Eastampton Community School

Grade 1 Science Curriculum

Unit 1: Patterns of Change in the Sky Instructional Days: 15

In this unit of study, students observe, describe, and predict some patterns in the movement of objects in the sky. The crosscutting concept of *patterns* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *analyzing and interpreting data*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-ESS1-1 and 1-ESS1-2.

Unit 2: Characteristics of Living Things Instructional Days: 15

In this unit of study, students develop an understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs, as well as how the behaviors of parents and offspring help offspring survive. The understanding that young plants and animals can be alike, but not exactly the same as, their parents, is developed. The crosscutting concept of *patterns* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *obtaining, evaluating, and communicating information* and *constructing explanations*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-LS3-1 and 1-LS1-2.

Unit 3: Mimicking Organisms to Solve Problems Instructional Days: 25

In this unit of study, students develop an understanding of how plants and animals use their parts to help them survive, grow, and meet their needs. Students also need opportunities to *develop possible solutions*. As students develop possible solutions, one challenge will be to keep them from immediately implementing the first solution they think of and to instead think through the problem carefully before acting. Having students sketch their ideas or make a physical model is a good way to engage them in shaping their ideas to meet the requirements of the problem. The crosscutting concept of *structure and function* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *constructing explanations, designing solutions*, and in *developing and using models*. Students are expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-LS1-1 and K-2-ETS1-2.

Unit 4: Light and Sound Instructional Days: 20

In this unit of study, students develop an understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. The idea that light travels from place to place can be understood by students at this level by placing objects made with different materials in the path of a beam of light and determining the effect of the different materials. The crosscutting concept of *cause and effect* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations*, *constructing explanations*, and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-PS4-2, 1-PS4-3, and 1-PS4-1.

Unit 5: Communicating with Light and Sound **Instructional Days: 25**

In this unit of study, students continue to develop their understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. Students apply their knowledge of light and sound to engage in engineering design to solve a simple problem involving communication with light and sound. The crosscutting concepts of *structure and function and influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *constructing explanations and designing solutions*, *asking questions and defining problems*, and *developing and using models*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-PS4-4, K-2-ETS1-1, and K-2-ETS1-2.

Note: *The number of instructional days is an estimate based on the information available at this time. 1 day equals approximately 42 minutes of seat time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.*

Recommended Instructional Days: 15

Grade 1 Science Unit 1: Patterns of Change in the Night Sky

NGSS:

Students who demonstrate understanding can:

1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted. [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]

1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]

Unit Summary

Can we predict how the sky will change over time?

In this unit of study, students observe, describe, and predict some patterns in the movement of objects in the sky. The crosscutting concept of *patterns* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations* and *analyzing and interpreting data*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-ESS1-1 and 1-ESS1-2.

Student Learning Objectives

Use observations of the sun, moon, and stars to describe patterns that can be predicted. *[Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.]* [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]* **(1-ESS1-1)**
Make observations at different times of year to relate the amount of daylight to the time of year. *[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.]* *[*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]* **(1- ESS1-2)**

Unit Sequence	
Part A: *What patterns of change can be predicted when observing the sun, moon, and stars?*	
Concepts	**Formative Assessments**
• Science assumes that natural events happen today as they happened in the past. • Many events are repeated. • Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. • Patterns in the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	*Students who understand the concepts can:* • Observe and use patterns in the natural world as evidence and to describe phenomena. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. • Use observations of the sun, moon, and stars to describe patterns that can be predicted. Examples of patterns could include: ✔ The sun and moon appear to rise in one part of the sky, move across the sky, and set. ✔ Stars other than our sun are visible at night but not during the day. *(Assessment of star patterns is limited to stars being seen at night and not during the day.)*

Unit Sequence	
Part B: *What is the relationship between the amount of daylight and the time of year?*	
Concepts	**Formative Assessments**
• Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. • Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	*Students who understand the concepts can:* • Observe and use patterns in the natural world as evidence and to describe phenomena. • Make observations (firsthand or from media) to collect data
	that can be used to make comparisons. • Make observations at different times of the year to relate the amount of daylight to the time of year. *(Note: The emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall; assessment is limited to relative amounts of daylight, not to quantifying the hours or time of daylight.)*

What It Looks Like in the Classroom

In this unit of study, students observe, describe, and predict some patterns of the movement of objects in the sky. Throughout the unit students look for patterns as they plan and carry out investigations and analyze and interpret data.

In this unit's progression of learning, students develop the understanding that natural events happen today as they happened in the past, and that many events are repeated. In addition, they observe and use patterns in the natural world as evidence and to describe phenomena. First graders ask questions and use observations of the sun, moon, and stars to describe apparent patterns of change in each. These patterns are then used to answer questions and make predictions. Some examples of patterns include:

- ✔ The sun and moon appear to rise in one part of the sky, move across the sky, and set.
- ✔ The shape of the moon appears to change over a period of time in a predictable pattern.
- ✔ Stars, other than our sun, are visible at night but not during the day.

After students observe and document these types of patterns over a period of time, they need opportunities to describe the patterns and to make predictions about the changes that occur in the objects in the sky. It is important that they use observed patterns as evidence to support predictions they might make about the sun, moon, and stars.

In this unit, students also learn that seasonal patterns of sunrise and sunset can be observed, described, and predicted. They relate the amount of daylight to the time of year by making observations at different times of the year. Over time, they collect and use data in order to identify the relationship between the amount of sunlight and the season. Grade 1 students are expected to make relative comparisons of the amount of daylight from one season to the next, and assessment should be

limited to relative amounts of daylight, not quantifying the hours or time of daylight.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

In this unit of study, students need opportunities to participate in shared research and writing projects about patterns of change in the sky. For example, students can use online resources or books to research the patterns of change that are visible over time when we observe the objects in the sky. With guidance from adults, students could create books that describe and illustrate the different patterns of change observed in objects in the sky. They could also describe and illustrate the relative amount of daylight in relation to the season using a sequenced set of journal entries or in a sequence-of-events foldable.

