



Diocese of Alexandria ~ Catholic Schools

Where faith and knowledge grow



## DIOCESE OF ALEXANDRIA

As the Diocese of Alexandria seeks to provide a comprehensive learning environment, we are charged to “Teach More” by showing how all learning flows from and relates to our Creator. In this way, we will give our teaching a deeper meaning and purpose than simply the content itself. With this as our goal, the Catholic Schools Office has intertwined our selected curricular standards with the Catholic Standards developed by the Cardinal Newman Society. Through the merging of these two curricula, English Language Arts, Mathematics, Science, and Social Studies, teachers will be provided a roadmap to guide student’s understanding and recognition of the relationship between learning and the connection to our God.

Thomas E. Roque, Sr.  
Superintendent of Catholic Schools



## DIOCESE OF ALEXANDRIA

Through comprehensive review of curricula from high performing districts throughout the United States in combination with parochial schools and Newman Cardinal Standards, the Curriculum Team for the Diocese of Alexandria has generated curricula for English Language Arts, Mathematics, Science, and Social Studies. The development of this framework is designed to guide the instructional path of teachers as they focus on the formation of their students in the areas of faith, academic excellence, responsible citizenry, and effective communication and collaboration. This process is a continuous improvement process with no defined beginning or end.

Barbara Forest, M.A.  
Courtney Gistorb, M.Ed.

Denese Carter, M.Ed.  
Tracy Bock, Ed.S.

# Frameworks



THE DIOCESE  
of ALEXANDRIA

## HOW TO USE

The frameworks are guides to instruction. The frameworks assist teachers in planning and pacing instruction. Specific dates or weeks that may be included in this document are for reference. Each school and teacher must consider the make-up of their students, focusing on the needs and strengths of each child when pacing and planning instruction.

The cycles for the year help pace instruction and ensure students have consistent coverage of the content. The duration (the suggested amount of time to spend on each cycle) does not accommodate for the scheduling of special events, inclement weather or school events. Teachers, with principal guidance, should adjust pacing as needed to accommodate for these events.

## RESEARCH-BASED HIGH-YIELD PRACTICES FOR INSTRUCTION

These strategies have proven effective in affecting student learning and achievement gains. As you plan daily instruction, consider how and where to integrate these strategies into the instructional sequence. Effect size is in parentheses. Please refer to the works of John Hattie for a complete description of instructional effect size.

- Classroom Discussion/Discourse (.82)
- Teacher Clarity/making the learning visible with expectations for learning (.75)
- Reciprocal Teaching (.74)
- Feedback (.73)
- Metacognitive Strategies (.69)

# Grade 5- Science



THE DIOCESE  
of ALEXANDRIA

Unit 1: PROPERTIES OF MATTER

Instructional Days: 15 days

## SUMMARY

*When matter changes, does its weight change?*

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.

## Student Learning Objectives

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

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

## Unit Sequence

### *Part A: How can properties be used to identify materials?*

#### Concepts

- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.
- Measurements of a variety of properties can be used to identify materials. *(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.)*

#### Formative Assessments

*Students who understand the concepts can:*

- Measure and describe physical quantities such as weight, time, temperature, and volume.
- Make observations and measurements to produce data that can serve as the basis for evidence for an explanation of a phenomenon.
- Make observations and measurements to identify materials based on their properties. Examples of materials to be identified could include:
  - ✓ Baking soda and other powders
  - ✓ Metals
  - ✓ Minerals
  - ✓ LiquidsExamples of properties could include:
  - ✓ Color
  - ✓ Hardness
  - ✓ Reflectivity
  - ✓ Electrical conductivity
  - ✓ Thermal conductivity
  - ✓ Response to magnetic forces
  - ✓ Solubility

### Unit Sequence

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

| Concepts  | Formative Assessments   |
|---|---|
| <ul style="list-style-type: none"><li>• Natural objects exist from the very small to the immensely large.</li><li>• 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.</li><li>• 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.</li></ul> | <p><i>Students who understand the concepts can:</i></p> <ul style="list-style-type: none"><li>• Develop a model to describe phenomena.</li><li>• Develop a model to describe that matter is made of particles too small to be seen. (Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.)<br/>Examples of evidence could include:<ul style="list-style-type: none"><li>✓ Adding air to expand a basketball</li><li>✓ Compressing air in a syringe</li><li>✓ Dissolving sugar in water</li><li>✓ Evaporating salt water</li></ul></li></ul> |

### Sample of Open Education Resources

[Material Properties:](#) The dangerous Androvax has crash-landed on Earth! Sabotage his escape plans by tricking him into building a space ship out of the wrong materials.

## Teacher Professional Learning Resources

### [NSTA Web Seminar: Teaching NGSS in Elementary School—Fifth Grade](#)

Carla Zembal-Saul, Professor of Science Education at Penn State University, Mary Starr, Executive Director of Michigan Mathematics and Science Centers Network, and Kathy Renfrew, K-5 Science Coordinator for VT Agency of Education, shared an overview of the NGSS for Fifth Grade level students. Strategies, such as Claims, Evidence and, Reasoning (CER) and Know, Learning, Evidence, Wondering and Science (KLEWS) were discussed. The bundling of performance expectations with a focus on scientific practices, disciplinary core ideas, and cross-cutting concepts was also presented as a strategy for pulling it all together.

