Structure, Function, & Information Processing
4LNG

A Fourth-Grade Unit
supporting
Next Generation Science Standards and
the Michigan Science Standards

developed and written by
Battle Creek Area Mathematics and Science Center
for

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# Structure, Function, & Information Processing

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Structure, Function, & Information Processing

UNIT INTRODUCTION

GRADE LEVEL:
Fourth Grade

THIS UNIT BUILDS KNOWLEDGE AND IS A PREREQUISITE FOR:
This unit builds on knowledge from:

- First Grade (1LNG, Plant and Animal Traits)

It is a prerequisite for Middle School:

- MSLNG1: Structure, Function and Information Processing

ABOUT THIS UNIT:
The performance expectations in Structure, Function, and Information Processing focus on helping students become familiar with plant and animal structures that are not visible. They begin to relate their understanding of the observable or macroscopic structures and behaviors to the exploration of internal structures. At this level, students have an understanding that living things need air and that animals breathe in air. In this unit they take a look at how the brain receives information and interprets information, and how the organism responds.

This unit also deepens students’ understanding of the structure and function of organisms, specifically focusing on the senses and the response to stimulus. Students explore how humans, other animals, and plants sense different kinds of inputs, including taste, touch, smell, sound, and sight. In animals the stimuli are sensed through different sense organs and processed through the brain, and then the organism responds. An emphasis in this unit is on the sense of sight, how light enables us to see, and how eyes take in reflected light. Students develop models to explain how light is reflected off objects and travels to the eye, and how the information from the eye is processed in the brain.

Students explore how memory also plays a key role in the information processing from stimuli. An animal’s memory of something hot, foul smelling, or bitter tasting can guide in decision making as to whether to touch, smell, eat, or avoid the object. Sensory input and memory enable animals to learn and affect behavior.

This unit builds on the knowledge gained from the first-grade unit Plant and Animal Traits. In their first-grade experience students conducted analogies and explored the Disciplinary Core Ideas:

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.

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.
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.

Throughout this fourth-grade unit there is an assumption that students come with an understanding of the structures that help plants and animals to survive and meet their needs. Students should have an understanding that all living things have structures that function to get food, take in water, and provide protection in their habitat.

Students will also be asked to draw on their understandings of light and sound from the first-grade physical science unit 1.PNG Waves: Light and Sound. The understanding that light travels outward from the light source and reflects off objects is key in understanding how the eye works. Students also need an understanding that sound is produced by vibrating objects and that sound can also cause objects to vibrate. Vibrations and sound were also reviewed in the 3.LNG Life Cycles and Survival unit.

Background Content Information

The following life science background information is helpful in understanding the concepts in this unit. This information is for the benefit of teachers and is not always appropriate for students. The sequence of lessons in this unit is intended to help fourth-grade students meet the performance expectations in the Next Generation Science Standards. The 4.LNG Structure, Function, and Information Processing unit is developed around the following essential questions:

• How are we able to see objects?

• How do sensory organs and internal and external structures help plants and animals obtain information, react to stimuli, and survive in an ecosystem?

Light

Light can be produced in many ways. Matter that is very hot emits light. For example, the sun emits light because the gases at its surface are very hot. Or, the filament of a light bulb is very hot (you can tell this by holding your hand near the bulb); we say it is “white hot” because it emits white light. Chemical reactions can also produce light. Examples of chemical reactions include the burning of wood or a candle wick. Certain gases, such as neon, emit light when an electric current passes through them. The sun and stars emit light because of the high temperatures maintained by nuclear reactions. Some objects give off light: the sun, for example, or a lamp. We see those objects by their own light. Other objects do not emit light, and we see them only from light that they reflect: for example, the moon or the page of a book.

There are many sources for light. Natural light sources include the sun, stars, fire, volcanoes, lightning, lightning bugs, and electric eels; artificial or human-made light sources include electric lamps, flashlights, burning candles, and lanterns.

Light travels from its source in straight paths in all directions. We cannot see light move, but scientists have proven that light rays travel at a speed of almost 300,000 kilometers per second, or 186,400 miles per second. Light travels so fast that we perceive it as instantaneous. When we turn on the lights, the light fills the room almost instantly. Light can also be described as bright or dim. The farther an observer is from a source of light, the dimmer the light appears to be.
When light strikes objects or substances, three things may happen: the light is absorbed, reflected, or transmitted (which means it passes through the substance). Most objects reflect a portion of the light that strikes them. The property of light absorption, reflection, or transmission can be identified to make materials useful in everyday situations.

