Wayne
Township Public Schools

First Grade
Science Curriculum

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WAYNE TOWNSHIP PUBLIC SCHOOL DISTRICT
ELEMENTARY SCIENCE CURRICULUM (JULY 2017)

I. COURSE OVERVIEW

The Wayne Township Public School elementary science program supports the philosophy of the New Jersey Science Learning Standards. Our students will develop an understanding of the disciplinary core ideas relative to physical sciences, life sciences, and earth and space sciences. and life science through experiential learning and engineering and technology, and through exposure to rich non-fiction text.

II. FRAMEWORK

Instruction is framed around 3-Dimensional learning as outlined in the Next Generation Science Standards including:

a. Disciplinary Core Ideas

i. Physical Sciences
   1. Matter and its interactions
   2. Motion and stability: Forces and interactions
   3. Energy
   4. Waves and their applications in technologies for information transfer

ii. Life Sciences
   1. From molecules to organisms: Structures and processes
   2. Ecosystems: Interactions, energy, and dynamics
   3. Heredity: Inheritance and variation of traits
   4. Biological evolution: Unity and diversity

iii. Earth and Space Sciences
   1. Earth's place in the universe
   2. Earth's systems
   3. Earth and human activity

iv. Engineering, Technology, and Applications of Science
   1. Engineering design
   2. Links among engineering, technology, science, and society

b. Scientific and Engineering Practices

i. Asking questions (for science) and defining problems (for engineering)
ii. Developing and using models
iii. Planning and carrying out investigations
iv. Analyzing and interpreting data
v. Using mathematics and computational thinking
vi. Constructing explanations (for science) and designing solutions (for engineering)
vii. Engaging in argument from evidence

viii. Obtaining, evaluating, and communicating information

c. Crosscutting Concepts

i. Look for and Analyze Patterns
ii. Cause and Effect
iii. Scale, Proportion, Quantity
iv. Systems and System Models
v. Energy and Matter, Flow, Cycles, Conservation
vi. Structure and Function
vii. Stability and Change

III. COMPONENTS

The curriculum includes the following components:

a. Scope and Sequence

b. Pacing Guide

c. Curricular Units

i. Unit Summary
ii. Student Learning Objectives
iii. Resources and Activities
iv. Background Information
v. Connections
    1. Prior and Future Learning
    2. Language Arts
    3. Mathematics
vi. Unit Sequence
vii. Modifications
viii. Assessment suggestions

IV. PROGRAM RESOURCES

a. National Geographic Exploring Science (Cengage Learning, 2015)

b. Science materials kits

c. Mystery Science online subscription

Grade 1 Unit 1: Characteristics of Living Things

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)**
See Content Evidence Statements for student performance expectations. See Evidence Statements for Engineering Design.

Resources and Activities
Exploring Science: Plants pgs. 42-43, Roots, Stems, Leaves pgs. 44-45, Flowers and Fruits pgs 46-47, Life Cycle pgs. 52-53, Young Plants Look Like Their Parents pgs. 54-55, Plants Can Be Different pgs. 56-58, Animal Parts pgs. 64-65,Look For Patterns pgs. 96-97, Young Animals Look Like Their Parents pgs. 98-99, Different Dogs pgs. 100-101, How Are Animals Alike and Different? pgs. 102-103 **Mystery Science**: See activities **Additional online resources**: (See table below) **Additional Activities**: (See table below) **Suggested Reading**: **Other**: Netflix Series- Baby Animals in the Wild **Materials Needed for Labs**: ES Lab Investigate Plants and Animals (pgs. 48-49)- bean plant in a pot, box with hole ES Lab Investigate Root Growth (pgs. 50-51)- tape, 2 plastic cups, 8 paper towels, 2 bean seeds, spoon, water, ruler, clay

