Audubon Public Schools

Grade 5: Science

Curriculum Guide

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Course Description

Grade 5: Science

The fifth grade science curriculum is based on the Next Generation Science Standards. Each unit has three dimensions: disciplinary core ideas, scientific and engineering practices, and crosscutting concepts. The disciplinary core ideas focus on scientific knowledge. The science and engineering practices require involvement in scientific inquiry. The crosscutting concepts connect scientific knowledge to other areas of learning.

The six units of study are: ●Properties of Matter ●Changes in Matter ●Energy and Matter in Ecosystems ● Earth Systems ● Water on the Earth ● Earth, the Moon, and the Stars .

This curriculum will incorporate the three strands of Science: Earth Science, Life Science, and Physical Science. Students will be guided to develop an understanding of the role of decomposers, consumers, and producers in a healthy ecosystem. They will investigate how the geosphere, hydrosphere, atmosphere, and biosphere interact. They will develop models to examine patterns caused by the relative positions of Earth and the Sun, and identify matter as particles of matter too small to be seen.

Overview / Progressions

Grade 5: Science

Overview		Earth and Space Systems	Life Science	Physical Science
Unit 1	**Properties of Matter**			5-PS1-1 5-PS1-3
Unit 2	**Changes to Matter**			5-PS1-2 5-PS1-4
Unit 3	**Energy and Matter in Ecosystems**		5-LS1-1, 5-LS2-1	5-PS3-1
Unit 4	**Water on the Earth**	5-ESS2-2 5-ESS3-1		
Unit 5	**Earth Systems**	5-ESS2-1 5-ESS3-1		

Unit 6	**Interactions within the Earth, Sun, and Moon System**	5-ESS1-1 5-ESS1-2		5-PS2-1

Science	Grade 5	Unit 1	15 Instructional Days

Unit 1- Properties of Matter: In this unit of study, students describe that matter is made of particles too small to be seen by developing a model. The crosscutting concept of scale, proportion, and quantity is called out as an organizing concept for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, and use these practices to demonstrate understanding of the core ideas. **(5-PS1-1 and 5-PS1-3)**	
Overarching Essential Questions	**Overarching Enduring Understandings**
What are the properties of matter that make a substance unique and identifiable?	Matter can have both physical and chemical properties. Characteristic properties such as density can be used to identify different substances
What evidence indicates that a substance has changed?	Matter can be classified as a pure substance or mixture and then further classified as an element, compounds, heterogeneous mixture or homogeneous mixture
How can chemical changes be used to improve materials?	Adding or removing thermal energy affects the motion and interaction of particles which accounts for their physical state (solid, liquid, or gas)
Student Learning Objectives	
Students analyze how adding air to a balloon changes its weight, thus showing that some matter (air) is too small to be seen. Students can then create a simple balance with a ruler, attach an air-filled balloon on each side, and then pop one balloon. Students should use this evidence to support the claim that all matter has weight, even though particles that make up the matter are too small to be seen.	5-PS-1

Students create atoms of their choice, according to the periodic table, using M&Ms or Skittles as the protons, neutrons, and electrons. Students then learn "The Atoms Family" song and add a verse to the lyrics about their chosen atom.	5-PS-1
Students make observations and measurements of different materials to determine their properties. Students can compare baking soda, powdered sugar, metal, minerals, and liquids and then categorize the substances in different groups based on their color, size, shape, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.	5-PS-3

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 phenomena. (5-PS1-1) **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 measurements to produce data to serve as the basis for	**PS1.A: Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects. (5-PS1-1) Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is	**Cause and Effect** Natural objects exist from the very small to the immensely large. (5-PS1-1) Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.,(5-PS1-3)

	evidence for an explanation of a phenomenon. (5-PS1-3) **Using Mathematics and Computational Thinking** Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.	made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)	

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1)
- **W.5.7** - Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2), (5-PS1-3), (5-PS1-4)
- **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. (5-PS1-2), (5-PS1-3), (5-PS1-4)
- **W.5.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2), (5-PS1-3), (5-PS1-4)

Mathematics

- **5.MD.A.1** - Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-PS1-2)
- **5.MD.C.3** - Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1)
- **5.MD.C.4** - Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5-PS1-1)
- **5.NBT.A.1** - Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. (5-PS1-1)
- **5.NF.B.7** - Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1)
- **MP.2** - Reason abstractly and quantitatively. (5-PS1-1), (5-PS1-2), (5-PS1-3)
- **MP.4** - Model with mathematics. (5-PS1-1), (5-PS1-2), (5-PS1-3)
- **MP.5** - Use appropriate tools strategically. (5-PS1-2), (5-PS1-3)

Three-Dimensional Teaching and Learning

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 phenomena. (5-PS1-1)

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.

- 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. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 3–5 level builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

Prior Learning
• Kindergarten Physical Science: Students should understand that pushes and pulls are forces of energy, and that speed and direction of an object can change due to a force being applied. (K-PS2-1, K-PS2-2) • First grade Physical Science: Students should understand the basics of sound and light. • Second grade Physical Science: Students are aware of different physical and chemical changes that can exist, and that some changes are irreversible (such as the burning of a match). • Third grade Physical Science: Students understand that magnetism is a type of force beyond simple pushes and pulls, as learned in kindergarten. Students understand the idea that an object's past motion can help inform and predict future motion. • Fourth grade Physical Science: Students should understand the concept of energy transfer, as from sound, light, heat, and electricity. Students should be aware that energy comes in many forms, and can be converted from one form to another.