Mathematic

Students need opportunities to represent and interpret data and to use addition and subtraction. The following examples from NGSS Appendix L could provide guidance for instruction and should be done with teacher support:

- ✔ Science example 1: There were 16 hours of daylight yesterday. On December 21, there were 8 hours of daylight. How many more hours of daylight were there yesterday than on December 21?
- ✔ Science example 2: Based on the data collected and posted on the bulletin board so far, which day has been the longest of the year so far? Which day has been the shortest?

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the 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 principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

Research on Student Learning

The ideas "the sun is a star" and "the earth orbits the sun" appear counter-intuitive to elementary-school students. The ideas "the sun is a star" and "the earth orbits the sun" and are not likely to be believed or even understood in elementary grades. Whether it is possible for elementary students to understand these concepts even with good teaching needs further investigation.

Explanations of the day-night cycle, the phases of the moon, and the seasons are very challenging for students. To understand these phenomena, students should first master the idea of a spherical earth, itself a challenging task. Similarly, students must understand the concept of "light reflection" and how the moon gets its light from the sun before they can understand the phases of the moon. Finally, students may not be able to understand explanations of any of these phenomena before they reasonably understand the relative size, motion, and distance of the sun, moon, and the earth (NSDL, 2015).

Prior Learning

This is the first opportunity for students to encounter these ideas.

Future Learning

Grade 3 Unit 2: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. *[Note: The emphasis is qualitative and conceptual understanding of forces. Quantitative understanding is at a later grade level.]*
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. *[Note: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.]*

Grade 5 Unit 6: Interactions within the Earth, Sun, Moon Systems

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

Connections to Other Units

N/A

Sample of Open Education Resources

The Dynamic Trio: In this lesson, students will learn about the stars, planets, and moons found in our solar system and how they relate to one another. The video segment enhances the learning. After a non-fiction read aloud, students work in groups to create models of the Solar System.

Our Super Star: This is a three part lesson where students use observations, activities, and videos to learn basic facts about the Sun. Students also model the mechanics of day and night and use solar energy to make a tasty treat. One of the videos is a time-lapse video of a sunrise and a sunset.

Keep a Moon Journal: The National Wildlife Federation's "Keep a Moon Journal" page allows students to get acquainted with the phases of the moon by keeping a moon journal to record their nightly observations for one month. The page has links to diagrams, a student printable, and activities connecting the journal to other content. The page is set up as a "family activity" and could be used as nightly homework for students then discussed weekly in class.

Patterns of Daylight: This is a mini-unit that can be taught directly after Space Part 1or independently. The author chose to teach the Space Part 1 unit (also available on Better Lesson! at http://betterlesson.com/lesson/613469/introduction-and-pre assessment) during January, and follows up at the end of the year in a recap in May. This lesson uses prior student knowledge and a video simulation.

Observing the Sun: This lesson is an activity where students create a sun tracker and monitor the sun's position over the course of a day. Examples of student journals and connections within a larger unit are provided.

Teacher Professional Learning Resources

Teaching NGSS in Elementary School—First Grade

The presenters were Carla Sembal-Saul, Professor of Science Education at Penn State University, Mary Starr, Executive Director at Michigan Mathematics and Science Centers Network, and Kathy Renfrew, K-5 Science Coordinator, VT Agency of Education and NGSS Curator introduced the *NGSS* Web seminar Series for K-5 educators.

After a brief overview of this *NGSS* for First Grade web seminar, Mary discussed the science and engineering practices in relation to teaching first grade. The web seminar focused on the concept of sound, and how performance expectations should be incorporated into teaching. Sound was further considered as a disciplinary core idea within first grade teaching. Participants viewed a video of a teacher supporting students in developing towards the performance expectations. The science and engineering practices of explanation and argument was considered within the lesson presented. Claim, evidence, reasoning and rebuttal were discussed, and a CER framework was shared. Carla introduced the KLEWS chart and discussed its use in an elementary classroom. Kathy shared the importance of classroom discourse and science talk. The web seminar closed with

the sharing of resources in relation to the NGSS and teaching K-5 grades. Ted, in closing, shared NSTA resources in relation to the NGSS.

Visit the resource collection.

Continue discussing this topic in the community forums.

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.

To view related resources, visit the resource collection.

Continue discussing this topic in the community forums.

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.

Continue the discussion in the Community Forums.

Appendix A: NGSS and Foundations for the Unit

<table>
<tr><td colspan="3">Use observations of the sun, moon, and stars to describe patterns that can be predicted. [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.] (1-ESS1-1)</td></tr>
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<tr><td colspan="3">The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:</td></tr>
<tr><td>Science and Engineering Practices</td><td>Disciplinary Core Ideas</td><td>Crosscutting Concepts</td></tr>
<tr><td>Planning and Carrying Out Investigations
• Plan and conduct investigations collaboratively to produce evidence to answer a question. (1-PS4-1),(1- PS4-3)
Planning and Carrying Out Investigations
• Make observations (firsthand or from media) to collect data that can be used to make comparisons. (1-ESS1-2)
Analyzing and Interpreting Data
• Use observations (firsthand or from</td><td>ESS1.A: The Universe and its Stars
• Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)
ESS1.B: Earth and the Solar System
• Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)</td><td>Patterns
• Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-1),(1-ESS1-2)
- -
Connections to Nature of Science
Scientific Knowledge Assumes an Order and Consistency in Natural Systems
• Science assumes natural events happen today as they happened in</td></tr>
</table>

media) to describe patterns in the natural world in order to answer scientific questions. (1-ESS1-1)		the past. (1-ESS1-1) • Many events are repeated. (1-ESS1-1)

English Language Arts	Mathematics
Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-ESS1-1),(1- ESS1-2) **W.1.7** With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-ESS1-1),(1-ESS1-2) **W.1.8**	Reason abstractly and quantitatively. *(1-ESS1-2)* **MP.2** Model with mathematics. *(1-ESS1-2)* **MP.4** Use appropriate tools strategically. *(1-ESS1-2)* **MP.5** Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations to represent the problem. *(1-ESS1-2)* **1.OA.A.1** Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. *(1-ESS1-2)* **1.MD.C.4**

Recommended Instructional Days: 15

Grade 1 Unit 2: Characteristics of Living Things

NGSS:

Students who demonstrate understanding can:

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like,their parents. [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [*Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.*]

1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

Unit Summary

In this unit of study, students develop an understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs, as well as how the behaviors of parents and offspring help offspring survive. The understanding that young plants and animals are like, but not exactly the same as, their parents is developed. The crosscutting concept of *patterns* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *obtaining, evaluating, and communicating information* and *constructing explanations*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-LS3-1 and 1-LS1-2.