View the [resource collection](#).

### [NSTA Web Seminar: Teaching NGSS in K-5: Constructing Explanations from Evidence](#)

Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the *NGSS* for K-5th grade. The web seminar focused on the three dimensional learning of the *NGSS*, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.

View the [resource collection](#).

### [NSTA Web Seminar: NGSS Core Ideas: Matter and Its Interactions](#)

Dr. Krajcik began the presentation by defining disciplinary core ideas and discussing the value of using core ideas to build understanding across time. He also talked about the way disciplinary core ideas work together with the other components of *NGSS*: scientific and engineering practices and crosscutting concepts. The program featured strategies for teaching about physical science concepts that answer questions such as "How do particles combine to form the variety of matter one observes?" and "How do substances combine or change (react) to make new substances?" Dr. Krajcik talked about the disciplinary core ideas for Properties of Matter and shared examples of student work. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

View the [resource collection](#).

## Appendix A: NGSS and Foundations for the Unit

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

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

The performance expectations above were developed using the following elements from the NRC document  
[\*A Framework for K-12 Science Education:\*](#)

| Science and Engineering Practices  | Disciplinary Core Ideas  | Crosscutting Concepts  |
|--|--|--|
| <p><b><u>Planning and Carrying Out Investigations</u></b></p> <ul style="list-style-type: none"> <li>• Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)</li> </ul> <p><b><u>Developing and Using Models</u></b></p> <ul style="list-style-type: none"> <li>• Use models to describe phenomena. (5-PS1-1)</li> </ul> | <p><b><u>PS1.A: Structure and Properties of Matter</u></b></p> <ul style="list-style-type: none"> <li>• 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)</li> <li>• 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</li> </ul> | <p><b><u>Scale, Proportion, and Quantity</u></b></p> <ul style="list-style-type: none"> <li>• Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-3)</li> <li>• Natural objects exist from the very small to the immensely large. (5-PS1-1)</li> </ul> |

|  |   |  |
|--|---|--|
|  | <p>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)</p> |  |
|--|---|--|

# Grade 5 - Science



THE DIOCESE  
of ALEXANDRIA

Unit 2: CHANGES TO MATTER

Instructional Days: 15 Days

## SUMMARY

*If I have a frozen water bottle that weighs 500 mg, how much will it weigh if the water melts?*

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.

This unit is based on 5-PS1-4 and 5-PS1-2.

## Student Learning Objectives

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

**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. [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.]. (5-PS1-2)**

## Unit Sequence

### *Part A: How can we make slime?*

| <b>Concepts</b>  | <b>Formative Assessment</b>   |
|--|---|
| <ul style="list-style-type: none"><li>• Cause-and-effect relationships are routinely identified, tested, and used to explain change.</li><li>• When two or more different substances are mixed, a new substance with different properties may be formed.</li></ul> | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"><li>• Identify, test, and use cause-and-effect relationships to explain change.</li><li>• Conduct an investigation collaboratively to produce data that can serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered.</li><li>• Conduct an investigation to determine whether the mixing of two or more substances results in new substances.</li></ul> |

## Unit Sequence

**Part B:** *How can baking soda and vinegar burst a zip-lock bag?*

| Concepts   | Formative Assessment  |
|--|---|
| <ul style="list-style-type: none"><li>• Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.</li><li>• The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.</li><li>• No matter what reaction or change in properties occurs, the total weight of the substances does not change. <i>(Note: Mass and weight are not distinguished at this grade level.)</i></li><li>• Science assumes consistent patterns in natural systems.</li></ul> | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"><li>• Measure and describe physical quantities such as weight, time, temperature, and volume.</li><li>• Measure and graph quantities such as weight to address scientific and engineering questions and problems.</li><li>• Measure and graph quantities to provide evidence that regardless of the type of change that occurs when substances are heated, cooled, or mixed, the total weight is conserved. <i>(Note: Assessment does not include distinguishing between mass and weight.)</i></li><li>• Examples of reactions or changes could include:<ul style="list-style-type: none"><li>✓ Phase changes</li><li>✓ Dissolving</li><li>✓ Mixing</li></ul></li></ul> |

## Sample of Open Education Resources

[Time for Slime](#): Students combine water and borax to create slime. Be sure to read and follow all of the cautions on the borax box label.

[Bubble Burst!](#) How can baking soda and vinegar burst a zip-lock bag?

[Flame Out](#): A candle flame is actually a chemical reaction in action! Candle wax is one of the chemicals in the reaction.

## Teacher Professional Learning Resources

### **Using the NGSS Practices in the Elementary Grades**

The presenters were Heidi Schweingruber from the National Research Council, Deborah Smith from Penn State University, and Jessica Jeffries from State College Area School District. In this seminar the presenters talked about applying the scientific and engineering practices described in A Framework for K-12 Science Education in elementary-level classrooms.