Properties of Matter	
Concept	**Formative Assessment**
Matter can be classified as either a pure substance or a mixture Pure substances are either elements or compounds. Elements are composed of only 1 type of atom and cannot be broken down into simpler substances. Compounds are composed of 2 or more different types of atoms chemically combined; compounds can only be broken down by chemical means. Mixtures can be classified as either heterogeneous or homogeneous. For heterogeneous mixtures, the substances comprising the mixture are not	*Students who understand the concepts are able to:* Categorize substances as either pure or mixture. Develop a method to categorize pure substances as either an element or compound Develop a method to categorize mixtures as either heterogeneous or homogeneous Create models to represent these substances on the atomic level

Modifications: ***Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)***

- *Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)*
- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques- auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- Create and present written descriptions to accompany the models developed
- Develop flow charts to assist in classification of substances

Mathematics-

- Calculate density after measuring mass and volume
- Apply graphical analysis to determine the relationship between energy, temperature, and the phase of substances

Samples of Open Education Resources for this unit:
Structures and Properties of Matter NGSS Lesson Plan Templates is a great source for lesson plan ideas for this unit. It includes printables, step-by-step instructions for lessons, and helpful videos and links. Brainpop: Matter and Chemistry is a video resource ideal for lesson hooks. Brainpop also provides quizzes and activities with each video which can be used for formative assessments. How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards. How to Grade STEM Projects is a blog post explaining how to assess STEM projects using rubrics and scales. Interactives: Matter is a collection of interactive websites ideal for science centers or exploratory learning for this unit. BetterLesson: Physical and Chemical Change Lab includes a step-by-step guide to physical and chemical change exploratory centers. (Note: Some centers can be altered according to materials available.) Teaching Channel: Physical and Chemical Changes Lesson is a video of a 5th grade teacher teaching a physical and chemical change hands-on sample lesson. 5th Grade Rocks: The Atoms Family can be used as a fun song to teach when learning about atoms. NSTA: Modeling Particles of Matter Instructional Sequence is a set of lessons and experiments for students to work through while investigating the differences in different matter. The Inquiry Project: Quick Matter Investigations is a set of video clips of mini experiments with different types of matter. This resource also includes suggested formative assessments to use alongside the lesson.

Science	Grade 5	Unit 2	15 Instructional Days

Unit 2 - Changes to Matter: In this unit of study, students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. The crosscutting concepts of cause and effect and scale, proportion, and quantity are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations and using mathematics and computational thinking. Students are expected to use these practices to demonstrate understanding of the core ideas. **5-PS1-4 and 5-PS1-2.**	
Overarching Essential Questions	**Overarching Enduring Understandings**
When matter changes, does its weight change?	Matter can have both physical and chemical properties.Characteristic properties such as density can be used to identify different substances
Can new substances be created by combining other substances?	Matter can be classified as a pure substance or mixture and then further classified as an element, compounds, heterogeneous mixture or homogeneous mixture
How can chemical changes be used to improve materials?	Adding or removing thermal energy affects the motion and interaction of particles which accounts for their physical state (solid, liquid, or gas)
Student Learning Objectives	
Students weigh and record the mass of a popsicle when frozen and melted. Students should find that the total weight of the system (popsicle, wrapper, and popsicle stick) stays the same, regardless of the change in the matter itself. Students can repeat this	5-PS-2

exploration with different substances: gelatin and water prior to and after setting, water and sugar prior to and after mixing, fruit salad prior to and after mixing, etc. In all cases, students should be able to argue that weight of matter is always conserved within the system.	
Students conduct an investigation and analyze a series of changes in centers and determine if they are physical or chemical changes. Centers may include breaking a pencil, melting ice, cutting paper, a banana turning brown, or mixing baking soda and vinegar. Students should be able to justify their answers with evidence of either a physical or chemical change.	5-PS-4
Students make observations and measurements of different materials to determine their properties. Students can compare baking soda, powdered sugar, metal, minerals, and liquids and then categorize the substances in different groups based on their color, size, shape, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.	5-PS-2; 5-PS-3

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
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. 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. **(5-PS1-4)**	**PS1.B: Structure and Properties of Matter** PS1.B: Chemical Reactions When two or more different substances are mixed, a new substance with different properties may be formed. **(5-PS1-4**) No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) **(5-PS1-2)**	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large. (5-PS1-1) Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. **(5-PS1- 2),(5-PS1-3)** ---------- Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems. **(5-PS1-2)**

Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3) **Using Mathematics and Computational Thinkin**g Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Measure and graph quantities such as weight to address scientific and engineering questions and problems. **(5-PS1-2)**		

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1)
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Three-Dimensional Teaching and Learning

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 phenomena. (5-PS1-1)

Planning and Carrying Out Investigations

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- 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. (5-PS1-4)
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Properties of Matter	
Concepts	**Formative Assessment**
Physical properties are characteristics of a material that can be observed or measured without changing the composition of the substances of the material Chemical properties are any property that produces a change in the composition of matter Physical changes occur when some properties of a material change, but the substances in the material stay the same Chemical changes occur when a substance reacts and forms one or more new substances	*Students who understand the concepts are able to:* Contrast physical and chemical properties for substances Contrast between physical and chemical changes for substances Categorize substances based on their properties Solve for the density of various objects by measuring their mass and volume and predict the type of matter for these objects through comparison to known densities

Modifications: ***Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)***

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- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- Create and present written descriptions to accompany the models developed
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Mathematics-

- Calculate density after measuring mass and volume
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Science	Grade 5	Unit 3	15 Instructional Days

Unit 3 -Energy and Matter in Ecosystems: In this unit of study, students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment, and they can explain that energy in animals' food was once energy from the sun. The crosscutting concepts of energy and matter and systems and system models are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in developing and using models and engaging in argument from evidence. Students are also expected to use these practices to demonstrate understanding of the core ideas. **5-LS1-1, 5-LS2-1, and 5-PS3-1.**	
Overarching Essential Questions	**Overarching Enduring Understandings**
How does matter and energy circulate through ecosystems?	Matter moves throughout a system between plants, animals, decomposers, and the environment, creating an interconnected web.
How do plants, animals, and decomposers rely on one another and on the environment?	Energy in animal's food was once energy from the sun.
Where does the energy in food come from and what is it used for?	Plants use primarily energy from the sun and air (not soil) to create food for other organisms.
Student Learning Objectives	
Students build biodomes using soda bottles, soil, plants, water, rocks, etc. and observe changes within the system over several weeks. Students should be able to not only make generalizations about their own biodomes, but also be able to compare results with other biodomes and analyze differences.	5-LS2-1

Students plant seeds in two different plastic baggie "environments": one with soil and water, the other with water only. The students should observe that the plant is able to survive off of water and sunlight alone.	5-LS1-1
Students analyze how different materials decompose in a plastic baggie (fruit, bread, etc.). Students track visual changes.	5-LS2-1
Students complete a STEM-based activity in which they explore soil biosolarization practices and how it can be a more sustainable pest-control option compared to typical practices. Students mimic the job of an agricultural engineer and replicate biosolarization techniques in the classroom using organic waste and soil and perform a lab to compare results.	5-LS2-1
Students explore how water moves through plants by placing celery, romaine, and roses into colored water and watching how the water moves through the capillaries of the plant. Students analyze the change over time and record the results in a daily journal entry.	5-LS1-1
Students research and create models of food chains and then present them in a "gallery walk" in the classroom. Students should be able to synthesize their presentations and find that in every food chain, the initial energy in the system came from the sun.	5-LS3-1