Topic Outline Resources

Topic:	District Resources:	Additional Resources:	Notes:
Living vs. Non-Living		Living and non-living picture sort cards Outside scavenger hunt of living vs. non-living	
Parts of Plants	ES pgs. 42-47 Lab ES-Investigate: Root Growth pgs: 50-51	Time lapse video of flower becoming fruit Brain Pop Jr. Parts of a Plant	*Quizzes can be taken online
Life Cycle of Plants	ES pgs. 50-53 Lab ES-Investigate: Plants and Light pgs: 48-49	Shared Reading "I'm a Seed" Brain Pop Jr. Life Cycle	*Quizzes can be taken online
Similarities and Difference Between Plants	ES pgs. 54-59 Lab ES- Make Observations pgs. 60-61 ES -Share and Compare (matching pictures of adult plants and young plants) pg. 50	Sort and classify leaves	*Sort and classify lesson by Lhoogstrate* (found in Grade 1 science resources) Pictures of leaves for sorting
Animal Parts	ES pgs. 64-65		

Animal Parents and Offspring	ES pgs. 96-103 ES- Share and Compare pgs. 102-103 LAB ES- Make Observations pgs. 104-105	Offspring and Parent picture match sort Animals within a species communicate with each other (see lesson plan by L.hoogstrate) Video of Animal Parents and Offspring Epic Nonfiction Book *Dolphins* Epic Nonfiction Book *How Do Animals Communicate?* Epic Nonfiction Book *How and Why Do Animals Communicate?*	Offspring and Parent lesson by Lhoogstrate

Before You Teach
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.

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 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.	*Students who understand the concepts are able to:* • Observe and use patterns in the natural world as evidence 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.

Assessments
Formative: See formative assessment options above **Benchmark**: Exploring Science Assessments (after completion of each discipline). Note: Benchmark for Life Science after Unit 2 on pages 152-165 of the Exploring Science Teacher Manual. **Summative**: Mystery Science Unit and/or Mystery Assessments **Alternative**: Science journal/notebook and digital notebook entries, labs, Stem Gauge Assessments (Google Folder), student self-evaluation rubrics (Exploring Science teacher manual at the conclusion of each lesson)

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 principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).
- Differentiation Strategies
  - Differentiation Strategies for Special Education Students
  - Differentiation Strategies for Gifted and Talented Students
  - Differentiation Strategies for ELL Students
  - Differentiation Strategies for At Risk Students
  - Differentiation Strategies for Students with a 504

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

Future Learning
Grade 3: 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: Structures and Functions** ● Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. **Grade 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.

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.

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 & Health
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**	<u>Mathematics</u> 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** <u>Comprehensive Health and PE</u> 2.1.2.PP.2: Explain the ways in which parents may care for their offspring (e.g., animals, people, fish)
WIDA	**Computer Science & Design Thinking**
ELD Standard 1: The Language of Social and Instructional Language ELD Standard 4: The Language of Science	8.1.2.AP.4: Break down a task into a sequence of steps. 8.2.2.ED.1: Communicate the function of a product or device.
Career Readiness, Life Literacies, and Key Skills	
CRP3. Consider the environmental, social and economic impacts of decisions. CRP4. Demonstrate creativity and innovation. CRP5. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Work productively in teams while using cultural/global competence.	

Grade 1 Unit 2: Mimicking Organisms to Solve Problems

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)
Analyze data from tests of two objects designed to solve the same problem to compare the strength and weaknesses of how each performs. (K-2-ETS1-3)
See Content Evidence Statements for student performance expectations. See Evidence Statements for Engineering Design.

Resources and Activities
Exploring Science: Animals See and Hear pgs. 66-67, Animals Grasp pgs. 68-69, Animals Protect pgs. 70-71, Animals Move pgs. 72-73, Animals Find What They Need pgs. 74-75, Animals take in Food, Water, and Air pgs. 76-77, Animal Senses pgs. 78-79, A Better Train pgs. 80-83, Hear Me pgs. 86-87, Warm Me pgs. 88-89, Carry Me pgs. 90-91, Protect Me pgs. 92-93, Meerkat Teachers pgs. 94-95 **Mystery Science**: Animal Superpowers: Why are Polar Bears White? Animal Superpowers- Why do birds have beaks? **Additional online resources**: See Table Below **Additional Activities**: See Table Below **Suggested Reading**: Little Polar Bear by Hans De Beer, Bats by Gail Gibson, Stella Luna by Janell Cannon **Materials Needed for Labs**: Mystery Science: Why are Polar Bears White?- "Color-A-Moth" handout, "A Look for Moth" handout, crayons, scissors and glue. Mystery Science: Why do Birds Have Beaks?- Plastic drinking straws, 3oz cups, 8oz cups, masking tape, elbow macaroni, towels, dry beans, scissors, Bird Beak Recording Sheet

