Bi-Borough Science Curriculum
Grade Five

Developed 2017
In Accordance with New Jersey Student Learning Standards for Science

Oradell Public School District
River Edge Public School District

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SCIENCE CURRICULUM - GRADE FIVE

UNIT ONE - *Physical Science*- Structure and Properties of Matter

(Approximately 20- 30 instructional sessions)

INTRODUCTION TO THE UNIT

Excerpt from model curriculum, Grade 5, Units 1 and 2,"Unit Summary"

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. (NJ State, Unit 1)

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. (NJ State, Unit 2)

Excerpt from model curriculum, Grade 5, Units 1 and 2- "What it looks like in the classroom"

The concepts and practices in this unit are foundational for understanding the relationship between changes to matter and its weight. During this unit of study, students will observe, measure, and identify materials based on their properties and begin to get a conceptual understanding of the particle nature of matter (i.e., all matter is made of particles too small to be seen).

In the first portion of the unit, students will focus on measuring and describing a variety of physical properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces and solubility. These observations

and measurements are used to produce data that serves as the basis for evidence that can be used to identify materials. Students need opportunities to observe, measure, and describe a variety of types of matter, such as baking soda and other powders; metals; minerals; and liquids. Standard units should be used to measure the properties of weight, time, temperature, and volume; however, at this grade level, mass and weight are not distinguished. In addition, students are not expected to understand density as a physical property, and no attempt should be made to define unseen particles or explain the atomic-scale mechanism of evaporation and condensation.

In the second portion of the unit, students make observations, gather evidence, and develop models in order to understand that matter is made up of particles too small to be seen. Matter of any type can be subdivided into small particles. In planning and carrying out simple investigations, students will produce data to be used as evidence to support the idea that even though matter is made of particles too small to be seen, matter can still exist and can be detected by means other than seeing. This evidence will be used to support students' thinking as they develop models that depict matter. For example, a model that represents solids at the particle level would show particles tightly packed, while a model that represents gases would show particles moving freely around in space. Observing such phenomena as adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, or evaporating salt water could help students to understand matter at the particle level and to build models that represent this phenomenon.

Although engineering design is not explicitly called out in this unit, students could incorporate engineering design in a number of ways as they explore the particle nature of matter. Students can design ways/tools to measure a given physical property, such as hardness, reflectivity, electrical or thermal conductivity, or response to magnetic forces. The engineering design process can be used to analyze students' models using criteria. Then students can improve their designs based on analysis. (NJ State Model Curriculum, Unit 1)

In this unit of study, students will use mathematical and computational thinking to understand the cause and effect relationship between physical changes in matter and conservation of weight. Throughout the unit, students need multiple opportunities to observe and document changes in matter due to physical changes, and to analyze data to explain changes that do or do not occur in the physical properties of matter. Students begin by planning and conducting investigations to determine whether or not a new substance is made when two or more substances are mixed.

As they work with a variety of substances, they should:

- Measure, observe, and document physical properties (e.g., color, mass, volume, size, shape, hardness, reflectivity, conductivity, and response to magnetic forces) of two or three substances.
- Mix the original substances.
- Measure, observe, and document the physical properties of the substance produced when the original substances are mixed.
- Compare data from the original substances to data from the substance produced, and determine what changes, if any, have occurred.
- Use observations and data as evidence to explain whether or not a new substance was produced, and to explain any changes that occurred when the original substances were mixed.

With each set of substances that students investigate, it is important that they use balances to measure the mass of the original substances and the mass of the substance made when the original substances are mixed. These data should be documented so that students can analyze the data. As they compare the data, they should recognize that when two or more substances are mixed, the mass of the resulting substance equals the sum of the masses of the original substances. In other words, the total mass is conserved.

Conservation of mass is a critical concept that is developed over time; therefore, students need multiple opportunities to investigate this phenomenon. Students should measure the mass of each substance, document the data they collect in a table or chart, and use the data as evidence that regardless of the changes that occur when mixing substances, the total weight of matter is conserved.

In addition to observing changes that occur when substances are mixed, students should also have opportunities to investigate other types of physical changes. For example, students can observe changes in matter due to heating, cooling, melting, freezing, and/or dissolving. As before, students should measure, observe, and document the physical properties of the substance before and after a physical change, and use the data as evidence to explain any changes that occur. The data should also provide evidence that regardless of the type of change that matter undergoes, the mass is conserved. (NJ State Model Curriculum, Unit 2)

NEW JERSEY STUDENT LEARNING STANDARDS

Science

Disciplinary Core Ideas

- 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)

- 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)

Crosscutting Concepts

- **Cause and Effect**
    - Cause and effect relationships are routinely identified, tested, 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)

Science and Engineering Practices

- **Developing and Using Models**
    - Develop a model to describe phenomena. (5-PS1-1)

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

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)

NEW JERSEY STUDENT LEARNING STANDARDS

Connections to:

Technology http://www.state.nj.us/education/aps/cccs/tech/

- **8.1** Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
- **8.2** Technology Education, Engineering, Design, and Computational Thinking -

  Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

ELA http://www.state.nj.us/education/cccs/2016/ela/

Reading- Informational

- **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)

Writing

- **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)

Speaking and Listening

- **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- PS3-1),(5-LS2-1)

Mathematics http://www.state.nj.us/education/cccs/2016/math/standards.pdf

Mathematical Practices

- **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)

Numbers & Operations in Base Ten

- **5.NBT.A.1** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1)
- **5.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)

Measurement & Data

- **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)

21st Century Life and Careers http://www.state.nj.us/education/aps/cccs/career/

- **9.3.12.AC-DES.1** Justify design solutions through the use of research documentation and analysis of data.
- **9.3.12.AC-DES.2** Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.

BIG IDEA/COMMON THREAD

Matter is made of particles too small to be seen. Regardless of the type of change that matter undergoes, the total weight of matter is conserved. The mixing of two or more substances results in new substances.

ENDURING UNDERSTANDINGS

- Matter exists as particles that are too small to see, and is always conserved, even if it seems to disappear.
- Measurements of a variety of observable properties can be used to identify particular materials.
- Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total weight remains the same.

ESSENTIAL QUESTIONS

- How can matter change?
- How can properties be used to identify materials?

ASSESSMENT

- Teacher-created formative assessments, such as:
    - Cumulative Projects (Individual or Group)
    - Data Collection and/or Journal Entries (charts/graphs/tables)
- Teacher observations, conferences
- Hands-on lab experiences

UNIT OBJECTIVES

Students will be able to …

- **Develop a model to describe that matter is made of particles too small to be seen.** (5-PS1-1)

  [Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.]

  [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

Disciplinary Ideas

- Understand that 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. (5-PS1-1)

Crosscutting Concepts

- Recognize that natural objects exist from the very small to the immensely large. (5-PS1-1)

Science and Engineering Practices

- Develop a model to describe phenomena. (5-PS1-1).