Student Learning Objectives

Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. *[Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.]* [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.*]* **(1-LS3-1)**
Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. *[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]* **(1-LS1-2)**

Unit Sequence	
Part A: *How are young plants and animals alike and different from their parents?*	
Concepts	**Formative Assessment**

• Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. • Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. • Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents.	*Students who understand the concepts are able to:* • Observe and use patterns in the natural world as evidence and to describe phenomena. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. ✔ Examples of patterns could include features plants or animals share. ✔ Examples of observations could include that leaves from the same kind of plant are the same shape but can differ in size and that a particular breed of puppy looks like its parents but is not exactly the same. *[Note: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]*

Unit Sequence	
Part B: *What types (patterns) of behavior can be observed among parents that help offspring survive?*	
Concepts	**Formative Assessment**
• Scientists look for patterns and order when making observations about the world. • Patterns in the natural world can be observed, used to	*Students who understand the concepts are able to:* • Observe and use patterns in the natural world as evidence

describe phenomena, and used as evidence. • Adult plants and animals can have young. • In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring survive.	and to describe phenomena. • Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. • Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. Examples of patterns of behaviors could include: ✔ The signals that offspring make, such as crying, cheeping, and other vocalizations. ✔ The responses of the parents, such as feeding, comforting, and protecting the offspring.

What It Looks Like in the Classroom

In this unit of study, students observe organisms in order to recognize that many types of young plants and animals are like, but not exactly the same as, their parents. Students also observe how organisms use their external parts to help them survive, grow, and meet their needs, and how the behaviors of parents and offspring help offspring survive. Throughout the unit, students will look for patterns; obtain, evaluate, and communicate information; and construct explanations.

People look for patterns in the natural world and use these patterns as evidence to describe phenomena. Students begin this unit by observing and comparing external features of organisms, looking for patterns in what they observe. They will need opportunities to observe a variety of plants and animals in order to look for similarities and differences in their features. For example, when comparing the shape, size, color, or number of leaves on plants, students begin to notice that plants of the same kind have leaves that are the same shape and color, but the leaves of one plant may differ from another in size or number. When comparing body coverings; number, size, and type of external features (legs, tail, eyes, mouth parts); body size, body coloring, or eye color of animals, students learn that animals of the same kind have the same type of body covering and the same number and types of external features, but the size of the body, the size of external features, body color, and/or eye color of individuals might differ. Making observations like these helps students recognize that young plants and animals look very much, but not exactly, like their parents, and that even though individuals of the same kind of plant or animal are

recognizable as similar, they can also vary in many ways.

In addition to observing and documenting similarities and differences in the external features of organisms, students also need opportunities to make direct observations, read texts, or use multimedia resources to determine patterns in the behaviors of parents and offspring that help offspring survive. While both plants and animals can have young, it is the parents of young animals who might engage in behaviors that help their young survive. Some examples of these patterns of behaviors could include the signals that offspring make, such as crying, cheeping, and other vocalizations, and the responses of parents, such as feeding, comforting, and protecting their young.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts

To integrate English Language Arts into this unit, students need opportunities to read informational texts to gather information about traits and behaviors of organisms. With adult guidance, they identify the main topic, retell key details from texts, and ask and answer questions about key details. Students should also participate in shared research and writing projects. They can gather information from a variety of preselected, grade-level-appropriate texts and resources and use that information to answer questions about traits and behaviors of organisms. In pairs or small groups, students can use pictures and words to create simple books that describe features that parents and offspring share or behaviors that parents and offspring exhibit that help offspring survive.

Mathematics

To integrate mathematics into this unit, students reason abstractly and quantitatively and use appropriate tools strategically as they collect and organize data, and use it to solve problems. For example, when students gather information about the shape, size, color, and number of leaves on plants, they can:

- ✔ Use grade-level-appropriate tools and strategies to measure, compare, and order leaves by length.
- ✔ Organize data (e.g., number of leaves) into simple graphs or tables, and then use strategies based on place value, properties of operations, and/or the relationship between addition and subtraction to make comparisons.
- ✔ Use drawings and equations as they solve problems (e.g., more or less, total amount, how many in each).

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the 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 principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

Research on Student Learning

N/A

Prior Learning

This is the students' first opportunity to make sense of these phenomena.

Future Learning

Grade 3 Unit 6: Organisms and the Environment

- Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size

Grade 4 Unit 3: Structures and Functions

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Grade 4 Unit 4: How Organisms Process Information

- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.

Connections to Other Units

N/A

Sample of Open Education Resources

Chip Off the Old Block: In this lesson students compare adult plants with young plants and then match pictures of adult animals with their young. They then are asked to identify specific physical traits of plants and animals that can be used to identify them. Note: The Parent/Offspring photo collection on page three incorrectly states the offspring of a horse is a pony.

Eat Like a Bird! January: This lesson and activity is one of several lessons about birds. In this lesson, students learn that bird beaks come in many different sizes and shape. Each beak has a specific shape and function to help the bird to get and eat food.

Why So Yummy? In this lesson students will investigate how fruits help some plants survive. The background information is important to the overall goals of this lesson. It states, "fruit-bearing plants can be distinguished from other plants, because they contain a reproductive structure that develops into an edible fruit. This reproductive structure is the shelter that protects the seeds until they are mature. This is important, because seeds are not distributed to the earth for germination until they are ripe." The teacher will need to purchase some fruits ahead of time for this lesson. Identifying a variety of fruits and especially fruits children might have less experience with will enhance the experience.