Topic Outline Resources

Topic:	District Resources:	Additional Resources	Notes:
Animal Survival	ES pgs. pgs. 68-69, 70-71,72-73, 74-75, 76-77 Mystery Science- Animal Superpowers: Why are Polar Bears White? Mystery Science: Animal Superpowers- Why do birds have beaks?	Pebble Go: Responses to the Environment -Hibernation -Migration Build a Nest Lab (see lesson plan by L.Hoogstrate) Watch video showing baby polar bear learning from parent	*Pages overlap- senses help animals survive *Provide students with different materials to create their own nest. Students will solve the problem of keeping babies warm and safe through a nest. * Have students research how animals respond to information they receive from the environment, e.g. what do animals do when there is not enough food? Take it further, what do humans do to get food?
Animal Senses	ES pgs. 68-69, 72-73, 78-79		*Pages overlap - senses help animals survive
Mimicking Organisms	ES Lab *Think Like an Engineer:* A Better Train pgs. 80-85	Create a project for students to design a device that provides a solution to a given human problem mimicking how plants or animals meet their needs. Brainpop Video: Camouflage Study Jams: Plants Adaptation Animal Adaptation	*Mimicking design lab for designing a device. (In grade 1 science resource) *Discussion of how and why people use Camouflage *Students can identify both ways humans mimic plants' and animals' adaptation to survive. There is also online quiz on Study Jams.

Before You Teach
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.

<table>
<tr><th colspan="2">Unit Sequence</th></tr>
<tr><td colspan="2">Part A: How can humans mimic how plants and animals use their external parts to help them survive and grow?</td></tr>
<tr><th>Concepts</th><th>Formative Assessment</th></tr>
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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.

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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.

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Assessments
Formative: See formative assessment options above **Benchmark**: Exploring Science Assessments (after completion of each discipline). Note: Benchmark for Life Science after Unit 2 on pages 152-165 of the Exploring Science Teacher Manual. **Summative**: Mystery Science Unit and/or Mystery Assessments **Alternative**: Science journal/notebook and digital notebook entries, labs, Stem Gauge Assessments (Google Folder), student self-evaluation rubrics (Exploring Science teacher manual at the conclusion of each lesson)

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.

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 principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).
- Differentiation Strategies
  - Differentiation Strategies for Special Education Students
  - Differentiation Strategies for Gifted and Talented Students
  - Differentiation Strategies for ELL Students
  - Differentiation Strategies for At Risk Students
  - Differentiation Strategies for Students with a 504

Prior Learning

Kindergarten: Weather

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

Future Learning

Grade 4: Structures and Functions
Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Grade 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 1, 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.

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-LS1-1) **Developing and Using Models** • Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)	**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-LS1-1) **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)	**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 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

	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)	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
WIDA	**Computer Science and Design Thinking**
ELD Standard 1: The Language of Social and Instructional Language ELD Standard 4: The Language of Science	8.1.2.AP.4: Break down a task into a sequence of steps. 8.2.2.ED.1: Communicate the function of a product or device.
Career Readiness, Life Literacies, and Key Skills	
CRP3. Consider the environmental, social and economic impacts of decisions. CRP4. Demonstrate creativity and innovation. CRP5. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Work productively in teams while using cultural/global competence.	

Grade 1 Unit 3: Patterns of Change in the Sky

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)**
See Content Evidence Statements for student performance expectations. See Evidence Statements for Engineering Design.