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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). Support an	**LS1.C: Organization for Matter and Energy Flow in Organisms** Plants acquire their material for growth chiefly from air and water. (5-LS1-1) **LS2.A: Interdependent Relationships in Ecosystems**	**Energy and Matter** Matter is transported into, out of, and within systems. (5-LS1-1) **Systems and System Models** A system can be described in terms of its components and their interactions. (5-LS2- 1)

argument with evidence, data, or a model. (5-LS1-1) Developing and Using Models Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. (5-LS2-1) ---------- Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena Science explanations describe the mechanisms for natural events. (5-LS2-1)	The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)	

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1)
- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-LS2-1), (5-PS3-1)
- **RI.5.9** - Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)
- **SL.5.5** - Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-LS2-1), (5-PS3-1)
- **W.5.1** - Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1)

Mathematics

- **5.MD.A.1** - Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-LS1-1)
- **MP.2** - Reason abstractly and quantitatively. (5-LS1-1), (5-LS2-1)
- **MP.4** - Model with mathematics. (5-LS1-1), (5-LS2-1)
- **MP.5** - Use appropriate tools strategically. (5-LS1-1)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 phenomena. (5-LS2-1)
- Use models to describe phenomena. (5-PS3-1)

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).

- Support an argument with evidence, data, or a model. (5-LS1-1)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events. (5-LS2-1)

Prior Learning

Kindergarten Life Science: Students should understand that organisms have different requirements in order to live, and that organisms can alter their environment in order to survive.

Second grade Life Science: Students should understand that plants need sun and water to survive, that animals can aid in the dispersal of seeds and pollinating of plants, and that ecosystems are extremely diverse.

Third grade Life Science: Students should understand that environments can greatly affect the plants and animals in that particular ecosystem, that some organisms are more likely to survive than others due to particular adaptations, and that organisms often adapt to changes in the environment.

Fifth grade Unit 2 Earth/Space Science: Students understand how the sun creates patterns in light, that gravity drives different cycles on Earth, and that water is unevenly distributed in, above, and below Earth's surface.

Properties of Matter	
Concepts	**Formative Assessment**
• Matter is transported into, out of, and within systems. • Plants acquire their material for growth chiefly from air and water • Science explanations describe the mechanisms for natural events. • A system can be described in terms of its components and their interactions. • The food of almost any kind of animal can be traced back to plants. • Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. • Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as decomposers. • Decomposition eventually restores (recycles) some materials back to the soil. • Organisms can survive only in environments in which their particular needs are met.	*Students who understand the concepts are able to:* • Describe how matter is transported into, out of, and within systems. • Support an argument with evidence, data, or a model. • Support an argument that plants get the materials they need for growth chiefly from air and water. (Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.) • Students who understand the concepts are able to: • Describe a system in terms of its components and interactions. • Develop a model to describe phenomena. • Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. (Assessment does not include molecular explanations.) • Emphasis is on the idea that matter that is not food—such as air, water, decomposed materials in soil—is changed into matter that is food. Examples of systems could include: Organisms Ecosystems Earth • Describe how energy can be transferred in various ways and between objects. • Use models to describe phenomena.

• Energy can be transferred in various ways and between objects. • The energy released from food was once energy from the sun, which was captured by plants in the chemical process that forms plant matter (from air and water). • Food provides animals with the materials they need for body repair and growth and the energy they need for motion and to maintain body warmth.	• Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. • Examples of models could include: Diagrams Flowcharts

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*

*Restructure lesson using UDL principles (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*

- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques- auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*

- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics
English Language Arts/Literacy- • Create and present written descriptions to accompany the models developed • Develop flow charts to assist in classification of substances *Mathematics-* • Calculate density after measuring mass and volume • Apply graphical analysis to determine the relationship between energy, temperature, and the phase of substances

Samples of Open Education Resources for this unit:
How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards. How to Grade STEM Projects is a blog post explaining how to assess STEM projects using rubrics and scales. Teaching Engineering: Biodomes provides a step-by-step guide to building biodomes, including pre and post-assessment ideas. Interactives: Animal Adaptations is a collection of interactive websites ideal for science centers or exploratory learning for this unit. A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information. Soil Biosolarization is a detailed STEM activity where students explore the sustainable practice of soil biosolarization. Water Movement Through Plants is a week-long lab in which students analyze how water moves through plants using colored water.

Science	Grade 5	Unit 4	15 Instructional Days

Unit 4 - Water on the Earth: Unit 4: Water on the Earth Instructional Days: 15 In this unit of study, students describe and graph data to provide evidence about the distribution of water on Earth. The crosscutting concepts of scale, proportion, quantity and systems, and systems models are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in using mathematics and computational thinking and in obtaining, evaluating, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on **5-ESS2-2 and 5-ESS3-1**	
Overarching Essential Questions	**Overarching Enduring Understandings**
How much water can be found in different places on Earth?	Earth's resources (such as fresh water) are spread unevenly on, below, and above Earth, and therefore should be protected by using science ideas.
How can individual communities use science ideas to protect the Earth's resources and environment?	
Student Learning Objectives	
Students hypothesize the amount of water on Earth available for human consumption. Teacher has 2-liter bottle of colored water to represent total amount of water on Earth and students take turns pouring out amounts into the following labeled containers: salt water, fresh water, ice caps, and soil/air/underground, water for human consumption. Students research true percentages and then revise their division of water (students will find only 1%-- approximately 2 drops--are available for human consumption). Full lab available here.	5-ESS3-1 5-ETS1-1
Students research water quality issues in New Jersey or in the United States. Students then draw, design, build and test a water filtration system in groups. e.	5-ESS2-2

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
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 example to describe a scientific principle. (5-ESS2-1) Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)	ESS2.C: The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)	Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2) Systems and System Models A system can be described in terms of its components and their interactions. (5-ESS2-1)

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS1-1), (5-PS2-1)
- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1)
- **RI.5.8** - Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (5-ESS1-1)
- **RI.5.9** - Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1), (5-PS2-1)
- **SL.5.5** - Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2)
- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
- **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. (5-ESS2-2), (5-ESS3-1)
- **W.5.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1

Mathematics

- **5.G.A.2** - Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)
- **MP.2** - Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **MP.4** - Model with mathematics. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **5.NBT.A.2** - Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 3–5 level builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

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/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

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.

- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

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).

- Support an argument with evidence, data, or a model. (5-ESS1-1), (5-PS2-1)

Prior Learning
Second grade Earth/Space Science: Students should understand that water comes in several forms and can be found in many places on Earth. Fourth grade Earth/Space Science: Students should understand that water can cause weather and erosion, that there are patterns in Earth's features, and that Earth's processes can affect humans.

Properties of Matter	
Concepts	**Formative Assessment**
• Standard units are used to measure and describe physical quantities such as weight and volume. • Nearly all of Earth's available water is in the ocean. • Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. • A system can be described in terms of its components and their interactions.	*Students who understand the concepts are able to:* ● *Describe physical quantities, such as weight and volume, in standard units.* ● *Describe and graph quantities such as area and volume to address scientific questions.* ● *Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. (Assessment is limited to oceans, lakes, rivers, glaciers, groundwater, and polar ice caps, and does not include the atmosphere.).*

• Science findings are limited to questions that can be answered with empirical evidence. • Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. • Individuals and communities are doing things to help protect Earth's resources and environments.	• Describe a system in terms of its components and interactions. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment

Modifications: ***Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)***

*Restructure lesson using UDL principles (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*

- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*

- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- English Language Arts Students use print and digital sources to gather information and data that describe the amount of freshwater and saltwater on the Earth and where it is found. As students gather information, they should organize the information into graphs, analyze and interpret the information to answer questions, and summarize the information in order to describe the amounts and percentages of fresh water and salt water on the Earth and to provide evidence about the distribution of water in oceans, lakes, streams, and reservoirs. Students also use several print and digital resources to find examples of: The effects of human activities in agriculture, industry, and everyday life on Earth's resources and environments

Mathematics-

- Mathematics Students model with mathematics by using tables, charts, and/or graphs to organize data and information they collect. This includes the amount of fresh and saltwater on Earth, the locations of both fresh and saltwater on Earth, how human activities affect Earth's resources, and ways in which communities protect the Earth's resources and environments. Students also reason abstractly and quantitatively when analyzing these data to use as evidence to support their thinking.

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Samples of Open Education Resources for this unit:

Kinesthetic Astronomy shows how to take science concepts outside to build understanding. On page 25 of the document, students can explore how different stars and constellations are in the sky during different seasons.

BrainsOn: Why is the Ocean Salty? BrainsOn is an NPR podcast for children that explores different concepts and questions that students have. This particular podcast explores the different types of water on Earth.

Mystery Science: Who Set the First Clock? is an exploratory lesson about the concept that time is based on the relative angle of the sun.

How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards.

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Interactives: Clouds & Water Cycle provides interactives and visuals for the concept that water is spread unevenly above, on, and below the Earth's surface.

A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information.

NSTA Water Filtration System is a lesson guide for a STEM lab where students design a water filtration system.

National Weather Service "What a Cycle" Lesson is a station-based interactive activity where students travel through stations to learn how water moves through Earth's systems.

Science	Grade 5	Unit 5	15 Instructional Days

Unit 5: Earth Systems: In this unit of study, students are able to describe ways in which the geosphere, biosphere, hydrosphere, and atmosphere interact. The crosscutting concept of systems and system models is called out as an organizing concept for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency in developing and using models, obtaining, evaluating, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based **on 5-ESS2-1 and 5-ESS3-1**	
Overarching Essential Questions	**Overarching Enduring Understandings**
How do the biosphere,hydrosphere, geosphere and atmosphere interact?	Each system on Earth directly or indirectly impacts the others, such as the oceans affecting weather patterns or the atmosphere affecting ecosystems.Energy in animal's food was once energy from the sun.
Student Learning Objectives	
Students analyze the impact of an oil spill on an environment. (Tin pan with water, feathers to mimic wildlife, rocks, soil, and plants.) Students add oil to the system and then hypothesize how to clean the system of the oil.	5-ESS3-1

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
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 example to describe a scientific	**ESS2.A:** Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans).	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight and volume**. (5-ESS2-2) Systems and System Models** A system can be described in terms of its components and their interactions**. (5-ESS2-1)**

principle. (5-ESS2-1) Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Describe and graph quantities such as area and volume to address scientific questions. **(5-ESS2-2)**----------	These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)**	

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Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS1-1), (5-PS2-1)
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- **SL.5.5** - Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2)
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- **5.G.A.2** - Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)
- **MP.2** - Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **MP.4** - Model with mathematics. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **5.NBT.A.2** - Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 represen events and design solutions.

- Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 3–5 level builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

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/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

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.

- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

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).

- Support an argument with evidence, data, or a model. (5-ESS1-1), (5-PS2-1)

Prior Learning

Second grade Earth/Space Science: Students should understand that water comes in several forms and can be found in many places on Earth.

Fourth grade Earth/Space Science: Students should understand that water can cause weather and erosion, that there are patterns in Earth's features, and that Earth's processes can affect humans.

Properties of Matter	
Concepts	**Formative Assessment**
• A system can be described in terms of its components and their interactions. • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). • The Earth's major systems interact in multiple ways to affect Earth's surface materials and processes. • The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. • Winds and clouds in the atmosphere interact with landforms to determine patterns of weather. • A system can be described in terms of its components and their interactions. • Science findings are limited to questions that can be answered with empirical evidence. • Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.	*Students who understand the concepts are able to:* • Describe a system in terms of its components and interactions. • Develop a model using an example to describe a scientific principle. • Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (The geosphere, hydrosphere, atmosphere, and biosphere are each a system. Assessment is limited to the interactions of two systems at a time.) • Examples could include: The influence of oceans on ecosystems, landform shape, and climate. The influence of the atmosphere on landforms and ecosystems through weather and climate. The influence of mountain ranges on the wind and clouds in the atmosphere. • Describe a system in terms of its components and interactions. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

• Individuals and communities are doing things to help protect Earth's resources and environments.	• Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Modifications: ***Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)***

*Restructure lesson using UDL principles (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*

- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- ***Reason abstractly and quantitatively when analyzing data used as evidence to explain how Earth's major systems interact and how human activities affect Earth's resources.***

Mathematics-

- ***Model with mathematics by using tables, charts, or graphs to organize data and information they collect to support explanations about the interactions that occur within and between Earth's systems.***

Samples of Open Education Resources for this unit:

Kinesthetic Astronomy shows how to take science concepts outside to build understanding. On page 25 of the document, students can explore how different stars and constellations are in the sky during different seasons.