5-PS1-1

Concepts	Students can...
• 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 means other than seeing. • Natural objects exist from the very small to the immensely large. • A model showing that gases are made from matter particles that are too small to see and are moving	• Understand that matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists • Develop a model to describe that matter is made of particles too small to be seen. Examples of evidence could include: • Adding air to expand a basketball • Adding air to expand a balloon • Compressing air in a syringe • Dissolving sugar in water

freely around in space can explain many observations.	• Evaporating salt water

Students will be able to …

- **Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** (5-PS1-2)

  [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.]
  [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

Disciplinary Ideas

- Understand that the amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.
- No matter what reaction or change in properties occurs, the total weight of the substances does not change.

Crosscutting Concepts

- Recognize that standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Science and Engineering Practices

- Measure and graph quantities such as weight to address scientific and engineering questions and problems.

5-PS1-2

Concepts	Students can...
• The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. • No matter what reaction or change in properties occurs, the total weight of the substances does not change. • Standard units are used to measure and describe physical	• Provide evidence that regardless of the type of change that occurs when substances are heated, cooled, or mixed, the total weight is conserved. Examples of reactions or changes could include: • Phase changes (condensing, melting, freezing) • Dissolving • Mixing

quantities such as weight, time, temperature, and volume.	• Measure and describe physical quantities such as weight, time, temperature, and volume.

Students will be able to …

- **Make observations and measurements to identify materials based on their properties**.(5-PS1-3)

  [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.]
  [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

Disciplinary Ideas

- Understand that measurements of a variety of properties can be used to identify materials.

Crosscutting Concepts

- Recognize that standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Science and Engineering Practices

- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

5-PS1-3

Concepts	Students can...
• Measurements of a variety of properties can be used to identify materials. • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.	• Identify materials based on their properties. Examples of materials to be identified could include: • Baking soda or other powders • Metals • Minerals • Liquids Examples of properties could include:

	• Color • Hardness • Reflectivity • Electrical conductivity • Thermal conductivity • Response to magnetic forces • Solubility • Measure and describe physical quantities such as weight, time, temperature, and volume. • Make observations and measurements to serve as evidence for an explanation.

Students will be able to …

- **Conduct an investigation to determine whether the mixing of two or more substances results in new substances.** (5-PS1-4)

Disciplinary Ideas

- Understand that when two or more different substances are mixed, a new substance with different properties may be formed.

Crosscutting Concepts

- Recognize that cause and effect relationships are routinely identified, tested, and used to explain change.

Science and Engineering Practices

- 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

Concepts	Students can...
• When two or more different substances are mixed, a new substance with different properties may be formed. • Cause-and-effect relationships are used to explain change.	• Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

	• Explain change through cause-and-effect relationships. • Conduct an investigation with controlled variables, to gather data.

SUGGESTED ACTIVITIES

- https://inquiryproject.terc.edu/curriculum/curriculum5/3_ice/inv_11/ A simple experiment for students to see once frozen how water changes weight.

- https://www.stevespanglerscience.com/lab/experiments/shaker-slime/ How can we make slime? This shows students how combining substances change the substance itself.

- What kind of model would best represent/describe matter as made of particles that are too small to be seen?

- http://thesciencepenguin.com/2014/07/time-to-teach-properties-of-matter.html In this unit, students will be introduced to the different states of matter by completing small experiments on each property.

- https://www.teacherspayteachers.com/FreeDownload/Properties-of-Matter-Chart-Sorting-Activity Properties of Matter chart and sorting activity.

- https://www.stevespanglerscience.com/lab/experiments/homemade-rock-candy/ This is a fun activity that allows students to see how matter changes by creating their favorite thing, candy!

- https://www.stevespanglerscience.com/lab/experiments/growing-and-shrinking-egg/ This is an investigation into chemical reactions that is fun and exciting.

- https://www.exploratorium.edu/science_explorer/bubblebomb.html Make a bubble bomb out of zip loc bag and baking soda, careful, this one could be messy.

- https://www.stevespanglerscience.com/lab/experiments/penny-drops/ Students will be able to see how water has amazing properties, cohesion and surface tension.

- http://www.inquiryinaction.org/chemistryreview/states_of_matter/ Discover how substances mix at different speeds in hot or cold water.
- https://tinyurl.com/l7gg9qx - a delicious physical lab involving changing cream into different states of matter. The end result is butter!

- https://tinyurl.com/m9zjvcg - create hot yellow gas in this chemical reaction lab

- https://tinyurl.com/elephanttoothepaste - create “elephant toothpaste” in this explosive chemical reaction lab

UNIT VOCABULARY

chemical change: the change of a material into an entirely different material with properties that are different from the original material.

chemical reaction: the process by which a chemical change occurs.

conservation of matter: matter can never be destroyed. During any change, matter is conserved.

condensation: the change from a gas to a liquid.

electrical conductivity: how well a substance allows electric current to pass through it.

evaporation: the change of state from a liquid into a gas.

magnetism: a force produced by magnets that pulls some metals.

matter: anything that takes up space and has weight. All matter is made of moving particles.

mixture: a combination of materials; the materials do not change into something else after they are mixed.

particles: all matter is made up of smaller pieces of matter.

physical changes: changes in a state from a solid to a liquid and back again.

solubility: the ability of one substance to dissolve another; a physical change in matter.

state change: a change of a substance from one state of matter to another. Some common state changes include: melting, and freezing.

states of matter: solid, liquid, gas.

substances: a material where each part of it is made of the same type of particle. No two particle types have exactly the same properties.

temperature: degree or intensity of heat present in a substance or object.

thermal conductivity: a property that describes how well a substance allows heat to pass through it.

time: an elapse of an event.

RESOURCES

Exploring Science, National Geographic

Supplies: As per lab manuals

Websites:
http://ngss.nsta.org/AccessStandardsByTopic.aspx - The NGSS standards
https://tinyurl.com/k7h7edh - instructional slides of matter concepts and skills
www.discoveryeducation.com - videos and lesson ideas
www.opened.com - background information for teachers and lesson ideas
www.inquiryinaction.org - chemistry lab experiments
http://www.chem4kids.com - background information for students
https://phet.colorado.edu - online simulations
https://concord.org/stem-resources - online simulations (some require Java)
https://ngsschemistry.wordpress.com/ - lesson ideas
http://learningcenter.nsta.org/ - background information for teachers and lesson ideas
http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas
http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas

MODIFICATIONS

- 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.
- Restructure lesson using UDL principles

  http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA
- See NGSS Appendix D

  http://www.nextgenscience.org/sites/ngss/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

SCIENCE CURRICULUM - GRADE FIVE

UNIT TWO - *Life Science*- Matter and Energy in Organisms and Ecosystems

(Approximately 20- 30 instructional sessions)

INTRODUCTION TO THE UNIT

Excerpt from NJ State Model Curriculum, Unit 3- "Unit Summary"

> 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.