Resources and Activities
Exploring Science: The Sun pgs. 110-111, Day and Night pgs. 112-113, The Sun in the Sky pgs. 114-115, The Moon pgs. 118-119, The Moon in the Sky pgs. 120-121, Stars pgs. 124-125, Star Patterns pgs. 126-127, Stars in the Sky pgs. 128-129, Patterns of Motion pgs. 130-131, Seasons pgs. 134-135, Light and Seasons pgs. 136-137 **Mystery Science**: Sun, Shadows, and Daily Patterns: Could a statue's shadow move? Sun, Shadows, and Daily Patterns: How can the sun help you if you're lost? **Additional online resources**: See table below **Additional Activities**: See table below **Schoolwide**: **Suggested Reading**: Bear's Shadow by Frank Asch, Kitten's First Full Moon by Kevin Henkes, So That's How the Moon Changes Shape by Alan Fowler **Schoolwide**: **Other**: **Lab Materials:** ES Lab Investigation: The Sun- crayons, paper ES Lab Investigation: The Moon- crayons, paper ES Lab Investigation: THe Night Sky- construction paper, night sky model Mystery Science: Could a Statue's Shadow Move? Paper gnomes, shadow patterns, flashlight, tape. Mystery Science: How Can the Sun Help you if You're Lost? Sun Finder template, paper fastener, scissors.

Topic Outline Resources

Topic:	District Resources:	Additional Resources:	Notes:
The Sun	ES pgs. 110-111, 112-113, 114-115 ES Lab Investigation: The Sun pgs. 116-117 Mystery Science:Sun, Shadows, and Daily Patterns: How can the sun help you if you're lost?	Sun Changes Investigation Discovery Education: *What is the Sun* Video?	
Patterns in the Sky	ES pgs. 130-131 Mystery Science: Sun, Shadows, and Daily Patterns: Could a statue's shadow move?		
The Moon	ES pgs. 118-119, 120-121 ES Lab Investigation: The Moon pgs. 122-123		
Stars	ES pgs. 124-125, 126-127, 128-129	Pebble Go: Stars Did you Know: Stars Video	*Research can be done in a graphic organizer
Seasons	ES pgs. 134-135, 136-137	Pebble Go: Seasons Bill Nye Explains Seasons Video	*Research can be done in a graphic organizer

Before You Teach
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.

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.)*

Assessments
Formative: See formative assessment options above **Benchmark**: Exploring Science Assessments (after completion of each discipline). Note: Benchmark for Earth and Space Science after Unit 3 on pages 166-169 of the Exploring Science Teacher Manual. **Summative**: Mystery Science Unit and/or Mystery Assessments **Alternative**: Science journal/notebook and digital notebook entries, labs, Stem Gauge Assessments (Google Folder), student self-evaluation rubrics (Exploring Science teacher manual at the conclusion of each lesson)

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.

Mathematics

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 principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).
- Differentiation Strategies
  - Differentiation Strategies for Special Education Students
  - Differentiation Strategies for Gifted and Talented Students
  - Differentiation Strategies for ELL Students
  - Differentiation Strategies for At Risk Students
  - Differentiation Strategies for Students with a 504

Prior Learning

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

Future Learning

Grade 3: 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 1 or 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.

Appendix A: NGSS and Foundations for the Unit		
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)**		
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) **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 media) to describe patterns in the natural world in order to answer scientific questions. (1-ESS1-1)	**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)	**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 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**
WIDA	**Computer Science and Design Thinking**
ELD Standard 1: The Language of Social and Instructional Language ELD Standard 4: The Language of Science	8.1.2.AP.4: Break down a task into a sequence of steps. 8.2.2.ED.1: Communicate the function of a product or device.
Career Readiness, Life Literacies, and Key Skills	
CRP3. Consider the environmental, social and economic impacts of decisions. CRP4. Demonstrate creativity and innovation. CRP5. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Work productively in teams while using cultural/global competence.	

Grade 1 Unit 4: Light and Sound

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)**
See Content Evidence Statements for student performance expectations. See Evidence Statements for Engineering Design.