BrainsOn: Why is the Ocean Salty? BrainsOn is an NPR podcast for children that explores different concepts and questions that students have. This particular podcast explores the different types of water on Earth.

Mystery Science: Who Set the First Clock? is an exploratory lesson about the concept that time is based on the relative angle of the sun.

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Interactives: Clouds & Water Cycle provides interactives and visuals for the concept that water is spread unevenly above, on, and below the Earth's surface.

A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information.

NSTA Water Filtration System is a lesson guide for a STEM lab where students design a water filtration system.

National Weather Service "What a Cycle" Lesson is a station-based interactive activity where students travel through stations to learn how water moves through Earth's systems.

Science	**Grade 5**	**Unit 6**	**15 Instructional Day**

Unit 6: Interactions Within the Earth, Sun, and Moon System: In this unit of study, students develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. The crosscutting concepts of patterns, cause and effect, and scale, proportion, and quantity are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in analyzing and interpreting data and engaging in argument from evidence. Students are also expected to use these practices to demonstrate an understanding of the core ideas. **This unit is based on 5-PS2-1, 5-ESS1-1, and5-ESS1-2.**	
Overarching Essential Questions	**Overarching Enduring Understandings**
How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?	There are patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
Student Learning Objectives	
Students create a shadow clock (paper plate sundial) and observe changes over the	5-ESS1-2

course of the day. Students should record graphical data and use evidence to support the argument that shadows change because of the change in direction of sunlight.	
Students create a model of the hydrologic (water) cycle and justify that the sun and gravity are the driving forces behind each part of the cycle. Students should be able to justify that without gravity, the water cycle would not function the way we know it to today.	5-PS2-1

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 example to describe a scientific **principle. (5-ESS2-1) Using Mathematics and Computational Thinking Mathematical** and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Describe and graph quantities such as area and volume to address scientific question**s. (5-ESS2-2)**	**ESS2.A: Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)**	**Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2) Systems and System Models A system can be described in terms of its components and their interactions. (5-ESS2-1**

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS1-1), (5-PS2-1)
- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1)
- **RI.5.8** - Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (5-ESS1-1)
- **RI.5.9** - Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1), (5-PS2-1)
- **SL.5.5** - Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2)
- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
- **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. (5-ESS2-2), (5-ESS3-1)
- **W.5.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1

Mathematics

- **5.G.A.2** - Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)
- **MP.2** - Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **MP.4** - Model with mathematics. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **5.NBT.A.2** - Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 represen events and design solutions.

- Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 3–5 level builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

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/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

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.

- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

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).

- Support an argument with evidence, data, or a model. (5-ESS1-1), (5-PS2-1)

Prior Learning

Second grade Earth/Space Science: Students should understand that water comes in several forms and can be found in many places on Earth.

Fourth grade Earth/Space Science: Students should understand that water can cause weather and erosion, that there are patterns in Earth's features, and that Earth's processes can affect humans.

Properties of Matter

Concepts	Formative Assessment
• Cause-and-effect relationships are routinely identified and used to explain change. • The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. • Unit Sequence Part B: What effect does the relative distance from Earth have on the apparent brightness of the sun and other stars? Concepts Formative Assessment • Natural objects exist from the very small to the immensely large. • The sun is a star that appears larger and brighter than other stars because it is closer. • Stars range greatly in their distance from Earth.) • • Unit Sequence Part C: What patterns do we notice when observing the sky? Concepts Formative Assessment • Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena. • The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its north and south poles, cause observable patterns. These include:Grade 5 Model Science Unit 6: Interactions Within the Earth, Sun, and Moon System (date 2.24.16)	• Students who understand the concepts are able to: • Identify cause-and-effect relationships in order to explain change. • Support an argument with evidence, data, or a model. • Support an argument that the gravitational force exerted by Earth on objects is directed down. ("Down" is a local description of the direction that points toward the center of the spherical Earth.) (Assessment does not include mathematical representation of gravitational force.). • Students who understand the concepts are able to: • Support an argument with evidence, data, or a model. • Support an argument that differences in the apparent brightness of the sun compared to that of other stars is due to their relative distances from Earth. (Assessment is limited to relative distances, not sizes, of stars, and does not include other factors that affect apparent brightness, such as stellar masses, age, or stage. • Students who understand the concepts are able to: • Sort, classify, communicate, and analyze simple rates of change for natural phenomena using similarities and differences in patterns. • Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. (Assessment does not include causes of seasons.) Examples of patterns could include: The position and motion of Earth with respect to the sun. Selected stars that are visible only in particular months.

	• Day and night Daily changes in the length and direction of shadows Different positions of the sun, moon, and stars at different times of the day, month, and year.

Modifications: ***Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)***

*Restructure lesson using UDL principles (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*

- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visua aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*
- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Leveraging English Language Arts/Literacy and Mathematics

English Language Arts/Literacy-

- ***Integrate information from multiple texts about the same topic to provide expertise.***

Mathematics-

- ***Reason abstractly and quantitatively. (5-ESS1-1),(5-ESS1-2) MP.2 Model with mathematics. (5-ESS1-1,(5-ESS1-2)) MP.4 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use wholenumber exponents to denote powers of 10. (5-ESS1-1) 5.NBT.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS1-2) 5.G.A.2***

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Samples of Open Education Resources for this unit:

Kinesthetic Astronomy shows how to take science concepts outside to build understanding. On page 25 of the document, students can explore how different stars and constellations are in the sky during different seasons.

BrainsOn: Why is the Ocean Salty? BrainsOn is an NPR podcast for children that explores different concepts and questions that students have. This particular podcast explores the different types of water on Earth.

Mystery Science: Who Set the First Clock? is an exploratory lesson about the concept that time is based on the relative angle of the sun.

How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards.

How to Grade STEM Projects is a blog post explaining how to assess STEM projects using rubrics and scales.

Interactives: Clouds & Water Cycle provides interactives and visuals for the concept that water is spread unevenly above, on, and below the Earth's surface.

A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information.

NSTA Water Filtration System is a lesson guide for a STEM lab where students design a water filtration system.

National Weather Service "What a Cycle" Lesson is a station-based interactive activity where students travel through stations to learn how water moves through Earth's systems.

