS1-1 Suggested Activities	4-ESS1-1 Recommended Formative Assessments
How Do Fossils Form and What Do They Show? (TCI: Unit 3, Lesson 5) Students will investigate fossil layers found in desert locations, which used to be a sea. (105 minutes) "Will a Mountain Last Forever?" (Mystery Science Birth of Rocks: Weathering & Destructive Forces) Students will investigate the breakdown of rocks using sugar cubes, (65 minutes)	• Compare images of the erosion of the Grand Canyon and images of the erosion of Niagara Falls. Compare and contrast the erosion. Link to Resources • Sugar Shake Data Sheet

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Identify the evidence that supports particular points in an explanation. **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.**	**ESS1.C: The History of Planet Earth** • Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.	**Patterns** • Patterns can be used as evidence to support an explanation. --- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.

Performance Expectation
4-ESS1-1 Earth's Place in the Universe

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
2.ESS1.C ; 3.LS4.A ; MS.LS4.A ; MS.ESS1.C ; MS.ESS2.A ; MS.ESS2.B

Common Core State Standards Connections:

ELA/Literacy -

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1)

W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-ESS1-1)*

Mathematics -

MP.2 Reason abstractly and quantitatively. *(4-ESS1-1)*

MP.4 Model with mathematics. *(4-ESS1-1)*

4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *(4-ESS1-1)*

Lesson Level Vocabulary: *fossil, fossil record*

DCI Domain Vocabulary:
Domains are bold:
- **Earth's Place in the Universe→The History of Planet Earth (ESS1)**
  form, earthquake, erosion, history, planet, surface, volcanic eruption, canyon, fossil, layer, prehistoric organism, record, global, ice age, landscape, local, mountain chain, prehistoric environment, presence, regional, rock layer, solar system, Earth force, plate tectonics, rock formation

Performance Expectation
4-PS3-1 Energy

Students who demonstrate understanding can:
Use evidence to construct an explanation relating the speed of an object to the energy of that object.
Clarification Statement: N/A
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.*

Lesson Level Photo Analysis: A falling rock has energy.
Lesson Level Phenomenon Video: When a fast soccer ball hits the net, the net moves more than when a slow soccer ball hits it.
note: all photo and video above links to suggested activities below

4-PS3-1 Suggested Activities	4-PS3-1 Recommended Formative Assessments
How Are Energy and Motion Related? (TCI: Unit 2, Lesson 1) Students will track how far a ball rolls when placed on a ramp at different (angles) heights. Using their observations, students will then experiment with angles and the amount of energy needed to make a ball roll exactly 1 m along the floor and then exactly 2 m along the floor. (100 minutes) **Mathematics connection: Teachers could use protractors to discuss angles and angle measurement.*	• Make a claim on how energy and motion are related, then explain how you would investigate this claim (page 12, student interactive notebook).

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Use evidence (e.g., measurements, observations, patterns) to construct an explanation. **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.**	**PS3.A: Definitions of Energy** • The faster a given object is moving, the more energy it possesses.	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Performance Expectation
4-PS3-1 Energy

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
MS.PS3.A

Common Core State Standards Connections:
ELA/Literacy -

RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)
RI.4.3	Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. *(4-PS3-1)*
W.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1)
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)

Mathematics -
N/A

Lesson Level Vocabulary: *transfer, energy, conserved*

DCI Domain Vocabulary:
Domains are bold:

- **Energy→Definitions of Energy (PS3)**
  flow, form, universe, electrical, properties, spring (coil), forms of energy, independent, possess, transport, conservation, conversion, convert, microscopic scale, particle, renewable energy, store, transfer

Performance Expectation
4-PS3-2 Energy

Students who demonstrate understanding can:
Make observations to provide evidence that energy can be transferred place to place by sound, light, heat, and electric currents.
Clarification Statement: *N/A*
Assessment Boundary: Assessment does not include quantitative measurements of energy.