Transparent materials transmit light, so it is possible to see clearly through these materials. Light travels through transparent objects. Other materials allow light to pass through, but the light is scattered in many directions. These translucent materials produce fuzzy images. Opaque materials absorb and/or reflect light. Light does not pass through these objects; it is not transmitted and cannot be seen through these objects. This blockage of light produces shadows. The closer an object is to the light source, the larger its shadow. The length of a shadow depends on the angle of the light source. How dark the shadow is depends on how much light is blocked.

The Eye
The eye is the main sensory organ that most animals depend on for survival and to make sense of the world. The sensors and nerve network in the eye take in light reflecting off objects and then send the message to the brain for processing.

The eyes are sense organs that are sensitive to light. The eyes act like a camera. Light reflected from an object enters the eye and focuses on the light-sensitive retina. Nerve impulses pass through the optic nerve, sending messages to the brain, and the brain interprets what is being seen. There are also structures of the body that protect the eyes.

Internal and External Structures and Survival
A variety of species are able to survive in different ecological settings. An understanding of the diversity of life helps students to understand how the Crosscutting Concept of Structure and Function applies to all living things. All living things grow, reproduce, and die. Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. Living things on Earth are rich in the diversity of structures that have evolved to perform their life functions.

5 E Learning Cycle
This unit was developed using the 5 E Learning Cycle (Bybee, 1997) for the instructional sequence. Use of the instructional sequence helps students to become engaged and recognize their current understandings, explore a common base of experiences to develop new ideas and thinking, verbalize and explain their findings, apply their new knowledge, and evaluate based on the understandings of others. The progression allows for the introduction of new ideas and concepts as students have a need to learn and a reason to apply the new material. The Learning Cycle progression also allows for thoughtful integration of reading informational text, writing about science, and application of science in the social world and their everyday lives.

You will see the instructional sequence as it drives the whole unit and also within each set of lessons. Within the individual lessons, the instructional sequence ensures that each lesson is framed to excite and draw on previous knowledge and progresses to a new understanding. (See the Learning Cycle Approach in the appendix, p.102.)
Science Talk
Within each lesson or series of connected lessons, students are given the opportunity to engage in “Science Talk.” Science Talk involves time for students to engage in purposeful conversation with their peers about what they observe or believe to be true, and to ask “what if” questions. It gives young learners the opportunity to say aloud what they have been thinking and hear the thoughts of others. Science Talk in the classroom is essential to the meaning-making process and central to learning. Teaching is not complete at the end of an activity; the learning is continuous, and students need time to put their understanding in their own words within a social situation where ideas are rehearsed between learners, mainly through conversation in which different ideas are brought together and worked on. (See Science Talk in appendix, pp. 104-105)

Reading in the Science Content
The Battle Creek Area Mathematics and Science Center’s primary focus is to help develop scientifically literate students, yet it is just as crucial for all students to develop the reading and writing skills that apply learning to content. This unit is complete with reading integrations that include reading within the content area. The reading primarily involves trade books carefully selected to enhance the science content learning as well as students’ reading skills. The trade book selections are integrated within activities and the Learning Cycle. These books may be used to engage learners and pique their curiosity about a subject, to help explain and define, elaborate, and make connections to the real world, or as an evaluation of what they have learned. The reading integration within this unit is aligned with the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects. The reading within this unit addresses the Reading Standards for Informational Text for fourth grade. (See Model for Guided Reading in appendix, pp. 99-99)

Six copies of each trade book featured in *Structure, Function, and Information Processing* are included in your kit. Additional copies or classroom sets can be ordered through the Battle Creek Area Mathematics and Science Center, (269) 213-3907.

Writing in Science Content
Most recent studies in how children learn suggest that students benefit in all content areas by writing within science and social studies classes. The benefits are recognized in both content knowledge and writing ability. Writing in the content “enhances critical thinking; allowing students to take greater responsibility for their own learning; promotes reflective thinking and questioning; and helps students make connections between events, people, and ideas” (*Teaching Writing within the Content, 2005*).