Appendix

5th Grade Science

Unit 1: Structure and Properties of Matter (PS) (30 Instructional Days)

Rationale: Students will gain a general understanding of matter and the conservation of matter in a system in this unit. Students will use models and experimentation to determine foundational concepts about matter: matter is made up of particles that are too small to be seen, the weight of matter is conserved no matter the changes it undergoes, and that combining substances can result in new substances. Students should understand matter in order to fully understand ecosystems and how energy and matter can cycle through systems (Units 2 & 3).

Content Statement: Students will learn about what matter is made up of, how matter can change, and the conservation of mass and matter in a system.

Overarching Essential Questions	Overarching Enduring Understandings
What is matter made up of?	Matter is made of particles too small to be seen.
When matter changes, does its weight change?	Regardless of the change that matter undergoes, the total weight of matter is conserved.
Can new substances be created by combining other substances?	Combining particular substances can result in the creation of a new substance.

Student Learning Experiences and Formative Assessments	NGSS *Standards*
Students analyze how adding air to a balloon changes its weight, thus showing that some matter (air) is too small to be seen. Students can then create a simple balance with a ruler, attach an air-filled balloon on each side, and then pop one balloon. Students should use this evidence to support the claim that all matter has weight, even though particles that make up the matter are too small to be seen.	5-PS1-1

Students weigh and record the mass of a popsicle when frozen and melted. Students should find that the total weight of the system (popsicle, wrapper, and popsicle stick) stays the same, regardless of the change in the matter itself. Students can repeat this exploration with different substances: gelatin and water prior to and after setting, water and sugar prior to and after mixing, fruit salad prior to and after mixing, etc. In all cases, students should be able to argue that weight of matter is always conserved within the system.	5-PS1-2
Students make observations and measurements of different materials to determine their properties. Students can compare baking soda, powdered sugar, metal, minerals, and liquids and then categorize the substances in different groups based on their color, size, shape, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.	5-PS1-3
Students conduct an investigation and analyze a series of changes in centers and determine if they are physical or chemical changes. Centers may include breaking a pencil, melting ice, cutting paper, a banana turning brown, or mixing baking soda and vinegar. Students should be able to justify their answers with evidence of either a physical or chemical change.	5-PS1-2 5-PS1-4
Students create atoms of their choice, according to the periodic table, using M&Ms or Skittles as the protons, neutrons, and electrons. Students then learn "The Atoms Family" song and add a verse to the lyrics about their chosen atom.	5-PS1-1

Summative (Benchmark) Assessment
Students choose a substance (salt, baking soda, sugar, etc.) and create a model of the substance at the molecular level. Students should be able to state/show the physical properties of the substance and state 3-4 ways that this substance can change physically or chemically. The student can display this information in a variety of ways: diorama, poster, digital design, journal entry from the perspective of a scientist or the molecules themselves, or any of the creative ways to display informational research stated here.

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1)
- **W.5.7** - Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2), (5-PS1-3), (5-PS1-4)
- **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. (5-PS1-2), (5-PS1-3), (5-PS1-4)
- **W.5.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2), (5-PS1-3), (5-PS1-4)

Mathematics

- **5.MD.A.1** - Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-PS1-2)
- **5.MD.C.3** - Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1)
- **5.MD.C.4** - Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5-PS1-1)
- **5.NBT.A.1** - Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. (5-PS1-1)
- **5.NF.B.7** - Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1)
- **MP.2** - Reason abstractly and quantitatively. (5-PS1-1), (5-PS1-2), (5-PS1-3)
- **MP.4** - Model with mathematics. (5-PS1-1), (5-PS1-2), (5-PS1-3)
- **MP.5** - Use appropriate tools strategically. (5-PS1-2), (5-PS1-3)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 phenomena. (5-PS1-1)

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.

- 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. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 3–5 level builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

Disciplinary Core Ideas:

PS1.A: Structure and Properties of Matter

- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)

PS1.B: Chemical Reactions

- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)

Cross-cutting Concepts:

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (5-PS1-4)

Scale, Proportion, and Quantity

- Natural objects exist from the very small to the immensely large. (5-PS1-1)
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2), (5-PS1-3)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (5-PS1-2)

Prior Learning
Kindergarten Physical Science: Students should understand that pushes and pulls are forces of energy, and that speed and direction of an object can change due to a force being applied. (K-PS2-1, K-PS2-2) First grade Physical Science: Students should understand the basics of sound and light. Second grade Physical Science: Students are aware of different physical and chemical changes that can exist, and that some changes are irreversible (such as the burning of a match). Third grade Physical Science: Students understand that magnetism is a type of force beyond simple pushes and pulls, as learned in kindergarten. Students understand the idea that an object's past motion can help inform and predict future motion. Fourth grade Physical Science: Students should understand the concept of energy transfer, as from sound, light, heat, and electricity. Students should be aware that energy comes in many forms, and can be converted from one form to another.

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*

*Restructure lesson using UDL principles (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*

- *Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.*
- *Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).*

- *Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).*
- *Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).*
- *Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.*
- *Use project-based science learning to connect science with observable phenomena.*
- *Structure the learning around explaining or solving a social or community-based issue.*
- *Provide ELL students with multiple literacy strategies.*
- *Collaborate with after-school programs or clubs to extend learning opportunities.*

Samples of Open Education Resources for this unit:

Structures and Properties of Matter NGSS Lesson Plan Templates is a great source for lesson plan ideas for this unit. It includes printables, step-by-step instructions for lessons, and helpful videos and links.

Brainpop: Matter and Chemistry is a video resource ideal for lesson hooks. Brainpop also provides quizzes and activities with each video which can be used for formative assessments.

How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards.

How to Grade STEM Projects is a blog post explaining how to assess STEM projects using rubrics and scales.

Interactives: Matter is a collection of interactive websites ideal for science centers or exploratory learning for this unit.

BetterLesson: Physical and Chemical Change Lab includes a step-by-step guide to physical and chemical change exploratory centers. (Note: Some centers can be altered according to materials available.)

Teaching Channel: Physical and Chemical Changes Lesson is a video of a 5th grade teacher teaching a physical and chemical change hands-on sample lesson.

5th Grade Rocks: The Atoms Family can be used as a fun song to teach when learning about atoms.

NSTA: Modeling Particles of Matter Instructional Sequence is a set of lessons and experiments for students to work through while investigating the differences in different matter.