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.

Continue the discussion in the community forums.

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.

Continue discussing this topic in the community forums.

NGSS Core Ideas: Heredity: Inheritance and Variation of Traits

The presenter was Ravit Golan Duncan of Rutgers University. The program featured strategies for teaching about life science concepts that answer questions such as "How are the characteristics of one generation related to the previous generation?" and "Why do individuals of the same species vary in how they look, function, and behave?"

Dr. Duncan began the presentation by discussing the importance of heredity as a disciplinary core idea. She then described how student learning should progress across grade levels and showed examples of common preconceptions. Dr. Duncan also shared strategies and resources for teaching about heredity. Participants had the opportunity to submit their questions and comments in the chat.

Visit the resource collection.

Continue discussing this topic in the community forums.

Appendix A: NGSS and Foundations for the Unit

Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. *[Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [*Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.*]* (**1-LS3-1**)
Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. *[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]* (**1-LS1-2**)
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
Analyzing and Interpreting Data • Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1) **Obtaining, Evaluating, and Communicating Information** • Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1-LS1-2)	**LS3.A: Inheritance of Traits** • Many characteristics of organisms are inherited from their parents. (3-LS3-1) **LS1.B: Growth and Development of Organisms** • Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)	**Patterns** • Similarities and differences in patterns can be used to sort and classify natural phenomena. (3-LS3- 1) • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2) - *Connections to Nature of*

		Science **Scientific Knowledge is Based on Empirical Evidence** • Scientists look for patterns and order when making observations about the world. (1-LS1-2)

English Language Arts	**Mathematics**
Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1) **RI.3.1** Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-1) **RI.3.2** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1) **RI.3.3** Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS1-1) **W.1.7** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-1) **SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. (3-LS3-1) **W.3.2**	Reason abstractly and quantitatively. (3-LS3-1) **MP.2** Model with mathematics. (3-LS3-1) **MP.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS3-1) **3.MD.B.4**

Recommended Instructional Days: 25

Grade 1 Science Unit 3: Mimicking Organisms to Solve Problems

NGSS:

Students who demonstrate understanding can:

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.* [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]

1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Unit Summary

In this unit of study, students develop an understanding of how plants and animals use their parts to help them survive, grow, and meet their needs. Students also need opportunities to develop possible solutions. As students develop possible solutions, one challenge will be to keep them from immediately implementing the first solution they think of and to instead think through the problem carefully before acting. Having students sketch their ideas or make a physical model is a good way to engage them in shaping their ideas to meet the requirements of the problem. The crosscutting concept of structure and function is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in constructing explanations, designing solutions, and in developing and using models. Students are expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-LS1-1 and K-2-ETS1-2.

Student Learning Objectives

Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.* *[Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]* **(1-LS1-1)**

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. (K-2-ETS1-2)

Unit Sequence

Part A: *How can humans mimic how plants and animals use their external parts to help them survive and grow?*

Concepts	Formative Assessment

• Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. • The shape and stability of structures of natural and designed objects are related to their function(s). • All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. • Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	*Students who understand the concepts are able to:* • Observe and describe how the shape and stability of structures of natural and designed objects are related to their functions. • Use materials to design a device that solves a specific problem or [design] a solution to a specific problem. • Use materials to design a solution to a human problem that mimics how plants and/or animals use their external parts to help them survive, grow, and meet their needs: Examples of human problems that can be solved by mimicking plant or animal solutions could include: ✔ Designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales. ✔ Stabilizing structures by mimicking animal tails and roots on plants. ✔ Keeping out intruders by mimicking thorns on branches and animal quills. ✔ Detecting intruders by mimicking eyes and ears. • Develop a simple model based on evidence to represent a proposed object or tool. • Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

What It Looks Like in the Classroom

In this unit of study, students investigate how plants and animals use their external structures to help them survive, grow, and meet their needs. Then students are challenged to apply their learning to design a solution to a human problem that mimics how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

In order to recognize ways in which animals and plants use their external structures, students need opportunities to observe and describe how the shape and stability of organisms' structures are related to their functions. Students can make direct observations and use media resources to find relevant examples for both plants and animals. They should observe that different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. In addition, animals have body parts that capture and convey different kinds of information from the environment, enabling them to respond to these inputs in ways that aid in survival. Plants, like animals, have different parts (roots, stems, leaves, flowers, fruits) that each serve specific functions in survival and growth, and plants also respond to external inputs. For each structure that students observe, they should describe how the shape and stability of that structure is related to its function.

The next step in this unit is to engage in engineering design. Students need opportunities to use materials to design a device that solves a specific human problem. Designs should mimic how plants and/or animals use their external parts to help them survive and grow. The engineering design process students engage in should include the following steps:

- As a class or in small groups, students participate in shared research to find examples of human-made products that have been designed and built by applying knowledge of the natural world. For each example, students identify the human problem(s) that the product solves and how that solution was designed using an understanding of the natural world.
- Students brainstorm possible human problems that can be solved by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Examples could include:
  - ✔ Designing clothing or equipment to protect bicyclists that mimics turtle shells, acorn shells, and animal scales. ✔ Stabilizing structures that mimic animal tails and plant roots.
  - ✔ Keeping out intruders by mimicking thorns on branches and animal quills.
  - ✔ Detecting intruders by mimicking eyes and ears.

- In small groups, students use sketches, drawings, or physical models to convey a design that solves a problem by mimicking one or more external structures of plants and/or animals.
- Use materials to create the design solution.

- Share the design solution with others in the class.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts

Students participate in shared research and writing projects. Engaging in engineering design provides a perfect opportunity for students to conduct shared research and complete writing projects. Students can use text and media resources to gather information about how the shape and stability of external structures of organisms are related to their functions. In addition, students can conduct simple research to find examples of how humans solve problems using an understanding of the natural world. Examples of writing projects could include creating a book that includes examples of how humans mimic the characteristics of organisms to design solutions to human problems. Students can also use drawings or other visual displays to accompany their design solutions. Students will need support from teachers to conduct shared research and complete writing projects.