Lesson Level Photo Analysis: How does the fire help people stay warm?
Lesson Level Phenomenon Video: This car is not moving, but the woman's hair is still blowing around.
note: all photo and video above links to suggested activities below

4-PS3-2 Suggested Activities	4-PS3-2 Recommended Formative Assessments
How Energy is Transferred By Sound, Light and Heat? (*TCI: Unit 2, Lesson 3*) Students will describe the different ways that energy is transferred by sound, light, and heat in different pictures. (85 minutes) *teacher note: also refer to video of underwater plant in TCI: Unit 1, Lesson 1, Slide 16	• Label the various ways energy is transferred. Link to Resources

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. ***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***	**PS3.A: Definitions of Energy** • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **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. • Light also transfers energy from place to place. • 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.	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Performance Expectation
4-PS3-2 Energy

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
MS.PS3.A ; MS.PS3.B ; MS.PS4.B

Common Core State Standards Connections:

ELA /Literacy –

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-2)

Mathematics —
N/A

Lesson Level Vocabulary: *absorb, reflect, vibrate*

DCI Domain Vocabulary:

Domains are bold:

- **Energy→Definitions of Energy; Conservation of Energy and Energy Transfer (PS3)**
  flow, form, universe, electrical, properties, spring (coil), forms of energy, independent, possess, transport, conservation, conversion, convert, microscopic scale, particle, renewable energy, store, transfer, liquid, melt, sound, speed, flow, form, state, region, surrounding, volume, collide, collision, Earth's surface, electrical, heat conduction, light absorption, properties, resource, sample, transform, vehicle, available, transport, chemical, conservation, conversion, current, electric current

Performance Expectation
3-5-ETS1-3 Engineering Design

Students who demonstrate understanding can:
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.
Clarification Statement: N/A
Assessment Boundary: N/A

Lesson Level Photo Analysis: **How does fire help people stay warm?**
Lesson Level Phenomenon Video: **This car is not moving, but the woman's hair is still blowing around.**
note: all photo and video above links to suggested activities below

3-5 ETS1-3 Suggested Activities	3-5 ETS1-3 Recommended Formative Assessments
How Energy is Transferred By Sound, Light and Heat? (*TCI: Unit 2, Lesson 3*) Students will describe the different ways that energy is transferred. (85 minutes)	• Complete Energy Performance Task.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **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.**	**ETS1.B: Developing Possible Solutions** • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **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.	**N/A**

Performance Expectation
3-5-ETS1-3 Engineering Design

Connections to other DCIs in Fourth Grade:
Fourth Grade: 4-ESS3-2

Articulation of DCIs across grade-levels:
K-2.ETS1.A ; K-2.ETS1.B ; K-2.ETS1.C ; MS.ETS1.B ; MS.ETS1.C

Common Core State Standards Connections:

ELA/Literacy -

W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-3)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-3)*

W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-3)*

Mathematics -

MP.2 Reason abstractly and quantitatively. *(3-5-ETS1-3)*

MP.4 Model with mathematics. *(3-5-ETS1-3)*

MP.5 Use appropriate tools strategically. *(3-5-ETS1-3)*

Lesson Level Vocabulary: *N/A*

DCI Domain Vocabulary:

Domains are bold:

- **Engineering Design→Developing Possible Solutions; Optimizing the Design Solution (ETS1)**
  diorama, existing, design problem, design process, design solution, designed, operate, peers, replicable experiment, reproducible result, independent, characteristic, flow, cost, difficulty, presentation, successful, failure point, independent, perform, collaboratively, prototype, test results, trial

Ledyard Next Generation Science Standards Grade 4

Unit 3: The Study of Nature's Impact on Humans

(22 days in Third Trimester April-June)

Anchoring Phenomenon
Earthquakes happen less often in Connecticut than in California. Wind farms off our Atlantic coast can generate electricity.