Excerpt from NJ State Model Curriculum, Unit 3- "What it looks like in the classroom"

In every habitat and ecosystem on Earth, plants and animals survive, grow, reproduce, die, and decay. What happens to the matter and energy that are part of each organism? Where does it come from and where does it go? In this unit of study, students make observations and use models to understand how energy flows and matter cycles through organisms and ecosystems.

Students should first understand that plants acquire their material for growth chiefly from air and water. Students will need opportunities to observe a variety of plants over time. As students document plants' continual need for water and air in order to grow, they

recognize that this evidence supports the argument that plants acquire their material for growth chiefly from air and water (not from soil). In addition, as students observe that plants also need sunlight, they begin to recognize that plants use energy from the sun to transform air and water into plant matter.

Once students understand that plants acquire material for growth from air and water, they need opportunities to observe animals and plants interacting within an ecosystem. Terrariums, such as those built in 3-liter bottles, are ideal for this because they are large enough for small plants and animals to survive and grow, yet easy to build and maintain. In these terrariums, students should observe plants growing and providing a source of food for small herbivores, carnivores consuming other animals, and decomposers that consume dead plant material.

All of these interactions may not be observable within a single terrarium; however, a class could use a number of 3-liter bottles to set up different ecosystems, each with a few carefully chosen plants and animals. This will give students opportunities to observe different types of interactions within a variety of enclosed systems.

When students record their observations of these small systems, it is important that students be able to:

- Identify the living and nonliving components of a system.
- Describe the interactions that occur between the living and nonliving components of each system.
- Develop models (such as food chains or food webs) that describe the movement of matter among plants, animals, decomposers, and the environment.

As students continue to observe each terrarium, they learn that:

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

- Organisms obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment.

Furthermore, students can conduct research to determine the effects of newly introduced species to an ecosystem.

After investigating the movement of matter in ecosystems, students revisit the concept of energy flow in systems. At the beginning of this unit of study, students learned that energy from the sun is transferred to plants, which then use that energy to change air and water into plant matter. After observing the interactions between the living and nonliving components of small ecosystems, students recognize that energy, like matter, is transferred from plants to animals. When animals consume plants, that food provides animals with the materials they need for body repair and growth and with the energy they need to maintain body warmth and for motion. Students can use diagrams or flowcharts to describe the flow of energy within an ecosystem, tracing the energy in animals' food back to the energy from the sun that was captured by plants.

NEW JERSEY STUDENT LEARNING STANDARDS

Science

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)

Crosscutting Concepts

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

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

Science and Engineering Practices

- **Developing and Using Models**
  - Use models to describe phenomena. (5-PS3-1)
  - Develop a model to describe phenomena. (5-LS2-1)

- **Engaging in Argument from Evidence**
  - 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)

NEW JERSEY STUDENT LEARNING STANDARDS

Connections to:

Technology http://www.state.nj.us/education/aps/cccs/tech/

- **8.1** Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
- **8.2** Technology Education, Engineering, Design, and Computational Thinking -

  Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

ELA http://www.state.nj.us/education/cccs/2016/ela/

Reading - Informational

- **RI.5.1** Quote accurately from a text and make relevant connections 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-PS3- 1),(5-LS2-1)
- **RI.5.9** Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)

Writing

- **W.5.1** Write opinion pieces on topics or texts, supporting a point of view, with reasons and information (5-LS1-1)
- **W.5.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Speaking and Listening

- **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- PS3-1),(5-LS2-1)

Mathematics http://www.state.nj.us/education/cccs/2016/math/standards.pdf

Mathematical Practices

- **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)

Measurement and Data

- **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)

21st Century Life and Careers http://www.state.nj.us/education/aps/cccs/career/

- **9.3.12.AC-DES.1** Justify design solutions through the use of research documentation and analysis of data.
- **9.3.12.AC-DES.2** Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.
- **9.3.12.AC-DES.6** Apply the techniques and skills of modern drafting, design, engineering, and construction to projects.

BIG IDEA/COMMON THREAD

Plants get the materials they need for growth chiefly from air and water. There is movement of matter among plants, animals, decomposers, and the environment. Energy in animals' food was once energy from the sun.

ENDURING UNDERSTANDINGS

- Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form. (PS3.A)
- Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival. (LS1.C)
- The food of almost any 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, while decomposers restore some materials back to the soil. (LS2.A)
- Matter cycles between the air and soil and among organisms as they live and die. (LS2.B)

ESSENTIAL QUESTIONS

- Where do plants get the materials they need for growth?
- How can energy in animals' food be traced to the sun?
- How does matter move among plants, animals, decomposers, and the environment?

ASSESSMENT

- Teacher-created formative assessments, such as:
    - Cumulative Projects (Individual or Group)
    - Data Collection (charts/graphs/tables)
- Teacher observations, conferences
- Hands-on lab experiences

UNIT OBJECTIVES

Students will be able to …

- **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. (5-PS3-1)**

  [Clarification Statement: Examples of models could include diagrams, and flowcharts.]

Disciplinary Ideas

- Understand that 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).
- Understand that 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.

Crosscutting Concepts

- Recognize that energy can be transferred in various ways and between objects.

Science and Engineering Practices

- Develop models to describe phenomena.

5-PS3-1

Concepts	Students can...

• 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
	• 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

need for motion and to maintain body warmth. • Energy can be transferred in various ways and between objects.	• Describe how energy can be transferred in various ways and between objects. • Use models to describe phenomena.

Students will be able to …

- **Support an argument that plants get the materials they need for growth chiefly from air and water. (5-LS1-1)**
  [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

Disciplinary Ideas

- Plants acquire their material for growth chiefly from air and water. (5-LS1-1)

Crosscutting Concepts

- Matter is transported into, out of, and within systems. (5-LS1-1)

Science and Engineering Practices

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

5-LS1-1

Concepts	Students can...
• Plants acquire their material for growth chiefly from air and water. • Matter is transported into, out of, and within systems.	• Support an argument that plants get the materials they need for growth chiefly from air and water. • Describe how matter is transported into, out of, and within systems. • Support an argument with evidence, data, or a model.

Students will be able to …

- **Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. (5-LS2-1)**

  [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.]
  [Assessment Boundary: Assessment does not include molecular explanations.]