Mathematics

N/A

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the 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 principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

Research on Student Learning

N/A

Prior Learning

Kindergarten Unit 3: Weather

- Asking questions, making observations, and gathering information are helpful in thinking about problems.

Future Learning

Grade 4 Unit 3: Structures and Functions

• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Grade 4 Unit 4: How Organisms Process Information

• Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.

Connections to Other Units

In **Unit 2, Characteristics of Living Things**, students observed and compared traits and patterns of behavior in organisms. This learning is foundational for the content and practices in this unit of study.

Sample of Open Education Resources

Eat Like a Bird! January: This lesson and activity is one of several lessons about birds. In this lesson, students learn that bird beaks come in many different sizes and shape. Each beak has a specific shape and function to help the bird to get and eat food.

Why So Yummy: In this lesson students will investigate how fruits help some plants survive. The background information is important to the overall goals of this lesson. It states, "fruit-bearing plants can be distinguished from other plants, because they contain a reproductive structure that develops into an edible fruit. This reproductive structure is the shelter that protects the seeds until they are mature. This is important, because seeds are not distributed to the earth for germination until they are ripe." The teacher will need to purchase some fruits ahead of time for this lesson. Identifying a variety of fruits and especially fruits children might have less experience with will enhance the experience.

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 with an overview of NSTA resources about *NGSS* available to teachers by Ted, and a Q & A session with Cary.

Visit the resource collection.

Continue discussing this topic in the community forums.

NGSS Core Ideas: From Molecules to Organisms: Structures and Processes

The presenters were Aaron Rogat of Educational Testing Service (ETS) and Barbara Hug of the University of Illinois at Urbana-Champaign. The program featured strategies for teaching about life science concepts that answer questions such as "How do the structures of organisms enable life's functions?" and "How do organisms grow and develop?"

Dr. Hug began the presentation by discussing the arrangement of life science core ideas within NGSS and comparing them to previous standards. Next, Dr. Rogat shared an example of a learning progression, showing how a concept can be taught from early elementary through high school. The presenters then talked about strategies for instruction and shared links to resources. Participants had the opportunity to submit their questions and comments in the chat.

Visit the resource collection.

Continue discussing this topic in the community forums.

Appendix A: NGSS and Foundations for the Unit

Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.* *[Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]* **(1-LS1-1)**

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. (K-2-ETS1-2)

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
Analyzing and Interpreting Data • Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1) **Constructing Explanations and Designing Solutions** • Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-	**LS1.A: Structure and Function** • All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-	**Patterns** • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2) **Structure and Function** • The shape and stability of structures of natural and designed objects are

1) **Developing and Using Models** • Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)	1) **LS1.B: Growth and Development of Organisms** Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2) **LS1.D: Information Processing** Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1) **ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)	related to their function(s). (1-LS1-1) • The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2) - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering and Technology on Society and the Natural World** • Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (1-LS1-1)

English Language Arts	Mathematics

Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions). (1-LS1-1) Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2- ETS1-2) **SL.2.5**	**N/A**

Recommended Instructional Days: 20

Grade 1 Science Unit 4: Light and Sound

NGSS:

Students who demonstrate understanding can:

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.[Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]

1-PS4-3. Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [*Assessment Boundary: Assessment does not include the speed of light.*]

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]

Unit Summary

In this unit of study, students develop an understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. The idea that light travels from place to place can be understood by students at this level by placing objects made with different materials in the path of a beam of light and determining the effect of the different materials.

The crosscutting concept of *cause and effect* is called out as an organizing concept for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *planning and carrying out investigations*, *constructing explanations*, and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives
Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. *[Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]* **(1-PS4-2)**
Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. *[Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]* **(1-PS4-3)**
Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. *[Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]* **(1-PS4-1)**

Unit Sequence	
Part A: *How can you prove that you can only see something when someone shines a light on it or if the object gives off its own light?*	
Concepts	**Formative Assessments**

• Simple tests can be designed to gather evidence to support or refute student ideas about causes. • Objects can be seen if light is available to illuminate them or if they give off their own light.	*Students who understand the concepts can:* • Design simple tests to gather evidence to support or refute ideas about cause and effect relationships. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Make observations (e.g., in a completely dark room, using a pinhole box, using video of a cave explorer with a flashlight) to construct an evidence-based account that objects can be seen only when illuminated (from an external light source or by an object giving off its own light).

Unit Sequence	
Part B: *What happens to a beam of light when you put different kinds of things in front of it?* *How would you design an experiment to prove your thinking?*	
Concepts	**Formative Assessments**
• Simple tests can be designed to gather evidence to support or refute student ideas about causes. • Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them,	*Students who understand the concepts can:* • Design simple tests to gather evidence to support or refute ideas about cause and effect relationships. • Plan and conduct investigations collaboratively to produce

where the light cannot reach. • Mirrors can be used to redirect a light beam. *(Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)*	data to serve as the basis for evidence to answer a question. • Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. Materials can be: − Transparent (clear plastic, glass) − Translucent (wax paper, thin cloth) − Opaque (cardboard, construction paper) − Reflective (a mirror, a shiny metal spoon)

Unit Sequence	
Part C: How do instruments (band) make sound?	
Concepts	**Formative Assessments**
• Sound can make matter vibrate, and vibrating matter can make sound. • Simple tests can be designed to gather evidence to support or refute student ideas about causes.	*Students who understand the concepts can:* • Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. • Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. • Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.

What It Looks Like in the Classroom

In this unit of study, students plan and conduct investigations and make observations as they explore sound and light energy. Students describe the relationships between sound and vibrating materials and the availability of light and the ability to see objects. They also investigate the effect on a beam of light when objects made of different materials are placed in its path. Throughout the unit, students will use their observations and data as evidence to determine cause-and-effect relationships in the natural world.

Students begin this unit by observing objects with and without available light. They need opportunities to observe a variety of objects in both illuminated and non-illuminated settings. For example, observations could be made in a completely dark room, or students can use a pinhole box to observe objects. Students can also watch videos of cave explorers deep in the earth, using light from a single flashlight. With experiences such as these, they will come to understand that objects can be seen only when illuminated, either from an external light source or by when they give off their own light.