Compelling Questions	Supporting Questions
What evidence of patterns and systems do we see in erosion, waves, and Earth's features?	• *Where are earthquakes and volcanoes formed?* • *What can people do about natural hazards?* • *What are some examples/properties of waves?* • *How can waves travel through Earth?*
Storyline	**Possible Student Misconceptions:**
Students will build an understanding of waves, Earth features, and energy transfer.	*Waves can only be seen.* *Natural disasters can be prevented.*

Unit 3: The Study of Nature's Impact on Humans Overview

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• **4-ESS2-2** • **4-ESS3-2** • **4-PS4-1** • **4-PS3-4** • **4-ESS3-1** • **3-5-ETS1-1** *Teacher Note: All the Performance Expectations above will be covered this unit and can be worked on concurrently. All Science and Engineering Practices and Crosscutting Concepts in bold are written in the Performance Expectations above. The italicized practices and crosscutting concepts, although not mentioned specifically, may be incorporated additionally in any science lesson at any time.*	• *1: Asking Questions and Defining Problems* • **2: Developing and Using Models** • *3: Planning and Carrying Out Investigations* • **4: Analyzing and Interpreting Data** • **5: Using Mathematical** *Computational Thinking* • **6: Constructing Explanations and Designing Solutions** • *7: Engaging in Argument from Evidence* • **8: Obtaining, Evaluating, and Communicating Information**	**ENGINEERING, TECHNOLOGY AND THE APPLICATION OF SCIENCE** • **ETS1 Engineering Design** -ETS1.A Defining and Delimiting an Engineering Problem -ETS1.B Developing Possible Solutions **EARTH AND SPACE SCIENCE** • **ESS2 Earth's Systems** -ESS2.B: Plate Tectonics and Large Scale Systems • **ESS3 Earth and Human Activity** -ESS3.A: Natural Resources -ESS3.B: Natural Hazards **PHYSICAL SCIENCE** • **PS3 Energy** -PS3.B: Conservation of Energy and Energy Transfer -PS3.D: Energy in Chemical Processes and Everyday Life • **PS4 Waves and Their Applications in Technologies for Information Transfer** -PS4.A: Wave Properties	• **1: Patterns** • **2: Cause and Effect** • *3: Scale, Proportion and Quantity* • *4: Systems and System Models* • **5: Energy and Matter** • *6: Structure and Function* • *7: Stability and Change*

Performance Expectation
4-ESS2-2 Earth's Systems

Students who demonstrate understanding can:
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: *N/A*

Lesson Level Photo Analysis: **What is happening and what patterns do we notice in the mountain range?**
Lesson Level Phenomenon Video: **The mountain has a crater on top where lava came out.**
note: all photo and video above links to suggested activities below

4-ESS2-2 Suggested Activities	4-ESS2-2 Recommended Formative Assessments
Where Are Earthquakes,Volcanoes and Mountains Formed? (*TCI: Unit 3, Lesson 6*) Students will create a map of mountains, volcanoes, and earthquakes around the world and use this map to look for patterns. (105 minutes) Could A Volcano Pop Up In Your Backyard? (*Mystery Science Fourth Grade The Birth of Rocks, Mystery 1*) Students will explore the patterns of where volcanoes exist in the world today and where volcanoes have existed in the past. In the activity, students will use coordinates to locate volcanoes in different regions of the world to identify a major pattern of volcanoes known as the Ring of Fire. (55 minutes)	• Plot data of world volcanic activity on world map. • Analyze world earthquake activity and mountain formations on world map to identify patterns.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data • Analyze and interpret data to make sense of phenomena using logical reasoning. **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.**	**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.	**Patterns** • Patterns can be used as evidence to support an explanation.