Disciplinary Ideas

- Understand that the food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. (5-LS2-1)
- 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. (5-LS2-1)
- Organisms can survive only in diverse and balanced environments in which their particular needs are met. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)
- Understand that 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)

Crosscutting Concepts

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

Science and Engineering Practices

- Develop a model to describe phenomena. (5-LS2-1)

5-LS2-1

Concepts	Students can...
• 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 system can be described in terms of its components and their interactions. • Science explanations describe the mechanisms for natural events.	• 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 a system in terms of its components and interactions. • Develop a model to describe an ecosystem. • Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

SUGGESTED ACTIVITIES

- Students design and conduct simple experiments using elodea and Bromthymol blue to determine whether plants consume or release carbon dioxide during photosynthesis. http://serc.carleton.edu/sp/mnstep/activities/35653.html

- Water activities- conservation, importance to the growth of plants, etc. http://scoutshonor.wikia.com/wiki/WOW_Wonders_of_Water_(Brownie_Journey)

- Soda bottle ecosystems https://www.misshumblebee.com/blog/index.php/soda-bottle-ecosystems/

- http://www.cpalms.org/Public/PreviewResourceLesson/Preview/152015 This activity helps students understand the flow of energy through an ecosystem and food web.

- Students build a model of a food web showing the relationships between organisms. http://forces.si.edu/main/pdf/2-5-WeavingTheWeb.pdf

- Yummy Yeast Lab - students grow yeast inside a plastic bag and observe how they decompose different fruits. https://tinyurl.com/m5snxb6

UNIT VOCABULARY

bacteria: bacteria are certain kinds of one-celled living things. Some bacteria are decomposers.

carbon dioxide: a gas used in air that is used to make food by photosynthesis.

chlorophyll: chlorophyll is the green pigment in plants that makes it possible for them to make food from carbon dioxide and water.

community: a community is made up of all the different populations that live and interact in an area.

consumers: an organism that gets energy by eating other organisms.

decomposer: a decomposer is an organism that breaks down dead organisms and the waste of living things.

ecosystem: all the living and nonliving things that interact with each other in an area.

food web: a food web is a network of food chains that shows how energy moves through an ecosystem.

fungi: fungi are types of plants, such as molds and mushrooms, that have no chlorophyll and live on the dead and decaying things. Fungi are decomposers.

glucose: a simple sugar that is an important energy source in living organisms produced during photosynthesis.

hydroponics: a method of growing plants in water instead of soil.

invasive species: a species that has been brought to a new place by people and can harm the environment.

nutrients: a part of food and soil that helps living things stay healthy and grow.

oxygen: a gas found in air that is produced as waste during photosynthesis.
photosynthesis: the chemical process that green plants use to turn water and carbon dioxide into food when the plant is exposed to light.

population: all the individuals of a species that live in an area.

producer: a living thing that makes its own food.

species: a group of similar living things that can produce offspring who can, in turn, produce offspring.

sunlight: light from the sun

water: A clear, colorless, odorless, and tasteless liquid, H_2O, essential for most plant and animal life.

RESOURCES

Exploring Science, National Geographic

Supplies: As per lab manuals

Websites:
http://ngss.nsta.org/AccessStandardsByTopic.aspx - The NGSS standards
https://tinyurl.com/kuv7ewp - instructional slides about life science concepts and skills
www.discoveryeducation.com - videos and lesson ideas
www.opened.com - background information for teachers and lesson ideas
https://phet.colorado.edu - online simulations
https://concord.org/stem-resources - online simulations (requires Java)
http://learningcenter.nsta.org/ - background information for teachers and lesson ideas
http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas
http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas

Reintroduction of Wolves to Yellowstone

MODIFICATIONS

- 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.
- Restructure lesson using UDL principles
    - http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA
- See NGSS Appendix D
    - http://www.nextgenscience.org/sites/ngss/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

SCIENCE CURRICULUM - GRADE FIVE

UNIT THREE - *Earth & Space Science*- Earth's Systems

(Approximately 20- 30 instructional sessions)

INTRODUCTION TO THE UNIT

Excerpt from NJ State model curriculum, Grade 5, Units 4 and 5 "What it looks like in the classroom"

In this unit of study, students develop models to describe the interactions that occur within and between major Earth systems and conduct research to learn how humans protect the Earth's resources. Students need to understand that Earth is a system made up of subsystems, all of which have multiple components that interact. Throughout this unit, students will consider scale and proportion when examining the amount of water on the Earth, and they will consider the impact that humans have on one of Earth's most valuable resources.

Foundational to this unit of study is the understanding of a system, its components, and the interactions that occur within the system. Initially, students may need opportunities to review familiar examples of systems, such as plants and animals, listing external and internal structures and processes and describing the interactions that occur within the system. Students can then begin to think about Earth's major systems, identifying the components and describing the interactions that occur within each.

For example:

- The geosphere is composed of solid and molten rock, soil, and sediments. Some processes that occur between the components of the geosphere include erosion, weathering, deposition, sedimentation, compaction heating, cooling, and flow. These processes cause continual change to rock, soil, and sediments.
- The hydrosphere is composed of water in all its forms. Water, unlike the vast majority of earth materials, occurs naturally on the Earth as a solid, liquid, or gas,

and it can be found on, above, and below the surface of the Earth. Some processes that occur in the hydrosphere include evaporation, condensation, precipitation, runoff, percolation, freezing, thawing, and flow. These processes cause water to change from one form to another in a continuous cycle.

- The atmosphere is a critical system made up of the gases that surround the Earth. The atmosphere helps to regulate Earth's climate and distribute heat around the globe, and it is composed of layers with specific properties and functions. This system, composed mainly of nitrogen, oxygen, argon, and carbon dioxide, also contains small amounts of other gases, including water vapor, which is found in the lowest level of the atmosphere where weather-related processes occur. In addition to weather processes, radiation, conduction, convection, carbon cycling, and the natural greenhouse effect are processes that occur in the atmosphere.
- The biosphere comprises living things, including humans. Living organisms can be found in each of the major systems of the Earth (the atmosphere, hydrosphere, and geosphere). Some processes that occur within the biosphere include transpiration, respiration, reproduction, photosynthesis, metabolism, growth, and decomposition.

Students conduct research, using informational texts and online resources, to determine the distribution of freshwater and saltwater among Earth's oceans, rivers, lakes, glaciers, groundwater, and polar ice caps. Students organize their data into graphs or charts, showing the allocation of freshwater and saltwater on Earth. (Amounts should be described in terms of volume, as well as in percentages.) They should look for examples of human activities in agriculture, industry, and in their everyday lives, and should describe, both orally and in writing, the ways in which these activities affect the land, oceans, streams, groundwater, air, and other organisms (both plants and animals). Students will need the opportunity to share their findings with the class, and then should conduct further research to find ways in which individual communities use science ideas to protect the Earth's resources and environments.

After comparing and analyzing data, students should be able to conclude the following:

- Nearly all of Earth's available water is in the ocean.
- Fresh water makes up less than 3% of the total amount of water on the Earth.
- Most fresh water is found in glaciers or underground.
- Only a tiny fraction of the freshwater on Earth is in streams, lakes, wetlands, and the atmosphere.