The Inquiry Project: Quick Matter Investigations is a set of video clips of mini experiments with different types of matter. This resource also includes suggested formative assessments to use alongside the lesson.

A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information.

5th Grade Science

Unit 2: Earth and Space Systems (ESS) (30 Instructional Days)

Rationale: Unit 2 provides the foundational Earth and Space science knowledge necessary prior to studying ecosystems in Unit 3. Students will learn how the movement of the Earth in proximity to the sun creates patterns in light. In conjunction with the effects of the sun, students will learn how gravity affects the different layered systems on and above the Earth's surface: biosphere, hydrosphere, geosphere, and atmosphere. This will also help establish an understanding of the distribution of water on, below, and above Earth's surface. It is through this unit that students will better understand how plants and animals will rely on these systems in Unit 3.

Content Statement: Students will learn about the patterns in light caused by the sun, the movement of materials due to gravity, the interactions between Earth's complex system of spheres, and the distribution of water on Earth.

Overarching Essential Questions	Overarching Enduring Understandings
How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?	There are patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
How do the biosphere, hydrosphere, geosphere and atmosphere interact?	Each system on Earth directly or indirectly impacts the others, such as the oceans affecting weather patterns or the atmosphere affecting ecosystems.
How much water can be found in different places on Earth? How can individual communities use science ideas to protect the Earth's resources and environment?	Earth's resources (such as fresh water) are spread unevenly on, below, and above Earth, and therefore should be protected by using science ideas.

Student Learning Experiences and Formative Assessments	NGSS *Standards*
Students create a shadow clock (paper plate sun dial) and observe changes over the course of the day. Students should record graphical data and use evidence to support the argument that shadows change because of the change in direction of sunlight.	5-ESS1-2
Students research water quality issues in New Jersey or in the United States. Students then draw, design, build and test a water filtration system in groups.	5-ESS3-1 5-ETS1-1
Students analyze the impact of an oil spill on an environment. (Tin pan with water, feathers to mimic wildlife, rocks, soil, and plants.) Students add oil to the system and then hypothesize how to clean the system of the oil.	5-ESS3-1

Students hypothesize the amount of water on Earth available for human consumption. Teacher has 2-liter bottle of colored water to represent total amount of water on Earth and students take turns pouring out amounts into the following labeled containers: salt water, fresh water, ice caps, and soil/air/underground, water for human consumption. Students research true percentages and then revise their division of water (students will find only 1%-- approximately 2 drops--are available for human consumption). Full lab available here.	5-ESS2-2
Students play a game to understand the interactions of Earth's spheres. Students act as a water molecule and take a trip through different stations representing the different parts of a cycle based on rolling a die. Students reflect after the activity and discuss the different routes that each student (or water molecule) took through the system. (Station setup here.)	5-ESS2-1
Students create a model of the hydrologic (water) cycle and justify that the sun and gravity are the driving forces behind each part of the cycle. Students should be able to justify that without gravity, the water cycle would not function the way we know it to today.	5-PS2-1

Summative (Benchmark) Assessment
Students create a model of two of the following systems: the geosphere, biosphere, hydrosphere, and atmosphere, and are able to show examples of how two or more systems interact. For example, a student may show how the oceans influence ecosystems, climate, and land shape, or how mountain ranges can affect winds and clouds in the atmosphere. Students should identify one issue threatening part of the Earth's resources or environment and argue how this affects one or more of the systems they modeled.

Embedded English Language Arts/Literacy and Mathematics
ELA/Literacy • **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS1-1), (5-PS2-1) • **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS1-1) • **RI.5.8** - Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). (5-ESS1-1) • **RI.5.9** - Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1), (5-PS2-1) • **SL.5.5** - Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS1-2) • **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1) • **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. (5-ESS2-2), (5-ESS3-1)

- **W.5.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1

Mathematics

- **5.G.A.2** - Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)
- **MP.2** - Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **MP.4** - Model with mathematics. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **5.NBT.A.2** - Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-ESS1-1)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 3–5 level builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

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/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

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.

- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

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).

- Support an argument with evidence, data, or a model. (5-ESS1-1), (5-PS2-1)

Disciplinary Core Ideas:

ESS2.A: Earth Materials and Systems

- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)

ESS2.C: The Roles of Water in Earth's Surface Processes

- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

ESS3.C: Human Impacts on Earth Systems

- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

PS2.B: Types of Interactions

- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)

ESS1.A: The Universe and Its Stars

- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)

ESS1.B: Earth and the Solar System

- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)

Cross-cutting Concepts:

Scale, Proportion, and Quantity

- Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)
- Natural objects exist from the very small to the immensely large. (5-ESS1-1)

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-ESS2-1), (5-ESS3-1)

Science Addresses Questions About the Natural and Material World

- Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)

Patterns

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2)

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)

Prior Learning
Second grade Earth/Space Science: Students should understand that water comes in several forms and can be found in many places on Earth. Fourth grade Earth/Space Science: Students should understand that water can cause weather and erosion, that there are patterns in Earth's features, and that Earth's processes can affect humans.

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*

*Restructure lesson using UDL principles (*http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA*)*

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Samples of Open Education Resources for this unit:

Kinesthetic Astronomy shows how to take science concepts outside to build understanding. On page 25 of the document, students can explore how different stars and constellations are in the sky during different seasons.

BrainsOn: Why is the Ocean Salty? BrainsOn is an NPR podcast for children that explores different concepts and questions that students have. This particular podcast explores the different types of water on Earth.

Mystery Science: Who Set the First Clock? is an exploratory lesson about the concept that time is based on the relative angle of the sun.

How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards.

How to Grade STEM Projects is a blog post explaining how to assess STEM projects using rubrics and scales.

Interactives: Clouds & Water Cycle provides interactives and visuals for the concept that water is spread unevenly above, on, and below the Earth's surface.

A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information.

NSTA Water Filtration System is a lesson guide for a STEM lab where students design a water filtration system.

National Weather Service "What a Cycle" Lesson is a station-based interactive activity where students travel through stations to learn how water moves through Earth's systems.

5th Grade Science

Unit 3: Matter and Energy in Organisms and Ecosystems (LS) (30 Instructional Days)

Rationale: Unit 3 naturally follows Unit 2, in which students learned about the movement and distribution of water on Earth, as well as the patterns that the sun creates on Earth. It is through this foundational knowledge that students better understand the content of this unit, in which they discover that energy and matter move through systems called ecosystems.