Next, students plan and conduct simple investigations to determine what happens to a beam of light when objects made of various materials are placed in its path. Students need the opportunity to explore the interaction of light with a variety of materials, and they should record what they observe with each one. When selecting materials to use, teachers should choose some that allow all light to pass through (transparent), some that allow only a portion of the light to pass through (translucent), some that do not allow any light to pass through (opaque), and some that redirect the beam of light (reflective). Examples could include clear plastic, glass, wax paper, thin cloth, cardboard, construction paper, shiny metal spoons, and mirrors.

As students observe the interaction between light and various materials, they should notice that when some or all of the light is blocked, a shadow is created beyond the object. If only a portion of light is blocked (translucent materials), a dim shadow will form, and some light will pass through the object. If all the light is blocked (opaque materials), students will see only see a dark shadow beyond the object. They will also observe that shiny materials reflect light, redirecting the beam of light in a different direction. Students should use their observations as evidence to support their explanations of how light interacts with various objects.

After investigating light energy, students continue to plan and conduct investigations to develop an understanding of some basic properties of sound. Students can use a variety of objects and materials to observe that vibrating materials can make sound and that sound can make materials vibrate. Students need multiple opportunities to experiment with a variety of objects that will make sound. Some opportunities could include:

- Gently tapping various sizes of tuning forks on a hard surface.

- Plucking string or rubber bands stretched across an open box.
- Cutting and stretching a balloon over an open can to make a drum that can be tapped.
- Holding the end of a ruler on the edge of a table, leaving the opposite end of the ruler hanging over the edge, and then plucking the hanging end of the ruler.
- Touching a vibrating tuning fork to the surface of water in a bowl.
- Placing dry rice grains on a drum's surface and then touching the drum with a vibrating tuning fork or placing the drum near the speaker of a portable sound system.
- Holding a piece of paper near the speaker of a portable sound system.

As students conduct these simple investigations, they will notice that when objects vibrate (tuning forks that have been tapped and string, rubber bands, and rulers that have been plucked), sound is created. They will also notice that sound will cause objects to vibrate (sound from a speaker causes rice grains to vibrate on the surface of a drum, the vibrating tuning fork causes ripples on the surface of water, and sound from the speaker also causes paper to move). Students should use these types of observations as evidence when explaining the cause and effect relationship between sound and vibrating materials.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

To integrate the CCSS for English Language Arts into this unit, students need opportunities to read informational texts in order to gather information about light and sound. With adult guidance, they identify the main topic and retell key details from texts and ask and answer questions about key details. Students should also participate in shared research and writing projects. They can gather information from a variety of preselected, grade-level appropriate texts and resources, and use that information to answer questions about light and sound. In pairs or small groups, students can use pictures and words to create simple books about vibration (sound) and illumination (light). The students' writing should include facts about the topic and have a sense of closure. Throughout the unit of study, students need multiple opportunities to share their experiences with light and sound in collaborative conversations with adults and peers, in small and large group settings.

Mathematic: **N/A**

Modifications

Teacher Note: Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list.

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

Research on Student Learning

N/A

Prior Learning

This is the first formal opportunity for students to engage with the disciplinary core ideas.

Future Learning

By the end of Grade 2, students understand that:

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.
- A great variety of objects can be built up from a small set of pieces.

By the end of Grade 4, students understand that:

- An object can be seen when light reflected from its surface enters the eyes.

Connections to Other Units

In Unit 5, Communicating With Light and Sound, students will continue to develop their understanding of the relationship between sound and vibrating materials, the idea that light travels from place to place, and the relationship between the availability of light and the ability to see objects. Students will apply their knowledge of these science concepts as they engage in engineering design to solve a simple problem involving communication with light and sound.

Sample of Open Education Resources

The "What it Looks Like in the Classroom" section of this document describes several student sense-making tasks. The Utah Education Network has created several resources for fourth grade science teachers.

Michigan NGSS Moodle: The purpose of this website to provide K-5 Science teachers with resources, lessons, and activities based on the NGSS which were created by teachers in our region.

Teacher Professional Learning Resources

NSTA Web Seminar: *NGSS Core Ideas: Waves and Their Applications in Technologies for Information Transfer*

This web seminar took place on September 24, 2013, from 6:30 p.m. to 8:00 p.m. eastern daylight time. The presenter was Ramon Lopez from the University of Texas at Arlington. The program featured strategies for teaching about physical science concepts that answer questions such as “How are waves used to transfer energy and information?” and “How are instruments that transmit and detect waves used to extend human senses?”

The web seminar is available at:

http://learningcenter.nsta.org/resource/?id=10.2505/9/WSNGSS13_Oct22 **Science Shorts: Making**

Waves

Children do not have to live near the coast to experience effects of water waves. They can throw stones into a pond and see the waves ripple outward, bob up and down while floating in a swimming pool, and splash water about while in a bathtub. As students discover how waves form and move, they can apply this understanding to other types of waves such as sound waves, light waves, and microwaves. (Adams, B., 2007)

This journal article is available at:

http://learningcenter.nsta.org/resource/?id=10.2505/4/sc07_044_05_50 **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.