As students become more comfortable with describing each system in terms of its components and interactions, they should begin to think about and discuss the interactions that occur between systems. This should be a natural progression in their learning, since students will discover that any interactions that occur within a system affect components of other systems. Students should develop models that describe ways in which any two Earth systems interact and how these interactions affect the living and nonliving components of the Earth.

Some examples include:

- The influence of oceans on ecosystems, landform shape, or climate.
- The impact of the atmosphere on landforms or ecosystems through weather and climate.
- The influence of mountain ranges on wind and clouds in the atmosphere.

As a class, students can brainstorm additional examples. They can use any type of model, such as diagrams or physical replicas, to describe the interactions that occur between any two systems, and they can choose to enhance the model with multimedia components or visual displays.

Once students have an understanding of the components and interactions that occur within and between Earth's major systems, they should gather information about the ways in which individual communities use science ideas to protect Earth's resources and environment. Students can work individually, in pairs, or in small groups to conduct research using books and other reliable media resources. They should paraphrase and summarize information as they take notes, then use their information to support their finished work. Humans are just one of many components in an ecosystem, yet our activities affect all parts of the ecosystem, many times in adverse ways.

Students' research should help them determine:

- How human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space
- What individuals and communities are doing to help protect Earth's resources and the environment.
- Students can share their work in a variety of ways and should provide a list of sources for the information in their finished work.
- Although engineering design is not explicitly called out in this unit, students could incorporate engineering design in a number of ways as they explore human impact on the environment.

- Students may design a way to promote local, sustainable agriculture, making healthy food available to more people in their communities while having minimizing the impact on the local environment.
- Students can design and implement a variety of recycling projects that have a positive impact on the environment by increasing the reuse of materials that normally end up in landfills and decreasing our reliance on earth resources.

NEW JERSEY STUDENT LEARNING STANDARDS

Science

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)

Crosscutting Concepts

- **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),(5-ESS3-1)

Science and Engineering Practices

- **Developing and Using Models**
    - Develop a model using an example to describe a scientific principle. (5-ESS2-1)

- **Using Mathematics and Computational Thinking**
    - Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

- **Obtaining, Evaluating, and Communicating Information**
    - Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

Connections to Nature of Science

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)

NEW JERSEY STUDENT LEARNING STANDARDS

Connections to:

Technology http://www.state.nj.us/education/aps/cccs/tech/

- **8.1** Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
- **8.2** Technology Education, Engineering, Design, and Computational Thinking -

Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

ELA http://www.state.nj.us/education/cccs/2016/ela/

Reading- Informational

- **RI.5.2** Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text. (5-ESS2-1)(5-ESS2-2)(5-ESS3-1)
- **RI.5.4** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject. area.(5-ESS2-1)(5-ESS2-2)(5-ESS3-1)
- **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-ESS2-1)(5-ESS2-2) (5-ESS3-1)
- **RI.5.9** Integrate and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
- **RI.5.10** By the end of the year, read and comprehend literary nonfiction at grade level text-complexity or above, with scaffolding as needed. (5-ESS2-1)(5-ESS2-2)(5-ESS3-1)

Writing

- **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)

Speaking and Listening

- **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- ESS2-1),(5-ESS2-2)

Mathematics http://www.state.nj.us/education/cccs/2016/math/standards.pdf

Mathematical Practices

- **MP.1** Make sense of problems and persevere in solving them. (5-ESS2-2)
- **MP.2** Reason abstractly and quantitatively.

(5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

- **MP.3** Construct viable arguments and critique the reasoning of others. (5-ESS3-1)
- **MP.4** Model with mathematics. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

Geometry

- **5.G.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-ESS2-2)

21st Century Life and Careers

http://www.state.nj.us/education/aps/cccs/career/

- **9.2.4.A.4** Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.
- **9.3.12.AC.2** Use architecture and construction skills to create and manage a project.
- **9.3.12.AC-DES.1** Justify design solutions through the use of research documentation and analysis of data.
- **9.3.12.AC-DES.2** Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.
- **9.3.12.AC-DES.6** Apply the techniques and skills of modern drafting, design, engineering, and construction to projects.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

BIG IDEA/COMMON THREAD

The geosphere, biosphere, hydrosphere, and/or atmosphere interact in various ways. The distribution of water on Earth can be described and graphed.

ENDURING UNDERSTANDINGS

- Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and disperse them. (ESS2.A)
- Most of Earth's water is in the ocean and much of Earth's freshwater is in glaciers or underground (ESS2.C)
- Societal activities have had major effects on land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments. (ESS3.C)

ESSENTIAL QUESTIONS

- In what ways do the geosphere, biosphere, hydrosphere, and/or atmosphere interact?
- Where is water found on the Earth and how is it distributed?
- How do individual communities use science ideas to protect the Earth's resources and environment?

ASSESSMENT

- Teacher-created formative assessments, such as:
    - Cumulative projects (individual or group)
    - Data collection (charts/graphs/tables)
- Teacher observations, conferences
- Hands-on lab experiences

UNIT OBJECTIVES

Students will be able to …

- **Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact**. (5-ESS2-1)

  [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.]
  [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

Disciplinary Ideas

- Understand that Earth has four major systems. They 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).
- Understand that the Earth's systems interact in multiple ways to affect Earth's surface materials and processes.
- Understand that the hydrosphere supports a variety of ecosystems and organisms, shapes landforms, and influences climate.
- Understand that the atmosphere influences landforms and weather.

Crosscutting Concepts

- Recognize that a system can be described in terms of its components and their interactions.

Science and Engineering Practices

- Develop a model using an example to describe a scientific principle.

5-ESS2-1

Concepts	Students can...
• Earth's major systems, *geosphere* (solid and molten rock, soil, and sediments), the *hydrosphere* (water and ice), the *atmosphere* (air), and the *biosphere* (living	• Describe a system in terms of its components and interactions. • Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or

things, including humans), interact in multiple ways. • The Earth's major systems support a variety of ecosystems and organisms, shape landforms, and influence climate. • A system can be described in terms of its components and their interactions.	atmosphere interact. (Note: two systems at a time) Examples may 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. • Develop a model using an example to describe a scientific principle.

Students will be able to …

- **Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** (5-ESS2-2)

  [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

Disciplinary Ideas

- Understand that nearly all of Earth's available water is in the ocean.
- Understand that most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

Crosscutting Concepts

- Recognize that standard units are used to measure and describe physical quantities such as weight, and volume.

Science and Engineering Practices

- Describe and graph quantities such as area and volume to address scientific questions.

5-ESS2-2

Concepts	Students can...
• Nearly all of Earth's available water is in the ocean.	• Understand that the amounts and percentages of water and fresh

• Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. • Standard units are used to measure and describe physical quantities such as weight and volume.	water in various reservoirs to provide evidence about the distribution of water on Earth. • Describe physical quantities, such as weight and volume, in standard units. • Describe and graph quantities such as area and volume to address scientific questions.