### **Teaching NGSS in K-5: Constructing Explanations from Evidence**

Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the NGSS for K-5th grade. The web seminar focused on the three dimensional learning of the NGSS, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.

### **NGSS Core Ideas: Matter and Its Interactions**

The presenter was Joe Krajcik from Michigan State University. The program featured strategies for teaching about physical science concepts that answer questions such as "How do particles combine to form the variety of matter one observes?" and "How do substances combine or change (react) to make new substances?"

Dr. Krajcik began the presentation by defining disciplinary core ideas and discussing the value of using core ideas to build understanding across time. He also talked about the way disciplinary core ideas work together with the other components of NGSS: scientific and engineering practices and crosscutting concepts. Dr. Krajcik talked about the disciplinary core ideas for PS1 and shared examples of student work. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

Visit the [resource collection](#).

## Appendix A: NGSS and Foundations for the Unit

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

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. *[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.]* (5-PS1-2)

The performance expectations above were developed using the following elements from the NRC document [\*A Framework for K-12 Science Education\*](#):

| Science and Engineering Practices  | Disciplinary Core Ideas   | Crosscutting Concepts   |
|--|---|---|
| <p><b>Planning and Carrying Out Investigations</b></p> <ul style="list-style-type: none"> <li>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)</li> </ul> <p><b>Using Mathematics and Computational Thinking</b></p> <ul style="list-style-type: none"> <li>Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)</li> </ul> | <p><b>PS1.A: Structure and Properties of Matter</b></p> <ul style="list-style-type: none"> <li>The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)</li> </ul> <p><b>PS1.B: Chemical Reactions</b></p> <ul style="list-style-type: none"> <li>When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)</li> </ul> | <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships are routinely identified and used to explain change. (5-PS1-4)</li> </ul> <p><b>Scale, Proportion, and Quantity</b></p> <ul style="list-style-type: none"> <li>Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2)</li> </ul> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b></p> <ul style="list-style-type: none"> <li>Science assumes consistent patterns in natural systems. (5-PS1-2)</li> </ul> |

# Grade 5 - Science



THE DIOCESE  
of ALEXANDRIA

Unit 3: ENERGY AND MATTER IN ECOSYSTEMS

Instructional Days: 15 Days

## SUMMARY

*What happens to the matter and energy that are part of each organism?*

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.

This unit is based on 5-LS1-1, 5-LS2-1, and 5-PS3-1.

## Student Learning Objectives

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

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

**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.** *[Clarification Statement: Examples of models could include diagrams, and flow charts.]* [\(5-PS3-1\)](#)

| Unit Sequence  |   |
|--|---|
| <b>Part A: Where do plants get the materials they need for growth?</b>   |   |
| Concepts   | Formative Assessment  |
| <ul style="list-style-type: none"> <li>Matter is transported into, out of, and within systems.</li> <li>Plants acquire their material for growth chiefly from air and water.</li> </ul>  | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> <li>Describe how matter is transported into, out of, and within systems.</li> <li>Support an argument with evidence, data, or a model.</li> <li>Support an argument that plants get the materials they need for growth chiefly from air and water. <i>(Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.)</i></li> </ul>   |
| Unit Sequence  |   |
| <b>Part B: How does matter move among plants, animals, decomposers, and the environment?</b>   |   |
| Concepts   | Formative Assessment  |
| <ul style="list-style-type: none"> <li>Science explanations describe the mechanisms for natural events.</li> <li>A system can be described in terms of its components and their interactions.</li> <li>The food of almost any kind of animal can be traced back to plants.</li> <li>Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants.</li> <li>Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as <i>decomposers</i>.</li> <li>Decomposition eventually restores (recycles) some materials back to the soil.</li> <li>Organisms can survive only in environments in which their particular needs are met.</li> </ul> | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> <li>Describe a system in terms of its components and interactions.</li> <li>Develop a model to describe phenomena.</li> <li>Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. <i>(Assessment does not include molecular explanations.)</i></li> <li>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: <ul style="list-style-type: none"> <li>✓ Organisms</li> <li>✓ Ecosystems</li> <li>✓ Earth</li> </ul> </li> </ul> |

## Unit Sequence

**Part C:** *How can energy in animals' food be traced to the sun?*

### Concepts

- Energy can be transferred in various ways and between objects.
- The energy released from food was once energy from the sun, which was captured by plants in the chemical process that forms plant matter (from air and water).
- Food provides animals with the materials they need for body repair and growth and the energy they need for motion and to maintain body warmth.

### Formative Assessment

*Students who understand the concepts are able to:*

- Describe how energy can be transferred in various ways and between objects.
- Use models to describe phenomena.
- 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

## Sample of Open Education Resources

[Bottle Biology Terrarium](#): Students will create a terrarium, make observations of the terrarium, then develop a model to explain how matter transfers within the ecosystem. This resource describes the process of creating a terrarium (which will serve as the phenomena that the students observe), but does not include specific lesson details or instructional strategies.