Resources and Activities
Exploring Science: Vibrate and Make Sound pgs. 4-5, Investigate Sound pgs. 6-9, Sounds Makes Things Vibrate pgs. 10-11, Investigate Vibration pgs. 12-15, Light pgs. 16-17, Light to See pgs. 18-19, Investigate Light and Dark pgs. 20-21, Shining Through pgs. 22-23, Blocking Some Light pgs. 24-25, Blocking All Light pgs. 26-27, Reflecting Light pgs. 28-29, Think Like a Scientist pgs. 30-31 **Mystery Science**:Light, Materials, Transparent, & Opaque: What if there were no windows? Sounds, Vibrations: How do they make silly sounds in cartoons? **Additional online resources**: See table below **Additional Activities**: See table below **Schoolwide**: **Suggested Reading**: Epic Online Book Me and My Shadow, Epic Online Book What are Sound Waves? **Schoolwide**: **Other**: **Materials Needed for Labs:** ES Lab Investigate Sound pgs. 6-7: rubber bands, cardboard box, hand lens ES Lab Investigate Vibration pgs. 12-13: balloons, paper towel tube ES Lab Investigate Light and Dark pgs. 20-21: cardboard box, flashlight, masking tape Mystery Science- Sounds, Vibrations: How do they make silly sounds in cartoons?: wooden ruler Mystery Science-Light, Materials, Transparent, & Opaque: What if there were no windows?: Activity 1 “Seeing & Sorting” : Sorting Sheets handout, transparent materials, translucent materials, and opaque materials. Activity 2 “Paper Stained Glass”: Tissue paper in many colors, flower shape handout, Glad Press'n Seal, windows

Topic Outline Resources

Topic:	District Resources:	Additional Resources:	Notes:
Sound	ES pgs. 4-5, 10-11, ES Lab Investigate Sound pgs. 6-7 ES Lab Think Like a Scientist pgs. 8-9 ES Lab Investigate Vibration pgs. 12-13 ES Lab Think Like a Scientist pgs. 14-15 Mystery Science Sounds, Vibrations: How do they make silly sounds in cartoons?	Epic Online Book What are Sound Waves? Space Jams: Sound	*Students can identify both ways humans mimic plants' and animals' adaptation to survive. There is also online quiz on Study Jams.
Light	ES pgs. 16-19 ES Lab Investigate Light and Dark pgs. 20-21	Pebble Go: What is Light?	*Research can be done in a graphic organizer
Translucent, Transparent, and Opaque	ES pgs. 22-29 ES Lab Think Like a Scientist pgs. 30-31 Mystery Science: Light, Materials, Transparent, & Opaque: What if there were no windows?	Epic Online Book Me and My Shadow	*Discuss how conducting science and civic investigations helps society.

Before You Teach

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.

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).

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, 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.)*	*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 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.

Assessments
Formative: See formative assessment options above **Benchmark**: Exploring Science Assessments (after completion of each discipline). Note: Benchmark for Physical Science after Unit 5 on pages 144-151 of the Exploring Science Teacher Manual. **Summative**: Mystery Science Unit and/or Mystery Assessments **Alternative**: Science journal/notebook and digital notebook entries, labs, Stem Gauge Assessments (Google Folder), student self-evaluation rubrics (Exploring Science teacher manual at the conclusion of each lesson)

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.

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 principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
● Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
● Use project-based science learning to connect science with observable phenomena.
● Structure the learning around explaining or solving a social or community-based issue.
● Provide ELL students with multiple literacy strategies.
● Collaborate with after-school programs or clubs to extend learning opportunities.
● Differentiation Strategies
  ● Differentiation Strategies for Special Education Students
  ● Differentiation Strategies for Gifted and Talented Students
  ● Differentiation Strategies for ELL Students
  ● Differentiation Strategies for At Risk Students
  ● Differentiation Strategies for Students with a 504

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.

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 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)	**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) ● 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)	**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** **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)

● Scientists use different ways to study the world. (1-PS4-1)	**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)	

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 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**	**N/A**
WIDA	**Computer Science & Design Thinking**
ELD Standard 1: The Language of Social and Instructional Language ELD Standard 4: The Language of Science	8.1.2.AP.4: Break down a task into a sequence of steps. 8.2.2.ED.1: Communicate the function of a product or device.