Performance Expectation
4-ESS2-2 Earth's Systems

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
2.ESS2.B ; 2.ESS2.C ; 5.ESS2.C ; MS.ESS1.C ; MS.ESS2.A ; MS.ESS2.B

Common Core State Standards Connections:

ELA/Literacy –

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

W.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

Mathematics -

4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. *(4-ESS2-2)*

Lesson Level Vocabulary: *earthquake, elevation, lava, magma, physical map, volcano*

DCI Domain Vocabulary:

Domains are bold:

- **Earth's Systems→Plate Tectonics and Large Scale Systems (ESS2)**
  earthquake, flow, history, mountain, ocean, planet, reflection, rock characteristics, surface, volcano, continent, fossil, layer, movement, sea floor, collide, cycle, Earth's surface, feature, properties, bedrock, mountain chain, mountain range, ocean floor, organism, plate, band, continental, continental boundary, gravitational, laboratory, ocean trench, plate tectonics, pressure, topographic map

Performance Expectation
4-ESS3-2 Earth and Human Activity

Students who demonstrate understanding can:
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, and volcanic eruptions.*

Lesson Level Photo Analysis: **How can people reduce the damage of natural hazards?**
Lesson Level Phenomenon Video: **Flood water is washing away parts of this city.**
note: all photo and video above links to suggested activities below

4-ESS3-2 Suggested Activities	4-ESS3-2 Recommended Formative Assessments
What Can People Do About Natural Hazards? (*TCI: Unit 3, Lesson 7)* Students will investigate the different natural hazards that affect people living in the Appalachian Mountains and Rocky Mountains. They will compare four hazard plan proposals to determine which one works best in each region. (115 minutes)	• Developing Hazard Plans: Performance Assessment: Develop a hazard plan for Ledyard, Connecticut for hurricanes and flooding. (Possible coordination with Ledyard Planning Director as a guest speaker to discuss with students)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **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.**	**ESS3.B: Natural Hazards** • A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.*(Note: This Disciplinary Core Idea can also be found in 3.WC.)* **ETS1.B: Designing Solutions to Engineering Problems** • Testing a solution involves investigating how well it performs under a range of likely conditions. *(secondary)*	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. --- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.

Performance Expectation
4-ESS3-2 Earth and Human Activity

Connections to other DCIs in Fourth Grade:
4.EST1.C

Articulation of DCIs across grade-levels:
K.ETS1.A ; 2.ETS1.B ; 2.ETS1.C ; MS.ESS2.A ; MS.ESS3.B ; MS.ETS1.B

Common Core State Standards Connections:

ELA/Literacy –

RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. *(4-ESS3-2)*
MP.4	Model with mathematics. *(4-ESS3-2)*
4.OA.A.1	Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. *(4-ESS3-2)*

Lesson Level Vocabulary: *natural hazard, seismic hazard, map, tsunami*

DCI Domain Vocabulary:

Domains are bold:

- **Earth and Human Activity→Natural Hazards (ESS3)**
  drought, earthquake, existing, forest fire, form, hurricane, surface, tornado, tsunami, volcanic eruption, everyday life, hazard, lightning rod, natural hazard, region, barrier, climate, designed world, force, global, local, natural resource, resistant, natural process

Performance Expectation
4-PS4-1 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.

Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.

Lesson Level Photo Analysis: What patterns do you see in water waves? How are waves different? How are waves connected to earthquakes?

Lesson Level Phenomenon Video: The crowd does a movement called "the wave" at sporting events. You can surf on water waves. Earthquakes cause Earth to move.

note: all photo and video above links to suggested activities below

4-PS4-1 Suggested Activities	4-PS4-1 Recommended Formative Assessments
What Are Some Examples of Waves? (*TCI: Unit 4, Lesson 1)* Students will investigate and explore models of different kinds of waves to identify similarities and differences. (85 minutes) What Are Some Properties of Waves? (*TCI: Unit 4, Lesson 2)* Students will use models of waves to describe differences between waves. They then make their descriptions more precise by using the concepts of amplitude and wavelength. Finally, they act out the different properties of waves with their bodies. (115 minutes) Which Waves Travel Through the Earth? *(TCI: Unit 4, Lesson 4*) Students investigate and model how Earth's crust moves due to three types of seismic waves. Students will also investigate the properties and effects of seismic waves and their similarities to other examples of waves. (70 minutes)	• Draw a model to explain the following wavelengths in a tray of water: small amplitude and long wavelength, small amplitude and short wavelength, large amplitude and long wavelength, large amplitude and short wavelength.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model using an analogy, example, or abstract representation to describe a scientific principle. **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.** --- **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns.	**PS4.A: Wave Properties** • Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.*(Note: This grade band endpoint was moved from K–2.)* • Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).	**Patterns** • Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.