[Biodomes Engineering Design Project](#): This activity is a culmination of a 16 day unit of study where students explore the biosphere's environments and ecosystems. In this final activity, students apply what they learned about plants, animals, and decomposers to design and create a model biodome. Engaging in the engineering design process, students construct a closed (system) environment containing plants and animals existing in equilibrium. Provided with a variety of materials (constraints), teams of students will use their imagination and culminating knowledge to design a biodome structure following the criteria of the activity that models how plants, insects, and decomposers work together in a system. (The activity can be conducted as a structured or open-ended design. It is recommended to allow students the opportunity to be true engineers and follow the opened-ended design.)

## Teacher Professional Learning Resources

### [Connections Between Practices in NGSS, Common Core Math, and Common Core ELA](#)

The presenter was Sarah Michaels from Clark University. In this seminar Dr. Michaels talked about connecting the scientific and engineering practices described in A Framework for K-12 Science Education with the Common Core State Standards in Mathematics and English Language Arts.

### [Engineering Design as a Core Idea](#)

The presenter was Cary Sneider, Associate Research Professor at Portland State University in Portland, Oregon. The seminar focused on the Core Idea of Engineering, led by Cary Sneider, Associate Research Professor at Portland State University. Cary explained the overall NGSS engineering components for K-2, MS and HS, and went through a number of practical examples of how teachers could develop modules and investigations for their students to learn them. Cary also spoke about the ways in which teachers could include cross-cutting engineering concepts to a number of classroom subjects. The seminar concluded Q & A session with Cary.

Visit the resource [collection](#).

### [NGSS Core Ideas: Energy](#)

The presenter was Jeff Nordine of the San Antonio Children's Museum. Ramon Lopez from the University of Texas at Arlington provided supporting remarks. The program featured strategies for teaching about physical science concepts that answer questions such as "How is energy transferred between objects or systems?" and "What is meant by conservation of energy?"

Dr. Nordine began the presentation by talking about the role of disciplinary core ideas within NGSS and the importance of energy as a core idea as well as a crosscutting concept. He then shared physicist Richard Feynman's definition of energy and related it to strategies for teaching about energy. Dr. Nordine talked about the elements of the energy core idea and discussed common student preconceptions. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

Visit the resource [collection](#).

### [NGSS Core Ideas: Ecosystems: Interactions, Energy, and Dynamics](#)

The presenters were Andy Anderson and Jennifer Doherty of Michigan State University. This was the ninth web seminar in a series focused on the disciplinary core ideas that are part of the Next Generation Science Standards (NGSS). The program featured strategies for teaching about life science concepts that answer questions such as "How do organisms interact with the living and nonliving environments to obtain matter and energy?" and "How do matter and energy move through an ecosystem?"

Dr. Anderson and Dr. Doherty began the presentation by discussing the two main strands of the ecosystems disciplinary core idea: community ecology and ecosystem science. They talked about common student preconceptions and strategies for addressing them. Next, Dr. Anderson and Dr. Doherty shared learning progressions for this core idea, showing how student understanding builds from elementary through high school. Last, the presenters described approaches for teaching about ecosystems and shared resources to use with students. Participants had the opportunity to submit their questions and comments in the chat.

Visit the [resource collection](#).

**Appendix A: NGSS and Foundations for the Unit**

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

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

**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.** *[Clarification Statement: Examples of models could include diagrams, and flow charts.]* (5-PS3-1)

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

| Science and Engineering Practices   | Disciplinary Core Ideas  | Crosscutting Concepts  |
|---|--|--|
| <p><b><u>Engaging in Argument from Evidence</u></b></p> <ul style="list-style-type: none"> <li>Support an argument with evidence, data, or a model. (5-LS1-1)</li> </ul> <p><b><u>Developing and Using Models</u></b></p> <ul style="list-style-type: none"> <li>Develop a model to describe phenomena. (5-S2-1)</li> <li><u>Use models to describe phenomena.</u> (5-PS3-1)</li> </ul> | <p><b><u>LS1.C: Organization for Matter and Energy Flow in Organisms</u></b></p> <ul style="list-style-type: none"> <li>Plants acquire their material for growth chiefly from air and water. (5-LS1-1)</li> </ul> <p><b><u>LS2.A: Interdependent Relationships in Ecosystems</u></b></p> <ul style="list-style-type: none"> <li>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</li> </ul> | <p><b><u>Energy and Matter</u></b></p> <ul style="list-style-type: none"> <li>Matter is transported into, out of, and within systems. (5-LS1-1)</li> <li>Energy can be transferred in various ways and between objects. (5-PS3-1)</li> </ul> <p><b><u>Systems and System Models</u></b></p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions. (5-LS2-1)</li> </ul> <p><b><i>Connections to the Nature of Science</i></b><br/> <b>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</b></p> <ul style="list-style-type: none"> <li>Science explanations describe the mechanisms for natural events. (5-LS2-1)</li> </ul> |

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)

**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, growth, and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1)

# Grade 5 - Science



THE DIOCESE  
of ALEXANDRIA

Unit 4: WATER ON THE EARTH

Instructional Days: 15 Days

## SUMMARY

*How do individual communities use science ideas to protect Earth's resources and environment?*

In this unit of study, students describe and graph data to provide evidence about the distribution of water on Earth. The crosscutting concepts of *scale, proportion, quantity* and *systems, and systems models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *using mathematics and computational thinking* and in *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 5-ESS2-2 and 5-ESS3-1.