Career Readiness, Life Literacies, and Key Skills

CRP3. Consider the environmental, social and economic impacts of decisions.
CRP4. Demonstrate creativity and innovation.
CRP5. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP9. Work productively in teams while using cultural/global competence.

9.2.2.CAP.1: Make a list of different types of jobs and describe the skills associated with each job.

Grade 1 Unit 5: Communicating with Light and Sound

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 (e.g., climate change) to define a simple problem that can be solved through the development of a new or improved object or tool. (K-5 NJSLS-S, pp.11 and 23)(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)
See Content Evidence Statements for student performance expectations. **See Evidence Statements for Engineering Design.**

Resources and Activities
Exploring Science: People Communicate pgs. 32-33, Investigate: Communicating with Sound pgs. 34-35, Design a Device pgs. 36-37 **Mystery Science**: N/A **Additional online resources**: See Table Below **Additional Activities**: See Table Below **Schoolwide**: **Suggested Reading**: Epic Online Book Sending Messages with Light and Sound **Schoolwide**: **Other**: **Materials Needed for Labs:** ES Lab Investigate: Communicating with Sound pgs. 34-35: paper cups, string, paper clips

Topic Outline Resources

Topic:	District Resources:	Additional Resources:	Notes:
Communication with Sound and Light	ES pgs. 32-33 ES Lab Investigate: Communicating with Sound pgs. 34-35 ES Lab Design a Device pgs. 36-37	Epic Online Book Sending Messages with Light and Sound	

Before You Teach
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.

<table>
<tr><th colspan="2">Unit Sequence</th></tr>
<tr><td colspan="2">Part A: How can light or sound be used to communicate over a distance?</td></tr>
<tr><th>Concepts</th><th>Formative Assessments</th></tr>
<tr><td>

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.

</td><td>
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

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Assessments
Formative: See formative assessment options above **Benchmark**: Exploring Science Assessments (after completion of each discipline). Note: Benchmark for Physical Science after Unit 5 on pages 144-151 of the Exploring Science Teacher Manual. **Summative**: Mystery Science Unit and/or Mystery Assessments **Alternative**: Science journal/notebook and digital notebook entries, labs, Stem Gauge Assessments (Google Folder), student self-evaluation rubrics (Exploring Science teacher manual at the conclusion of each lesson)

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. *Mathematics* 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 principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).
● Differentiation Strategies
  ● Differentiation Strategies for Special Education Students
  ● Differentiation Strategies for Gifted and Talented Students
  ● Differentiation Strategies for ELL Students
  ● Differentiation Strategies for At Risk Students
  ● Differentiation Strategies for Students with a 504

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 2, 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 2, 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.

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 (e.g., climate change) to define a simple problem that can be solved through the development of a new or improved object or tool. (K-5 NJSLS-S, pp.11 and 23) (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** ● 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)	**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 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)	**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 technologies in their lives; human life would be very different without technology. (1-PS4-4)

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-PS4-4) **W.1.7** 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. (K-2-ETS1-1) **W.2.8** 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**	Reason abstractly and quantitatively. (K-2-ETS1-1) **MP.2** Model with mathematics. (K-2-ETS1-1) **MP.4** Use appropriate tools strategically. (1-PS4-4),(K-2-ETS1-1) **MP.5** Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1-PS4-4) **1.MD.A.1** Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps. (1-PS4-4) **1.MD.A.2** 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**
WIDA	**Computer Science and Design Thinking**
ELD Standard 1: The Language of Social and Instructional Language ELD Standard 4: The Language of Science	8.1.2.AP.4: Break down a task into a sequence of steps. 8.2.2.ED.1: Communicate the function of a product or device.
Career Readiness, Life Literacies, and Key Skills	
CRP3. Consider the environmental, social and economic impacts of decisions. CRP4. Demonstrate creativity and innovation. CRP5. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Work productively in teams while using cultural/global competence.	