Students will be able to …

- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. (5-ESS3-1)

Disciplinary Ideas

- Understand that 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 taking initiatives to help protect Earth's resources and environments.

Crosscutting Concepts

- Recognize that a system can be described in terms of its components and their interactions.

Science and Engineering Practices

- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

5-ESS3-1

Concepts	Students can...
• Human activities in agriculture, industry, and everyday life have	• Obtain and combine information about ways individual communities

had major effects on the land, vegetation, streams, ocean, air, and even outer space. ● Individuals and communities are doing things to help protect Earth's resources and environments. ● A system can be described in terms of its components and their interactions.	use science ideas to protect the Earth's resources and environment. ● 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.

SUGGESTED ACTIVITIES

- NOAA What-a-Cycle: http://ngss.nsta.org/Resource.aspx?ResourceID=13

  http://www.srh.noaa.gov/jetstream/atmos/ll_whatacycle.html Through role-playing as a particle of water, students gain an understanding of the complexity of the movement of water through earth's systems. Stations are set-up for nine different water reservoirs associated with the water cycle. On each turn, students roll the dice at each station and either stay in place or move to a different location. Students track their unique journey through the water cycle to later share and discuss the strengths and limitations of the game as a model for the movement of water through Earth's systems.

- Shower Curtain Watershed: https://www.montereybayaquarium.org/-/m/pdf/education/curriculum/shower_curtain_watershed.pdf What is a watershed? How do our actions affect the health of a watershed? Students explore these questions by analyzing pictures and identifying watershed features. Students then make a watershed model using a plastic shower curtain, a spray bottle of water and themselves or classroom objects The objectives of the lesson are to: a) Identify nonliving and living

features found in a watershed. b) Understand how human activities can affect watersheds.

- Let's Build a Dam! - http://tryengineering.org/lessons/engineeradam.pdf STEAM activity that focuses on the different uses of dams and how they are engineered using organic and inorganic materials. Students work in teams to develop a system of damming water in a trough. The system must completely hold back the water and also have a way of executing a controlled release.

- Hydroponics Water Bottle Lab- http://www.conference.ifas.ufl.edu/aitc/presentations/Session%202/Hooked%20on%20Hydroponics%20in%20the%20Classroom/Chybion%20(all%20files%20combined)handout.pdf Create a hydroponics water system where soil is self-watered. Students can see the relationship between the hydrosphere, geosphere, and biosphere.

- Pollution Patrol- http://tryengineering.org/sites/default/files/lessons/aus/pollutionpatrol.pdf- STEAM activity that focuses on devices that are used to detect air pollution. Teams of students construct outdoor air pollution detectors from everyday materials. They then test their devices to see how much particulate pollutants they can capture in their classroom due to human activity.

- Develop a model: You've learned about Earth's geosphere, hydrosphere, atmosphere, and biosphere and have seen ways which these systems interact. How can you develop a model to describe an interaction between two of Earth's spheres? For example, you might show how weather and climate affect landforms, or how mountain ranges affect clouds and rain, or how the ocean affects the shape of the land. Draw diagrams, poster, 3-D model, or a computer animation. Present it to the class, include the identification of the spheres involved and describe their interactions.

- Graphing Water Data- Most of the Earth's surface is covered with water, but from which source? Water is located in five main reservoirs: ocean water; ice caps and glaciers; groundwater; surface water, such as streams and lakes; and the atmosphere in the form of water vapor. For this activity, research these five reservoirs, the volume of water they hold, and graph them on a coordinate grid in

the form of a bar graph.
(http://hyperphysics.phy-astr.gsu.edu/hbase/Tables/waterres.html)

- Plants and Pollution- How does polluted soil impact a plant's ability to grow?

- https://app.discoveryeducation.com/player/view/assetGuid/f98e890b-eb33-4607-9012-937736208b84 Discovery Education Interactive Activity- Identifies different effects forces have on earth.

- Global Water Distribution: http://mass.pbslearningmedia.org/resource/ess05.sci.ess.watcyc.lp_waterconservation/water-conservation/ In this lesson sequence, students predict and model the availability of water on Earth and discuss methods that can be used to purify and conserve this critical resource. They also assess how much water they and their families typically use, and think about ways to reduce their water usage. Finally, students explore different techniques being employed for water management around the world, including the use of dams to create reservoirs.

- Simulating an Oil Spill to Understand Environmental Impact: https://www.teachingchannel.org/videos/natural-resources-lesson-plan This 8 minute instructional video provides a model for teachers to follow of a week long investigation of oil spills and the environmental impact they have on shorelines and creatures. Students take on the task of cleaning up a simulated oil spill.

- Oil Spill Solutions- http://tryengineering.org/sites/default/files/lessons/spillsolutions.pdf- STEAM activity that focuses on how engineers use various techniques to provide speedy solutions to oil spills or other threats to natural water resources. Through this lesson, students work in teams to analyze an "oil spill" in the classroom, then design, build, and test a system to first contain, and then remove the oil from the water. Students select from everyday items to build their oil containment and clean-up systems, evaluate the effectiveness of their solution and those of other teams, and present their findings to the class.

- https://pmm.nasa.gov/education/lesson-plans/connect-spheres-earth-systems-interactions Students will investigate Earth systems by making observations in nature and identifying systems in the natural world.

- http://www.earthsciweek.org/classroom-activities/ngss
Multiple labs that correlate to the NGSS-S standards for Earth Systems

- Plants and Pollution experiment
  https://www.education.com/science-fair/article/plants-experience-pollution-plants-grow/

- Plants and pollution activity
  https://blogs.longwood.edu/pollutionissues/ph-level-or-specific-pollutant/

UNIT VOCABULARY

atmosphere: the Earth system that is made up of a mixture of gases that is air

biosphere: the Earth system that includes all the living things found on Earth

climate: the general weather of a place over a long period of time, such as many years

fresh water: water that is not salty (contains less than 500 parts per million (ppm) of dissolved salts)

gas: matter that spreads to fill a space

geosphere: the solid part of the earth consisting of the crust and outer mantle

glacier: a very large area of ice that moves slowly down a slope, valley or wide area of land

greenhouse effect: the trapping of some solar radiation by a planet's atmosphere, increasing the temperature on and near the surface

hydrosphere: all the water at or near the Earth's surface, including liquid bodies of water, frozen water as ice and snow, water found underground and water found in the atmosphere.