Performance Expectation
4-PS4-1 Waves and Their Applications in Technologies for Information Transfer

Connections to other DCIs in Fourth Grade:
4.PS3.A ; **4.PS3.B**

Articulation of DCIs across grade-levels:
MS.PS4.A

Common Core State Standards Connections:

ELA/Literacy -

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-PS4-1)*

Mathematics -

MP.4 Model with mathematics. *(4-PS4-1)*

4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. *(4-PS4-1*

Lesson Level Vocabulary: *crest, matter, rest position, trough, wave, amplitude, dependent, frequency, independent, wavelength, earthquake, seismic waves*

DCI Domain Vocabulary:
Domains are bold:

- **Waves and Their Applications in Technologies for Information Transfer→Wave Properties (PS4)**
  light reflection, surface, water wave, absorb, properties, properties of sound, sound wave, amplitude, dependent, light emission, light refraction, net motion, transmit, wave, wavelength, wave peaks

Performance Expectation
4-PS3-4 Energy

Students who demonstrate understanding can:
Apply scientific ideas to design, test, and refine and 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.*

Lesson Level Photo Analysis: Why are roller coasters constructed the way they are?
Lesson Level Phenomenon Video: Roller coaster
note: all photo and video above links to suggested activities below

4-PS3-4 Suggested Activities	4-PS3-4 Recommended Formative Assessments
Roller Coaster Building *(Science Buddies)* Students will build a roller coaster for marbles using foam pipe insulation and to investigate how much of the gravitational potential energy of a marble at the starting point is converted to the kinetic energy of the marble at various points along the track. (3-5 class periods)	• Write an explanation of how energy is converted from stored energy to kinetic energy. • Use roller coaster images to identify forms potential and kinetic energy.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Apply scientific ideas to solve design problems. **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.**	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. 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. ETS1.A: Defining Engineering Problems • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. *(secondary)*	Energy and Matter • Energy can be transferred in various ways and between objects. --- ***Connections to Engineering, Technology, and Applications of Science*** Influence of Engineering, Technology, and Science on Society and the Natural World • Engineers improve existing technologies or develop new ones. --- ***Connections to Nature of Science*** **Science is a Human Endeavor** • Most scientists and engineers work in teams. • Science affects everyday life.

Performance Expectation
4-PS3-4 Energy

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
K.ETS1.A ; 2.ETS1.B ; 5.PS3.D ; 5.LS1.C ; MS.PS3.A ; MS.PS3.B ; MS.ETS1.B ; MS.ETS1.C

Common Core State Standards Connections:

ELA/Literacy –

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-4)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-4)

Mathematics –

4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. *(4-PS3-4)*

Lesson Level Vocabulary: *potential energy, kinetic energy, conservation of energy, gravity, velocity, friction, slope*

DCI Domain Vocabulary:

Domains are bold:

- **Energy→Conservation of Energy and Energy Transfer; Energy in Chemical Processes and Everyday Life (PS3)**
  liquid, melt, sound, speed, flow, form, state, region, surrounding, volume, collide, collision, Earth's surface, electrical, heat conduction, light absorption, properties, resource, sample, transform, vehicle, available, transport, chemical, conservation, conversion, convert, current, electric circuit, electric current, electrical energy, heat transfer, particle, passive, solar heater, stored energy, transfer

Performance Expectation
4-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:
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.*
Assessment Boundary: N/A