## Student Learning Objectives

**Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.] (5-ESS2-2)**

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

| Unit Sequence  |  |
|--|--|
| <b>Part A:</b> <i>Where is water found on the Earth? What percentage of the Earth's water is fresh water?</i>  |  |
| Concepts   | Formative Assessment   |
| <ul style="list-style-type: none"> <li>Standard units are used to measure and describe physical quantities such as weight and volume.</li> <li>Nearly all of Earth's available water is in the ocean.</li> <li>Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.</li> </ul>   | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> <li>Describe physical quantities, such as weight and volume, in standard units.</li> <li>Describe and graph quantities such as area and volume to address scientific questions.</li> <li>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.<br/><i>(Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.)</i></li> </ul> |
| Unit Sequence  |  |
| <b>Part B:</b> <i>How do individual communities use science ideas to protect Earth's resources and environment?</i>  |  |
| Concepts   | Formative Assessment   |
| <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions.</li> <li>Science findings are limited to questions that can be answered with empirical evidence.</li> <li>Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.</li> <li>Individuals and communities are doing things to help protect Earth's resources and environments.</li> </ul> | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> <li>Describe a system in terms of its components and interactions.</li> <li>Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.</li> <li>Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</li> </ul>   |

## Sample of Open Education Resources

**Global Water Distribution:** 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:** 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. Educator uses the 5E curriculum model to engage students with fiction and non-fiction texts before exploring methods that simulate an oil spill and its cleanup. Video demonstrates the key portions of the activity and models appropriate teacher questioning and interactions with the students.

## Teacher Professional Learning Resources

### **Teaching NGSS in K-5: Making Meaning through Discourse**

The presenters were Carla Zembal-Saul, (Penn State University), Mary Starr, (Michigan Mathematics and Science Centers Network), and Kathy Renfrew (Vermont Agency of Education). After a brief introduction about the Next Generation Science Standards (NGSS), Zembal-Saul, Starr, and Renfrew gave context to the NGSS specifically for K-5 teachers, discussing three-dimensional learning, performance expectations, and background information on the NGSS framework for K-5. The presenters also gave a number of examples and tips on how to approach NGSS with students, and took participants' questions. The web seminar ended with the presentation of a number of recommended NSTA resources for participants to explore.

View the [resource collection](#).

### **Evaluating Resources for NGSS: The EQuIP Rubric**

The presenters were Brian J. Reiser, Professor of Learning Sciences in the School of Education and Social Policy at Northwestern University, and Joe Krajcik, Director of the CREATE for STEM Institute.

After a brief overview of the NGSS, Brian Reiser, Professor of Learning Sciences, School of Education at Northwestern University and Joe Krajcik, Director of CREATE for STEM Institute of Michigan State University introduced the Educators Evaluating Quality Instructional Products (EQuIP) Rubric. The web seminar focused on how explaining how the EQuIP rubric can be used to evaluate curriculum materials, including individual lessons, to determine alignment of the lesson and/or materials with the NGSS. Three-dimensional learning was defined, highlighted and discussed in relation to the rubric and the NGSS. An emphasis was placed on how to achieve the conceptual shifts expectations of NGSS and three-dimensional learning using the rubric as a guide. Links to the lesson plans presented and hard copies of materials discussed, including the EQuIP rubric, were provided to participants. The web seminar concluded with an overview of NSTA resources on the NGSS available to teachers by Ted, and a Q & A with Brian Reiser and Joe Krajcik.

View the [resource collection](#).

### **NGSS Crosscutting Concepts: Systems and System Models**

The presenter was Ramon Lopez from the University of Texas at Arlington. Dr. Lopez began the presentation by discussing the importance of systems and system models as a crosscutting concept. He talked about the key features of a system: boundaries, components, and flows and interactions. Dr. Lopez also described different types of system models, including conceptual, mathematical, physical, and computational models. Participants discussed their current classroom applications of systems and system models and brainstormed ways to address challenges associated with teaching this crosscutting concept.

### **[NGSS Core Ideas: Earth's Systems](#)**

The presenter was Jill Wertheim from National Geographic Society. The program featured strategies for teaching about Earth science concepts that answer questions such as "What regulates weather and climate?" and "What causes earthquakes and volcanoes?"

Dr. Wertheim began the presentation by introducing a framework for thinking about content related to Earth systems. She then showed learning progressions for each concept within the Earth's Systems disciplinary core idea and shared resources and strategies for addressing student preconceptions. Dr. Wertheim also talked about changes in the way *NGSS* addresses these ideas compared to previous common approaches.