reservoir: a large natural or artificial lake used as a source of water supply

salt water: water containing salt. 96.5% of all the Earth's water is contained within the oceans as salt water, while the remaining 3.5% is freshwater lakes and frozen water locked up in glaciers and the polar ice caps

system: an organized structure for arranging or classifying

volume: the amount of space that a substance or object occupies

RESOURCES

Exploring Science, National Geographic

Supplies: As per lab manuals

Websites:
http://ngss.nsta.org/AccessStandardsByTopic.aspx - The NGSS standards
www.discoveryeducation.com - videos and lesson ideas
https://app.discoveryeducation.com/learn/collections/5c7f9e8d-8dfb-4b47-b621-d9f8c39e828a?utm_campaign=Curated_Collections&utm_medium=Search_Banner&utm_source=DiscoveryEducation
www.opened.com - background information for teachers and lesson ideas
http://learningcenter.nsta.org/ - background information for teachers and lesson ideas
http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas
http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas
http://www.studyjams.com -Study Jams
http://www.brainpop.com- BrainPop
http://www.flocabulary.com- Flocabulary

MODIFICATIONS

- 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.
- Restructure lesson using UDL principles

  http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA
- See NGSS Appendix D

  http://www.nextgenscience.org/sites/ngss/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

SCIENCE CURRICULUM - GRADE FIVE

UNIT FOUR - *Earth and Space Science*- Space Systems:Stars and the Solar System

(Approximately 20- 30 instructional sessions)

INTRODUCTION TO THE UNIT

Excerpt from model curriculum- Grade 5, Unit 6, "What it looks like in the classroom"

In this unit of study, students explore the effects of gravity and determine the effect that relative distance has on the apparent brightness of stars. They also collect and analyze data in order to describe patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

To begin the progression of learning in this unit, students explore the effects of gravity by holding up and releasing a variety of objects from a variety of heights and locations. Students should record and use their observations to describe the interaction that occurs between each object and the Earth. In addition, students should use their observations as evidence to support an argument that the gravitational force exerted by the Earth on objects is directed “down” (towards the center of the Earth), no matter the height or location from which an object is released.

Next, students investigate the effect of distance on the apparent brightness of stars. Using information from a variety of print or digital sources, students learn that natural objects vary in size, from very small to immensely large. Stars, which vary in size, also range greatly in their distance from the Earth. The sun, which is also a star, is much, much closer to the Earth than any other star in the universe. Once students understand these concepts, they should explore the effect of distance on the apparent brightness of the sun in relation to other stars. This can be accomplished by modeling the effect using a light source, such as a bright flashlight. As students vary the distance of the light from their eyes, they should notice that the farther away the light is, the less bright it appears. Observations should again be recorded and used as evidence to support the argument that the differences in the apparent brightness of the sun compared to that of other stars is due to their relative distances from the Earth.

To continue the progression of learning, students investigate the following observable patterns of change that occur due to the position and motion of the Earth, sun, moon, and stars.

- **Day and night:** This pattern of change is a daily, cyclical pattern that occurs due to the rotation of the Earth every 24 hours. Students can observe model simulations using online or digital resources, or they can create models in class of the day/night pattern caused by the daily rotation of the Earth.
- **The length and direction of shadows:** These two interrelated patterns of change are daily, cyclical patterns that can be observed and described through direct observation. Students need the opportunity to observe a stationary object at chosen intervals throughout the day and across a few days. They should measure and record the length of the shadow and record the direction of the shadow (using drawings and cardinal directions), then use the data to describe the patterns observed.
- **The position of the sun in the daytime sky:** This daily, cyclical pattern of change can also be directly observed. Students will need the opportunity to make and record observations of the position of the sun in the sky at chosen intervals

throughout the day and across a few days. Data should then be analyzed in order to describe the pattern observed.

- **The appearance of the moon in the night sky:** This cyclical pattern of change repeats approximately every 28 days. Students can use media and online resources to find data that can be displayed graphically (pictures in a calendar, for example), which will allow them to describe the pattern of change that occurs in the appearance of the moon every four weeks.
- **The position of the moon in the night sky:** This daily, cyclical pattern of change can be directly observed, but students would have to make observations of the position of the moon in the sky at chosen intervals throughout the night, which is not recommended. Instead, students can use media and online resources to learn that the moon, like the sun, appears to rise in the eastern sky and set in the western sky every night.
- **The position of the stars in the night sky:** Because the position of the stars changes across the seasons, students will need to use media and online resources to learn about this pattern of change.

Whether students gather information and data from direct observations or from media and online sources, they should organize all data in graphical displays so that the data can be used to describe the patterns of change.

NEW JERSEY STUDENT LEARNING STANDARDS

Science

Disciplinary Core Ideas

- **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)

Crosscutting Concepts

- **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)
- **Scale, Proportion, and Quantity**
  - Natural objects exist from the very small to the immensely large. (5-ESS1- 1)

Science and Engineering Practices

- **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-PS2-1),(5-ESS1-1)

NEW JERSEY STUDENT LEARNING STANDARDS

Connections to:

Technology http://www.nj.gov/education/aps/cccs/tech/

- **8.1** Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
- **8.2** Technology Education, Engineering, Design, and Computational Thinking -

  Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the

individual, global society, and the environment.

ELA **http://www.nj.gov/education/cccs/2016/ela/**

Reading - Informational

- **RI.5.1** Quote accurately from a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text. (5-PS2-1),(5-ESS1-1)
- **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 and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1),(5-ESS1-1)

Writing

- **W.5.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1),(5-ESS1-1)

Speaking and Listening

- **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)

Mathematics **http://www.nj.gov/education/cccs/2016/math/standards.pdf**

- **MP.2** Reason abstractly and quantitatively. (5-ESS1-1),(5-ESS1-2)
- **MP.4** Model with mathematics. (5-ESS1-1),(5-ESS1-2)
- **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)
- **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-ESS1-2)

21st Century Life and Careers **http://www.nj.gov/education/aps/cccs/career/**

- **9.3.12.AC.2** Use architecture and construction skills to create and manage a project.
- **9.3.12.AC-DES.1** Justify design solutions through the use of research

documentation and analysis of data.
- **9.3.12.AC-DES.2** Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues.
- **9.3.12.AC-DES.6** Apply the techniques and skills of modern drafting, design, engineering, and construction to projects.
- **9.3.MN-HSE.3** Demonstrate a safety inspection process to assure a healthy and safe manufacturing environment.
- **9.3.MN-MIR.2** Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment.

BIG IDEA/COMMON THREAD

The sun's motion in the sky cause patterns that are observable and quantifiable. These patterns of daily changes occur as length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

ENDURING UNDERSTANDINGS

- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.
- Stars range greatly in size and distance from Earth and this can explain their relative brightness.
- The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.

ESSENTIAL QUESTIONS

- How do lengths and directions of shadows or relative lengths of day and night change from day to day?
- How does the appearance of some stars change in different seasons?

ASSESSMENT

- Teacher-created formative assessments, such as:
    - Cumulative projects (individual or group)

    - Data collection (charts/graphs/tables)
- Teacher observations, conferences
- Hands-on lab experiences

UNIT OBJECTIVES

Students will be able to …

- **Support an argument that the gravitational force exerted by Earth on objects is directed down. (5-PS2-1)**

  [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.]