Content Statement: Students will learn about the way that matter moves through ecosystems through plants, animals, decomposers, and the environment and that energy in food was once energy from the sun.

Overarching Essential Questions	Overarching Enduring Understandings
How does matter and energy circulate through ecosystems?	Matter moves throughout a system between plants, animals, decomposers, and the environment, creating an interconnected web.
How do plants, animals, and decomposers rely on one another and on the environment?	Energy in animal's food was once energy from the sun.

Where does the energy in food come from and what is it used for?	Plants use primarily energy from the sun and air (not soil) to create food for other organisms.

Student Learning Experiences and Formative Assessments	
	NGSS *Standards*
Students build biodomes using soda bottles, soil, plants, water, rocks, etc. and observe changes within the system over several weeks. Students should be able to not only make generalizations about their own biodomes, but also be able to compare results with other biodomes and analyze differences.	5-LS2-1
Students plant seeds in two different plastic baggie "environments": one with soil and water, the other with water only. The students should observe that the plant is able to survive off of water and sunlight alone.	5-LS1-1
Students analyze how different materials decompose in a plastic baggie (fruit, bread, etc.). Students track visual changes.	5-LS2-1
Students complete a STEM-based activity in which they explore soil biosolarization practices and how it can be a more sustainable pest-control option compared to typical practices. Students mimic the job of an agricultural engineer and replicate biosolarization techniques in the classroom using organic waste and soil and perform a lab to compare results.	5-LS2-1
Students explore how water moves through plants by placing celery, romaine, and roses into colored water and watching how the water moves through the capillaries of the plant. Students analyze the change over time and record the results in a daily journal entry.	5-LS1-1
Students research and create models of food chains and then present them in a "gallery walk" in the classroom. Students should be able to synthesize their presentations and find that in every food chain, the initial energy in the system came from the sun.	5-PS3-1

Summative (Benchmark) Assessment
Students should be able to organize a set of plants, animals, and decomposers in two ways: in order of the flow of energy, and in trophic levels. Students should be able to make generalizations about each grouping. Students should be able to hypothesize the effects on the system if one of the components were disrupted (e.g. If the plants were removed, if the predator population doubled in size, if the plants did not receive enough solar energy, if there was no soil in the system, etc.).

Embedded English Language Arts/Literacy and Mathematics

ELA/Literacy

- **RI.5.1** - Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-LS1-1)
- **RI.5.7** - Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-LS2-1), (5-PS3-1)
- **RI.5.9** - Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)
- **SL.5.5** - Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-LS2-1), (5-PS3-1)
- **W.5.1** - Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1)

Mathematics

- **5.MD.A.1** - Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. (5-LS1-1)
- **MP.2** - Reason abstractly and quantitatively. (5-LS1-1), (5-LS2-1)
- **MP.4** - Model with mathematics. (5-LS1-1), (5-LS2-1)
- **MP.5** - Use appropriate tools strategically. (5-LS1-1)

Three-Dimensional Teaching and Learning

Scientific Practices:

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 phenomena. (5-LS2-1)
- Use models to describe phenomena. (5-PS3-1)

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).

- Support an argument with evidence, data, or a model. (5-LS1-1)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events. (5-LS2-1)

Disciplinary Core Ideas:

PS3.D: Energy in Chemical Processes and Everyday Life

- The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1)

LS1.C: Organization for Matter and Energy Flow in Organisms

- Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)
- Plants acquire their material for growth chiefly from air and water. (5-LS1-1)

LS2.A: Interdependent Relationships in Ecosystems

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

Cross-cutting Concepts:

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-LS2-1)

Energy and Matter

- Energy can be transferred in various ways and between objects. (5-PS3-1)
- Matter is transported into, out of, and within systems. (5-LS1-1)

Prior Learning
Kindergarten Life Science: Students should understand that organisms have different requirements in order to live, and that organisms can alter their environment in order to survive. Second grade Life Science: Students should understand that plants need sun and water to survive, that animals can aid in the dispersal of seeds and pollinating of plants, and that ecosystems are extremely diverse. Third grade Life Science: Students should understand that environments can greatly affect the plants and animals in that particular ecosystem, that some organisms are more likely to survive than others due to particular adaptations, and that organisms often adapt to changes in the environment. Fifth grade Unit 2 Earth/Space Science: Students understand how the sun creates patterns in light, that gravity drives different cycles on Earth, and that water is unevenly distributed in, above, and below Earth's surface.

Modifications: *Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.(See NGSS Appendix D)*

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Samples of Open Education Resources for this unit:
How to Read NGSS is a guide to reading and interpreting the Next Generation Science Standards.
How to Grade STEM Projects is a blog post explaining how to assess STEM projects using rubrics and scales.
Teaching Engineering: Biodomes provides a step-by-step guide to building biodomes, including pre and post-assessment ideas.
Interactives: Animal Adaptations is a collection of interactive websites ideal for science centers or exploratory learning for this unit.
A-Z Ways to Publish Research is a list of creative ways for students to present and publish research or information.
Soil Biosolarization is a detailed STEM activity where students explore the sustainable practice of soil biosolarization.
Water Movement Through Plants is a week-long lab in which students analyze how water moves through plants using colored water.

Appendix

Differentiation

Enrichment	● Utilize collaborative media tools ● Provide differentiated feedback ● Opportunities for reflection ● Encourage student voice and input ● Model close reading ● Distinguish long term and short term goals
Intervention & Modification	● Utilize “skeleton notes” where some required information is already filled in for the student ● Provide access to a variety of tools for responses ● Provide opportunities to build familiarity and to practice with multiple media tools ● Leveled text and activities that adapt as students build skills ● Provide multiple means of action and expression ● Consider learning styles and interests ● Provide differentiated mentors ● Graphic organizers
ELLs	● Pre-teach new vocabulary and meaning of symbols ● Embed glossaries or definitions ● Provide translations ● Connect new vocabulary to background knowledge ● Provide flash cards ● Incorporate as many learning senses as possible ● Portray structure, relationships, and associations through concept webs ● Graphic organizers
21st Century Skills	

- Creativity
- Innovation
- Critical Thinking
- Problem Solving
- Communication
- Collaboration

Integrating Technology

- Chromebooks
- Internet research
- Online programs
- Virtual collaboration and projects
- Presentations using presentation hardware and software