### **[NGSS Core Ideas: Earth and Human Activity](#)**

The presenters were Susan Buhr Sullivan, Director of the CIRES Education and Outreach Group at University of Colorado; and Aida Awad, Science Department Chair at Maine East High School in Park Ridge, IL and president of the National Association of Geoscience Teachers (NAGT). The program featured strategies for teaching about Earth science concepts that answer questions such as "How do humans depend on Earth's resources?" and "How do humans change the planet?"

Dr. Buhr Sullivan began the presentation by describing the interconnections between this disciplinary core idea and other components of *NGSS*. She then talked about building a foundation for key concepts related to Earth and Human Activity at the elementary level. Ms. Awad continued the discussion by sharing the progression of this core idea through the middle school level and on to high school. The presenters provided a list of resources and activities that teachers can use to begin implementing *NGSS* in the classroom.

Visit the [resource collection](#).

**Appendix A: NGSS and Foundations for the Unit**

**Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.] (5-ESS2-2)**

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

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

| Science and Engineering Practices   | Disciplinary Core Ideas   | Crosscutting Concepts   |
|---|---|---|
| <p><b><u>Using Mathematics and Computational Thinking</u></b></p> <ul style="list-style-type: none"> <li>Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)</li> </ul> <p><b><u>Obtaining, Evaluating, and Communicating Information</u></b></p> <ul style="list-style-type: none"> <li>Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)</li> </ul> | <p><b><u>ESS2.C: The Roles of Water in Earth’s Surface Processes</u></b></p> <ul style="list-style-type: none"> <li>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)</li> </ul> <p><b><u>ESS3.C: Human Impacts on Earth Systems</u></b></p> <ul style="list-style-type: none"> <li>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)</li> </ul> | <p><b><u>Scale, Proportion, and Quantity</u></b></p> <ul style="list-style-type: none"> <li>Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)</li> </ul> <p><b><u>Systems and System Models</u></b></p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions. (5-ESS3-1)</li> </ul> <p><i>Connections to Nature of Science</i></p> <p><b>Science Addresses Questions About the Natural and Material World.</b></p> <ul style="list-style-type: none"> <li>Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)</li> </ul> |

# Grade 5 - Science



THE DIOCESE  
of ALEXANDRIA

Unit 5: EARTH SYSTEMS

Instructional Days: 20 Days

## SUMMARY

*How do individual communities use science ideas to protect Earth's resources and environment?*

In this unit of study, students are able to describe ways in which the geosphere, biosphere, hydrosphere, and atmosphere interact. The crosscutting concept of *systems and system models* is called out as an organizing concept for this disciplinary core idea. Students are expected to demonstrate grade-appropriate proficiency in *developing and using models, obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 5-ESS2-1 and 5-ESS3-1.

## Student Learning Objectives

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

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

## Unit Sequence

**Part A:** *In what ways do the geosphere, biosphere, hydrosphere, and/or atmosphere interact?*

### Concepts

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

### Formative Assessment

*Students who understand the concepts are able to:*

- Describe a system in terms of its components and interactions.
- Develop a model using an example to describe a scientific principle.
- Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. *(The geosphere, hydrosphere, atmosphere, and biosphere are each a system. Assessment is limited to the interactions of two systems at a time.)*
- Examples could include:
  - ✓ The influence of oceans on ecosystems, landform shape, and climate.
  - ✓ The influence of the atmosphere on landforms and ecosystems through weather and climate.
  - ✓ The influence of mountain ranges on the wind and clouds in the atmosphere.

## Unit Sequence

**Part B:** *How do individual communities use science ideas to protect Earth's resources and environment?*

### Concepts

- A system can be described in terms of its components and their interactions.
- Science findings are limited to questions that can be answered with empirical evidence.
- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.
- Individuals and communities are doing things to help protect Earth's resources and environments.

### Formative Assessment

*Students who understand the concepts are able to:*

- Describe a system in terms of its components and interactions.
- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

## Sample of Open Education Resources

[NOAA What-a-Cycle](#): 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](#): 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.

## Teacher Professional Learning Resources

### **Assessment for the Next Generation Science Standards**

The presenters were Joan Herman, Co-Director Emeritus of the National Center for Research on Evaluation, Standards, and Student Testing (CRESST) at UCLA; and Nancy Butler Songer, Professor of Science Education and Learning Technologies, University of Michigan.

Dr. Herman began the presentation by summarizing a report by the National Research Council on assessment for the Next Generation Science Standards (NGSS). She talked about the development of the report and shared key findings. Next, Dr. Songer discussed challenges for classroom implementation and provided examples of tasks that can be used with students to assess their proficiency on the NGSS performance expectations. Participants had the opportunity to submit questions and share their feedback in the chat.

View the [resource collection](#).

### **NGSS Crosscutting Concepts: Patterns**

The presenter was Kristin Gunckel from the University of Arizona. Dr. Gunckel began the presentation by discussing how patterns fit in with experiences and explanations to make up scientific inquiry. Then she talked about the role of patterns in NGSS and showed how the crosscutting concept of patterns progresses across grade bands. After participants shared their ideas about using patterns in their own classrooms, Dr. Gunckel shared instructional examples from the elementary, middle school, and high school levels.