Lesson Level Photo Analysis: **What are some ways homes can get electricity or other energy?**
Lesson Level Phenomenon Video: **Lots of different resources can provide energy.**
note: all photo and video above links to suggested activities below

4-ESS3-1 Suggested Activities	4-ESS3-1 Recommended Formative Assessments
How Do People Choose Energy Resources? (*TCI: Unit 2, Lesson 6)* Students will consider what kinds of advantages and disadvantages natural resources have, and how these factors affect the resources that people and communities choose to us. Students will research energy resources. (85 minutes)	• Identify the best energy resource (Power Plant) Ledyard should use.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Obtain and combine information from books and other reliable media to explain phenomena. **Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.**	**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.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. --- ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Knowledge of relevant scientific concepts and research findings is important in engineering. **Influence of Engineering, Technology, and Science on Society and the Natural World** • Over time, people's needs and wants change, as do their demands for new and improved technologies.

Performance Expectation
4-ESS3-1 Earth and Human Activity

Connections to other DCIs in Fourth Grade:
N/A

Articulation of DCIs across grade-levels:
5.ESS3.C ; MS.PS3.D ; MS.ESS2.A ; MS.ESS3.A ; MS.ESS3.C ; MS.ESS3.D

Common Core State Standards Connections:

ELA/Literacy –

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. *(4-ESS3-1)*

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS3-1)

W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-ESS3-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(4-ESS3-1)*

MP.4 Model with mathematics. *(4-ESS3-1)*

4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1)

Lesson Level Vocabulary: *renewable resource, natural resource, nonrenewable resource*

DCI Domain Vocabulary:

Domains are bold:

- **Earth and Human Activity→Natural Resources (ESS3)**
  coal, form, habitat, health, ocean, period (time), pollution, dam, human population, population, surrounding, animal product, atmosphere, biodiversity, designed world, fresh water, improved, metal, oil, resource, resource availability, weathering, fissile material, fossil fuel, fuel, mining, natural resource, nonrenewable, renewable, renewable resource, surface mining, conservation, nonrenewable energy, renewable energy

Performance Expectation
3-5 ETS1-1 Engineering Design

Students who demonstrate understanding can:
Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Lesson Level Photo Analysis: **Why are roller coasters constructed the way they are?**
Lesson Level Phenomenon Video: **Roller coaster**
note: all photo and video above links to suggested activities below

3-5 ETS1-1 Suggested Activities	3-5 ETS1-1 Recommended Formative Assessments
Roller Coaster Building *(Science Buddies)* Students will build a roller coaster for marbles using foam pipe insulation and to investigate how much of the gravitational potential energy of a marble at the starting point is converted to the kinetic energy of the marble at various points along the track. (3-5 class periods)	• Write an explanation of how energy is converted from stored energy to kinetic energy. • Use roller coaster images to identify forms potential and kinetic energy.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. **Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.**	**ETS1.A: Defining and Delimiting Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	**Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies.

Performance Expectation
3-5-ETS1-1 Engineering Design

Connections to other DCIs in Fourth Grade:
Fourth Grade: 4-PS3-4

Articulation of DCIs across grade-levels:
K-2.ETS1.A ; MS.ETS1.A ; MS.ETS1.B

Common Core State Standards Connections:
ELA/Literacy -

W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1)*
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1)*

Mathematics -

MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-1)*
MP.4	Model with mathematics. *(3-5-ETS1-1)*
MP.5	Use appropriate tools strategically. *(3-5-ETS1-1)*
3-5.OA	Operations and Algebraic Thinking *(3-ETS1-1)*

Lesson Level Vocabulary: *potential energy, kinetic energy, conservation of energy, gravity, velocity, friction, slope*

DCI Domain Vocabulary:
Domains are bold:

- **Engineering Design→Defining and Delimiting Engineering Problems (ETS1)**
  challenge, health, pollution, cost, situation, climate, design problem, design solution, designed world, feature, improved, operate, proposal, question formulation, resource, success, successful, global, local, natural resource, requirement, societal, supply, testable