  [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]

Disciplinary Ideas

- Understand that the gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

Crosscutting Concepts

- Recognize that cause and effect relationships are routinely identified and used to explain change.

Science and Engineering Practices

- Develop an argument with evidence, data, or a model.

5-PS2-1

Concepts	Students can...
• The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. • Cause-and-effect relationships are routinely identified and used to explain change.	• Understand 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.) • Identify cause-and-effect relationships in order to explain change. • Support an argument with evidence, data, or a model.

Students will be able to …

- **Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. (5-ESS1-1)**

  [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

Disciplinary Ideas

- Understand 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.

Crosscutting Concepts

- Recognize natural objects exist from the very small to the immensely large.

Science and Engineering Practices

- Develop an argument with evidence, data, or a model.

5-ESS1-1

Concepts	Students can...
• The sun is a star that appears larger and brighter than other stars because it is closer. • Stars range greatly in their distance from Earth. • Natural objects exist from the very small to the immensely large.	• Understand that differences in the apparent brightness of the sun compared to that of other stars is due to their relative distances from Earth. • Support an argument with evidence, data, or a model.

Students will be able to …

- **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. (5-ESS1-2)**
  [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.]
  [Assessment Boundary: Assessment does not include causes of seasons.]

Disciplinary Ideas

- Understand that the orbits of Earth around the sun, and of the moon around Earth, together with the rotation of Earth on its axis between its North and South poles, cause observable patterns.
- These patterns include:
  - day and night
  - daily changes in the length and direction of shadows
  - different positions of the sun, moon, and stars at different times of the day, month, and year.

Crosscutting Concepts

- Recognize the similarities and differences in patterns can be used to sort,

classify, communicate and analyze change for natural phenomena.

Science and Engineering Practices

- Represent data in graphical displays (line graphs or line plots) to reveal patterns that indicate relationships.

5-ESS1-2

Concepts	Students can...

• The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth on its axis between its north and south poles, cause observable patterns. These include:
  ○ Day and night
  ○ Daily changes in the length and direction of shadows
  ○ Different positions of the sun, moon, and stars at different times of the day, month, and year.
• Similarities and differences in patterns can be used to sort, classify, communicate, and analyze change.
	• Identify patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
	• Sort, classify, communicate, and analyze simple rates of change.
	• Represent data in graphical displays (line plots and line graphs) to reveal patterns that indicate relationships.

SUGGESTED ACTIVITIES

Non-fiction reading about Galileo's famous gravity drop experiment.
http://www.ellenjmchenry.com/homeschool-freedownloads/energymachines-games/documents/GravityLab.pdf

Galileo's Gravity Experiment. In this interactive web activity, observe the effect gravity has upon objects.
http://www.pbs.org/wgbh/nova/pisa/expe_flash_1.html

Gravity Ball Drop Lab
https://tinyurl.com/kryaexn

Day and night interactive picture, click anywhere on the picture and you will see how different continents experience day and night.

http://www.fourmilab.ch/cgi-bin/Earth?imgsize=1024&opt=-l&lat=28.0417&ns=North&lon=-116.083&ew=West&alt=149249513&img=learth.evif&date=0

Disney pixar video about day and night:
https://www.youtube.com/watch?v=mXhnuK3knOs

An experiment with shadows on a wall and a flashlight
http://www.primaryresources.co.uk/science/pdfs/KSlight5a.pdf

Experiment with the sun and a sundial
http://www.sciencemadesimple.co.uk/curriculum-blogs/primary-blogs/light_and_shadows

Experiment with the sun and other students casting and analyzing shadows
https://stardate.org/sites/default/files/pdfs/teachers/ShadowPlay.pdf

Simple science experiment, gravity water drop
http://www.metrofamilymagazine.com/July-2014/Simple-Science-Experiments-Gravity-Water-Drop/

Moon phases interactive animation
http://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::800::600::/sites/dl/free/0072482621/78778/Lunar_Nav.swf::Lunar%20Phases%20Interactive

DIY constellation projector
http://playgroundparkbench.com/printable-constellation-cards/

Making Shadows - A STEM lab where students create a model of the Sun and how it creates different shadows based around its movement
https://tinyurl.com/ml6vb4w

UNIT VOCABULARY

absolute brightness: an object's absolute brightness is how bright the object actually is, not its apparent brightness, which can be impacted by distance from the object.

apparent brightness: an object's apparent brightness is how bright it appears in the sky, not its actual or absolute brightness, which can be impacted by distance from the object.

apparent motion: motion that seems to happen.

axis: an imaginary line about which a body rotates

constellation: a pattern of stars, which are man made.

gravity: a force that pulls one object towards another object of greater mass.

line plot: a line plot is a graph that shows frequency of data along a number line.

line graph: a useful for displaying data or information that changes continuously over time.

moon phases: how the moon appears from Earth.

New Moon
Waxing Crescent Moon
First Quarter Moon
Waxing Gibbous Moon
Full Moon
Waning Gibbous Moon
Third Quarter Moon
Waning Crescent Moon

orbit: the path a revolving body follows.

revolution: the motion of one object around another.

rotate: spin around.

star: a ball of hot gas that gives off light and other types of energy that range greatly in size and energy.

RESOURCES

Exploring Science, National Geographic

Supplies: As per lab manuals

Websites:
http://ngss.nsta.org/AccessStandardsByTopic.aspx - The NGSS standards
http://stars.chromeexperiments.com/ - star animation
http://www.skymaponline.net/ - star map, which shows magnitude and distance
http://www.bbc.co.uk/schools/scienceclips/ages/7_8/light_shadows_fs.shtml - interactive shadow generating activity using the sun and moon

www.discoveryeducation.com - videos and lesson ideas
www.opened.com - background information for teachers and lesson ideas
https://phet.colorado.edu/sims/html/gravity-and-orbits/latest/gravity-and-orbits_en.html - online simulations
http://learningcenter.nsta.org/ - background information for teachers and lesson ideas
http://ngss.nsta.org/Classroom-Resources.aspx - lesson ideas
http://sciencespot.net/Pages/refdeskNextGen.html - lesson ideas

MODIFICATIONS

- 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).
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- Use project-based science learning to connect science with observable phenomena.

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- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles
    - http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA
- See NGSS Appendix D
    - http://www.nextgenscience.org/sites/ngss/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Appendix A
3-5 Engineering Design Standards

Students who demonstrate understanding can:
3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Disciplinary Core Ideas
ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1) Planning and Carrying Out Investigations

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Influence of Science, Engineering, and Technology on Society and the Natural World

People's needs and wants change over time, as do their demands for new and improved technologies. (3- 5-ETS1-1)

- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)