### **NGSS Crosscutting Concepts: Structure and Function**

The presenters were Cindy Hmelo-Silver and Rebecca Jordan from Rutgers University. Dr. Hmelo-Silver and Dr. Jordan began the presentation by discussing the role of the crosscutting concept of structure and function within NGSS. They then asked participants to think about the example of a sponge and discuss in the chat how a sponge's structure relates to its function. The presenters introduced the Structure-Behavior-Function (SBF) theory and talked about the importance of examining the relationships between mechanisms and structures. They also discussed the use of models to explore these concepts. Participants drew their own models for one example and shared their thoughts about using this strategy in the classroom.

### **NGSS Core Ideas: Earth and Human Activity**

The presenters were Susan Buhr Sullivan, Director of the CIRES Education and Outreach Group at University of Colorado; and Aida Awad, Science Department Chair at Maine East High School in Park Ridge, IL and president of the National Association of Geoscience Teachers (NAGT). The program featured strategies for teaching about Earth science concepts that answer questions such as "How do humans depend on Earth's resources?" and "How do humans change the planet?"

Dr. Buhr Sullivan began the presentation by describing the interconnections between this disciplinary core idea and other components of NGSS. She then talked about building a foundation for key concepts related to Earth and

Human Activity at the elementary level. Ms. Awad continued the discussion by sharing the progression of this core idea through the middle school level and on to high school. The presenters provided a list of resources and activities that teachers can use to begin implementing *NGSS* in the classroom.

Visit the [resource collection](#).

**Appendix A: NGSS and Foundations for the Unit**

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

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

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

| Science and Engineering Practices  | Disciplinary Core Ideas   | Crosscutting Concepts  |
|--|---|--|
| <p><b><u>Developing and Using Models</u></b></p> <ul style="list-style-type: none"> <li>Develop a model using an example to describe a scientific principle. (5-ESS2-1)</li> </ul> <p><b><u>Obtaining, Evaluating, and Communicating Information</u></b></p> <ul style="list-style-type: none"> <li>Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)</li> </ul> | <p><b><u>ESS2.A: Earth Materials and Systems</u></b></p> <ul style="list-style-type: none"> <li>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)</li> </ul> <p><b><u>ESS3.C: Human Impacts on Earth Systems</u></b></p> <ul style="list-style-type: none"> <li>Human activities in agriculture, industry, and everyday life have</li> </ul> | <p><b><u>Systems and System Models</u></b></p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions. (5-ESS2-1),(5-ESS3-1)</li> </ul> <p><b><i>Connections to Nature of Science</i></b><br/> <b>Science Addresses Questions About the Natural and Material World.</b></p> <ul style="list-style-type: none"> <li>Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)</li> </ul> |

|  |  |  |
|--|--|--|
|  | <p>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)</p> |  |
|--|--|--|

# Grade 5 - Science



THE DIOCESE  
of ALEXANDRIA

Unit 6: INTERACTIONS WITHIN THE EARTH, SUN, AND MOON SYSTEM

Instructional Days: 20 Days

## SUMMARY

### *What patterns do we notice when observing the sky?*

In this unit of study, students develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. The crosscutting concepts of *patterns, cause and effect, and scale, proportion, and quantity* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *analyzing and interpreting data* and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

This unit is based on 5-PS2-1, 5-ESS1-1, and 5-ESS1-2.

## Student Learning Objectives

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

**Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** *[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).]* **(5-ESS1-1)**

**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.** *[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.]* **(5-ESS1-2)**

| <b>Unit Sequence</b>  |   |
|---|---|
| <b>Part A:</b> <i>What effect does Earth's gravitational force have on objects?</i>   |   |
| <b>Concepts</b>   | <b>Formative Assessment</b>   |
| <ul style="list-style-type: none"> <li>• Cause-and-effect relationships are routinely identified and used to explain change.</li> <li>• The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.</li> </ul>              | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> <li>• Identify cause-and-effect relationships in order to explain change.</li> <li>• Support an argument with evidence, data, or a model.</li> <li>• Support an argument that the gravitational force exerted by Earth on objects is directed down. ("Down" is a local description of the direction that points toward the center of the spherical Earth.) <i>(Assessment does not include mathematical representation of gravitational force.)</i></li> </ul> |
| <b>Unit Sequence</b>  |   |
| <b>Part B:</b> <i>What effect does the relative distance from Earth have on the apparent brightness of the sun and other stars?</i>   |   |
| <b>Concepts</b>   | <b>Formative Assessment</b>   |
| <ul style="list-style-type: none"> <li>• Natural objects exist from the very small to the immensely large.</li> <li>• The sun is a star that appears larger and brighter than other stars because it is closer.</li> <li>• Stars range greatly in their distance from Earth.</li> </ul> | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> <li>• Support an argument with evidence, data, or a model.</li> <li>• Support an argument that differences in the apparent brightness of the sun compared to that of other stars is due to their relative distances from Earth. <i>(Assessment is limited to relative distances, not sizes, of stars, and does not include other factors that affect apparent brightness, such as stellar masses, age, or stage.)</i></li> </ul>                               |