The web seminar is available at: http://learningcenter.nsta.org/products/symposia_seminars/NGSS/webseminar49.aspx

Appendix A: NGSS and Foundations for the Unit

Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. *[Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]* **(1-PS4-2)**
Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. *[Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]* **(1-PS4-3)**
Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. *[Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]* **(1-PS4-1)**
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
Planning and Carrying Out Investigations • Plan and conduct investigations collaboratively to produce evidence to answer a question. (1-PS4-1),(1- PS4-3) **Constructing Explanations and Designing Solutions** • Make observations (firsthand or from	**PS4.A: Wave Properties** • Sound can make matter vibrate, and vibrating matter can make sound. (1- PS4-1) **PS4.B: Electromagnetic Radiation** • Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3) - **Connections to Engineering, Technology, and Applications of Science**

media) to construct an evidence based account for natural phenomena. (1-PS4-2) • Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4) - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Science investigations begin with a question. (1-PS4-1) • Scientists use different ways to study the world. (1-PS4-1)	• Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3) **PS4.C: Information Technologies and Instrumentation** • People also use a variety of devices to communicate (send and receive information) over long distances. (1- PS4-4)	**Influence of Engineering, Technology, and Science, on Society and the Natural World** • People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)

English Language Arts	**Mathematics**
Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. (1-PS4-2) **W.1.2** Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1),(1-PS4- 2),(1-PS4-3) **W.1.7** With guidance and support from adults, recall information from	**N/A**

experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3) **W.1.8** Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. (1-PS4-1),(1-PS4-2),(1-PS4-3) **SL.1.1**	

Recommended Instructional Days: 25

Grade 1 Science Unit 5: Communicating with Light and Sound

NGSS:

Students who demonstrate understanding can:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]

Unit Summary

How would we communicate over a distance without the use of any of the devices that people currently use?

In this unit of study, students continue to develop their understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. Students apply their knowledge of light and sound to engage in engineering design to solve a simple problem involving communication with light and sound. The crosscutting concepts of *structure and function and influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for the disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *constructing explanations and designing solutions*, *asking questions and defining problems*, and *developing and using models*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on 1-PS4-4, K-2-ETS1-1, and K-2-ETS1-2.

Student Learning Objectives

Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* [*Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]* **(1-PS4-4)**

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. (K-2-ETS1-2)

Unit Sequence

Part A: *How can light or sound be used to communicate over a distance?*

Concepts	Formative Assessments

• The shape and stability of structures of natural and designed objects are related to their function(s). • People depend on various technologies in their lives; human life would be very different without technology. • People also use a variety of devices to communicate (send and receive information) over long distances. • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	*Students who understand the concepts can:* • Describe how the shape and stability of structures are related to their function. • Ask questions based on observations to find more information about the natural and/or designed world. • Define a simple problem that can be solved through the development of a new or improved object or tool. • Ask questions, make observations, and gather information about a situation people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool. • Develop a simple model based on evidence to represent a proposed object or tool. • Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. • Use tools and materials provided to design a device that solves a specific problem. • Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. Examples of devices could include:

	✔ A light source to send signals ✔ Paper cup and string telephones ✔ A pattern of drum beats

What It Looks Like in the Classroom

Students continue to develop their understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. Students will apply their knowledge of light and sound to solve a simple problem involving communication with light and sound.

During this unit, students learn that people depend on various technologies in their lives, and that life would be very different without technology. Technology plays an important role in the development of devices that allow us to communicate (send and receive information) over long distances. Engineers design and build many kinds of devices, such as those used for communication. Like engineers, students engage in the engineering design process in order to design and build a device that uses light or sound to communicate over a distance.

This process should include the following steps:

- ✔ Students brainstorm a list of ways that people communicate over a distance. Some examples include telephones, cellular phones, email, and video conferencing (by computer).
- ✔ Ask students, “How would we communicate over a distance without the use of any of the devices that people currently use?”
- ✔ Use that question to guide the class to define the problem: Design and build a device that allows us to communicate over a distance.
- ✔ As a class, determine the criteria that will be used to evaluate the design solutions. One criterion MUST be that the device uses either light or sound.
- ✔ Also as a class, determine possible constraints, such as available materials and amount of time allotted for designing

and building the device.

✔ Small groups conduct research, looking for examples of devices that use light or sound to communicate over a distance.

✔ Small groups can then use tools and materials to design and build their devices. Examples could include a light source that sends a signal, paper cup and string telephones, or a pattern of drumbeats.

✔ Groups should prepare a sketch or drawing of their device. They should label the components and describe, in writing, how each component relates to the function of the device.

✔ Groups should present their devices to the class, demonstrating how they work.

✔ Students then determine which devices work as intended based on the criteria, using data as evidence to support their thinking.

Students should ask questions, make observations, gather information, and communicate with peers throughout the design process. Guidance and support from the teacher is also a critical part of the design process.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

Students will participate in shared research and writing projects as they engage in engineering design. Students can use text and media resources to first gather information about devices that use light or sound to communicate over a distance. They can demonstrate understanding of key details in a text by asking and answering questions during class and small-group discussions. In addition, students recall information from experiences or gather information from provided sources to support their thinking as they design and build their device. As students complete their devices, they prepare a sketch or drawing of their device, label the components, and describe, in writing, how each component relates to the function of the device and how their communication device works. Students can also write a “how-to” book describing how to use tools and materials to build their design. Students can also use drawings or other visual displays to accompany their writing in order to describe their thought process and clarify their ideas. Adult support should be provided throughout the process.

Mathematic

Students need opportunities to use tools to for a variety of purposes as they design and build devices for communicating with light or sound. They can use objects such as interlocking cubes or paper clips to measure length in nonstandard units,

expressing their measurements as whole numbers. Students can also use indirect measurement (i.e., compare the lengths of two objects indirectly by using a third object) to order three objects by length. For example, they might compare the lengths of string used for paper-cup telephones and observe and describe the relative effectiveness of each length of string.

Students can also use graphs to organize data, such as the number of drumbeats, and then analyze the data to find a pattern. Students will reason abstractly and quantitatively as they organize data into graphs, analyze the data, and use it to solve simple put-together, take-apart, and compare problems.

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the 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 principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

Research on Student Learning

Many students do not believe that their eyes receive light when they look at an object. Students' conceptions of vision vary from the notion that light fills space ("the room is full of light") and the eye "sees" without anything linking it to the object to the idea that light illuminates surfaces that we can see by the action of our eyes on them. The conception that the eye sees without anything linking it to the object persists after traditional instruction in optics (NSDL, 2015)

Prior Learning

In **Unit 4, Light and Sound**, students planned and conducted investigations to understand the relationship between vibrating materials and sound. They learned that vibrating materials can make sound and that sound can make materials vibrate. Students observed that light is necessary for objects to be seen and that light travels from place to place. They also investigated the effect of placing objects made with different materials in the path of a beam of light. This learning is foundational for the content and practices in this unit of study.