## Unit Sequence

*Part C: What patterns do we notice when observing the sky?*

| Concepts   | Formative Assessment   |
|--|--|
| <ul style="list-style-type: none"><li>• Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.</li><li>• 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:<ul style="list-style-type: none"><li>✓ Day and night</li><li>✓ Daily changes in the length and direction of shadows</li><li>✓ Different positions of the sun, moon, and stars at different times of the day, month, and year.</li></ul></li></ul> | <p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"><li>• Sort, classify, communicate, and analyze simple rates of change for natural phenomena using similarities and differences in patterns.</li><li>• Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.</li><li>• 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. (<i>Assessment does not include causes of seasons.</i>) Examples of patterns could include:<ul style="list-style-type: none"><li>✓ The position and motion of Earth with respect to the sun.</li><li>✓ Selected stars that are visible only in particular months.</li></ul></li></ul> |

## Sample of Open Education Resources

[Gravity and Falling Objects](#): PBS Learning Media lesson where students investigate the force of gravity and how all objects, regardless of mass, fall to the ground at the same rate.

NASA's [Solar System Exploration](#) website contains several resources that educators and students can use to make sense of the night sky.

[Our Super Star](#): PBS Learning Media lesson that guides students to understand the basic facts about the Sun, model the mechanics of day and night, and use solar energy to make a tasty treat.

## Teacher Professional Learning Resources

*Framework for K-12 Science Education*, [Developing and Using Models](#): This section of the Framework provides a deeper explanation of what it means for students to develop and use models. Modeling is especially important when concepts are too large or too small for students to have direct experience.

[APPENDIX F: Science and Engineering Practices in the NGSS](#), The Framework uses the term “practices,” rather than “science processes” or “inquiry” skills for a specific reason: We use the term “practices” instead of a term such as “skills” to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. (NRC Framework, 2012, p. 30). Appendix F provides further clarification of each science and engineering practice as well as specific details about what each looks like in each grade band.

### [NGSS Crosscutting Concepts: Stability and Change](#)

The presenter was Brett Moulding, director of the Partnership for Effective Science Teaching and Learning. Mr. Moulding began the web seminar by defining stability and change and discussing the inclusion of this concept in previous standards documents such as the National Science Education Standards (NSES). Participants brainstormed examples of science phenomena that can be explained by using the concept of stability and change. Some of their ideas included Earth’s orbit around the Sun, carrying capacity of ecosystems, and replication of DNA. Mr. Moulding then discussed the role of stability and change within NGSS. Participants again shared their ideas in the chat, providing their thoughts about classroom implementation of this crosscutting concept.

### [NGSS Core Ideas: Earth’s Place in the Universe](#)

The presenter was Julia Plummer from Penn State University. The program featured strategies for teaching about Earth science concepts that answer questions such as "What goes on in stars?" and "What patterns are caused by Earth's movements in the solar system?"

Dr. Plummer began the presentation by discussing what students should know about the disciplinary core idea of Earth's Place in the Universe. She talked about using the scientific and engineering practices to help engage students. Participants shared their ideas about applying this core idea to the classroom, and then Dr. Plummer shared strategies for effective instruction. She also discussed the importance of spatial thinking for students to begin thinking scientifically about these concepts.

## Appendix A: NGSS and Foundations for the Unit

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

**Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** *[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).]* [\(5-ESS1-1\)](#)

**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.** *[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.]* [\(5-ESS1-2\)](#)

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

| Science and Engineering Practices  | Disciplinary Core Ideas   | Crosscutting Concepts  |
|--|---|--|
| <p><a href="#">Developing and Using Models</a></p> <ul style="list-style-type: none"> <li>Develop a model using an example to describe a scientific principle. (5-ESS2-1)</li> </ul> <p><a href="#">Engaging in Argument from Evidence</a></p> <ul style="list-style-type: none"> <li>Support an argument with evidence, data, or a model. (5-PS2-1), (5-ESS1-1)</li> </ul> <p><a href="#">Analyzing and Interpreting Data</a></p> <ul style="list-style-type: none"> <li>Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)</li> </ul> | <p><a href="#">PS2.B: Types of Interactions</a></p> <ul style="list-style-type: none"> <li>The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center. (5-PS2-1)</li> </ul> <p><a href="#">ESS1.A: The Universe and its Stars</a></p> <ul style="list-style-type: none"> <li>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)</li> </ul> <p><a href="#">ESS1.B: Earth and the Solar System</a></p> <ul style="list-style-type: none"> <li>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</li> </ul> | <p><a href="#">Cause and Effect</a></p> <ul style="list-style-type: none"> <li>Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)</li> </ul> <p><a href="#">Scale, Proportion, and Quantity</a></p> <ul style="list-style-type: none"> <li>Natural objects exist from the very small to the immensely large. (5-ESS1-1)</li> </ul> <p><a href="#">Patterns</a></p> <ul style="list-style-type: none"> <li>Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2)</li> </ul> |

|  |  |  |
|--|--|--|
|  | <p>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)</p> |  |
|--|--|--|