In **Unit 3, Mimicking Organisms to Solve Problems**, students engaged in engineering design in order to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Students learned that designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Future Learning

Grade 2 Unit 1: Relationships in Habitats

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary)*

Grade 2 Unit 2: Properties of Matter

• Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. • Matter can be described and classified by its observable properties.

• Different properties are suited to different purposes.

• A great variety of objects can be built up from a small set of pieces.

Grade 4 Unit 5: Transfer of Energy

• An object can be seen when light reflected from its surface enters the eyes.

• Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.

Connections to Other Units

In **Unit 4, Light and Sound**, students planned and conducted investigations to understand the relationship between vibrating materials and sound. They learned that vibrating materials can make sound and that sound can make materials vibrate. Students observed that light is necessary for objects to be seen and that light travels from place to place. They also investigated the effect of placing objects made with different materials in the path of a beam of light. This learning is foundational for the content and practices in this unit of study.

In **Unit 3, Mimicking Organisms to Solve Problems**, students engaged in engineering design in order to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Students learned that designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Sample of Open Education Resources

Assessing Light Knowledge - two lessons: In these lessons the students work as partners planning and designing a communication device that will signal across the gym or hallway from one partner to the other partner. The communication device must only use light and objects that block or change the light.

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.

Continue discussing this topic in the community forums.

NGSS Crosscutting Concepts: Patterns

The presenter was Kristin Gunckel from the University of Arizona. This was the first seminar in a series of seven focused on the crosscutting concepts that are part of the Next Generation Science Standards (NGSS).

NGSS Crosscutting Concepts: Structure and Function

The presenters were Cindy Hmelo-Silver and Rebecca Jordan from Rutgers University. This was the sixth web seminar in a series of seven focused on the crosscutting concepts that are part of the Next Generation Science Standards (NGSS).

Appendix A: NGSS and Foundations for the Unit

Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* [*Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]* **(1-PS4-4)**

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. (K-2-ETS1-2)

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
Planning and Carrying Out Investigations • Plan and conduct investigations collaboratively to produce evidence to answer a question. (1-PS4-1),(1- PS4-3) **Constructing Explanations and Designing Solutions** • Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4) **Asking Questions and Defining Problems**	**PS4.C: Information Technologies and Instrumentation** • People also use a variety of devices to communicate (send and receive information) over long distances. (1- PS4-4) **ETS1.A: Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) • Asking questions, making	**Structure and Function** • The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2) ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science, on Society and the Natural World** • People depend on various

• Ask questions based on observations to find more information about the natural and/or designed world(s). (K 2-ETS1-1) • Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2- ETS1-1) **Developing and Using Models** • Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)	observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) • Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1) **ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)	technologies in their lives; human life would be very different without technology. (1-PS4-4)

Cross Curricular Standards	
English Language Arts Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS3-3) **W.K.2** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1) **RI.2.1** With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1) **W.2.6** Recall information from experiences or gather information from provided sources to answer a question.	**Mathematics** Reason abstractly and quantitatively. (K-2-ETS1-1) **MP.2** Model with mathematics. (K-2-ETS1-1) **MP.4** Use appropriate tools strategically. (K-2-ETS1-1) **MP.5** Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1) **2.MD.D.10**

(K-2-ETS1-1)	

W.2.8

Technology
8.1.2.A.2
8.1.2.A.4
8.1.2.A.5

21st Century Life and Careers
9.2.4.A.1
CRP1
CRP2
CRP4

Modifications for SpEd/ESL/students at Risk/Gifted
Supports, Accommodations, and Modifications must be provided as stated in IEP,504 Plan, or I-Team Intervention Plan , and may include (but not limited to) the following**:**

Presentation accommodations:

- Listen to audio recordings instead of reading text
- Learn content from audio books, movies, videos and digital media instead of reading print versions
- Use alternate texts at lower readability level
- Work with fewer items per page or line and/or materials in a larger print size
- Use magnification device, screen reader, or Braille/Nemeth Code
- Use audio amplification device (e.g., hearing aid (s) , auditory trainer, sound-field system (which may require teacher use of microphone) • Be given a written list of instructions
- Record a lesson, instead of taking notes
- Have another student share class notes with him
- Be given an outline of a lesson
- Be given a copy of teachers' lecture notes
- Be given a study guide to assist in preparing for assessments
- Use visual presentations of verbal material, such as word webs and visual organizers

- Use manipulatives to teach or demonstrate concepts
- Have curriculum materials translated into native language

Response accommodations:

- Use sign language, a communication device, Braille, other technology, or native language other than English
- Dictate answers to scribe
- Capture responses on an audio recorder
- Use a spelling dictionary or electronic spell-checker

- Use a word processor to type notes or give responses in class
- Use a calculator or table of “math facts”
- Respond directly in the test booklet rather than on an answer sheet.

Setting accommodations:

- Work or take a test in a different setting, such as a quiet room with few distractions
- Sit where he learns best (for example, near the teacher, away from distractions)
- Use special lighting or acoustics
- Take a test in a small group setting
- Use sensory tools such as an exercise band that can be looped around a chair’s legs (so fidgety kids can kick it and quietly get their energy out) • Use noise buffers such as headphones, earphones, or earplugs

Timing accommodations:

- Take more time to complete a task or a test
- Have extra time to process oral information and directions
- Take frequent breaks, such as after completing task

Scheduling accommodations:

- Take more time to complete a project
- Take a test in several timed sessions or over several days
- Take sections of a test in a different order
- Take a test at a specific time of day

Organization skills accommodations:

- Use an alarm to help with time management
- Mark texts with a highlighter
- Have help coordination assignments in a book or planner
- Receive study skills instruction

Assignment modifications:

- Complete fewer or different homework problems than peers
- Write shorter papers
- Answer fewer or different test questions

- Create alternate projects or assignments

Curriculum modifications:

- Learn different material (such as continuing to work on multiplication while classmates move on to fractions, or moving ahead to an extension concept/skill while classmates continue to work on a core skill)