The Battle Creek Area Mathematics and Science Center writing integration component of the units asserts that the writing process is a method of learning and instruction. Writing within the content allows students to revise and revisit their thinking and writing throughout the lesson, helps students discover what they know, and generates purpose for their writing. Audience and purpose are essential traits for all types of writing, and writing within science is no exception. Writing requires students to problem solve, and it is appropriate to make the time for purposeful writing during the course of the content-area instruction. The writing integration aspect of this unit is complete with pre-writing strategies that help students recognize and organize what they know and scoring rubrics for assessing the content. Refer to selected Teacher Guide activities and the Student Journal pages for a complete description of how writing is integrated within this unit.
Writing integration within this unit is aligned with the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects. The writing within this unit addresses the Writing Standards for fourth grade.

Literacy integration within this unit includes the opportunity for students to respond to informational text, both orally and through writing. The Common Core State Standards strongly emphasize the importance of opportunities for students to respond to informational text and to write about what they have learned. Recent research suggests that writing about texts and engaging in the act of writing text increases reading comprehension in students.* This unit provides multiple opportunities for students to write in response to reading about the content of structure and function at the fourth-grade level.

* (International Reading Association: Literacy Implementation Guidance for the ELA Common Core State Standards, 2012)

**Engineering Design Process**
The Engineering Design Process provides students with a series of steps to guide them as they solve problems and design and test products, models, and solutions. The process is cyclical, yet not necessarily in an order. Students are encouraged to evaluate as they progress through the process, revisit the mission often, and revise thinking and their plan multiple times as the process unfolds.

Engineers do not always follow the Engineering Design Process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change the design. Engineers must always keep in mind the mission or problem they are trying to solve and the limitations (cost, time, materials, etc.) that are part of the solution to the problem. Two key elements in working as an engineer are teamwork and design-test-and-redesign. (See Engineering Design Process in the appendix, p. 104.)

**Key Terms**
The Key Terms in this unit represent the instructionally useful terms for the activities. Students build vocabulary, and terms are introduced as they become useful and necessary. A list of suggested Key Terms for this unit is available for the teacher in the appendix. The list is not all-inclusive or all-necessary, and your class discussion may produce terms that are not on the list but have an importance and are instructionally useful for students.

**Estimated Time**
The Estimated Time described in each activity is an approximate number of minutes for completion. You may want to divide the estimated minutes over several days.
Curriculum Alignment Color Coding
In the margins of each unit you will find the color-coded alignment to the Next Generation Science Standards (NGSS) and Common Core State Standards for English Language Arts and Mathematics. The NGSS color coding is consistent with the NGSS document:

**BLUE: SCIENCE AND ENGINEERING PRACTICES**—The Science and Engineering Practices emphasize the importance of engaging in scientific investigations of the natural world as well as the practices of engineering to identify and solve problems. Acquiring the skills in the Science and Engineering Practices at an early age supports a better understanding of how scientists and engineers acquire and apply scientific knowledge and how engineering solutions are developed to help solve problems. The eight Science and Engineering Practices are:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Not all eight practices are included in every unit. However, as one practice is brought to the forefront, you may notice that other practices are also present.

**ORANGE: DISCIPLINARY CORE IDEAS**—The Disciplinary Core Ideas are the scientific concepts that all students should understand in order to make sense of the world. Disciplinary Core Ideas are developed across the disciplines Physical Sciences, Life Sciences, Earth Sciences, and Engineering, Technology and Applications of Science. The core concepts for Life Science are:

Interdependent Relationships in Ecosystems
Structure, Function, and Information Processing
Inheritance and Variation of Traits
Matter and Energy in Organisms and Ecosystems

This unit focuses on the Core Idea Structure, Function and Information Processing.
GREEN: CROSSCUTTING CONCEPTS—Crosscutting Concepts are the concepts that are present and occurring throughout the disciplinary boundaries. They play an important part in the understanding of the connections between Physical Sciences, Earth Sciences, Life Sciences, and Engineering, Technology and Applications of Sciences. They provide the framework for connection knowledge across the disciplines. The Crosscutting Concepts are:

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change

The Crosscutting Concepts stress the importance for students to recognize and become accustomed to applying the concepts common to so many areas of science and engineering.


PURPLE: PHENOMENA—Phenomena in the implementation of the Next Generation Science Standards engage students in making observations to raise questions and brainstorm ideas for investigation of questions relating to their observations. Phenomena are introduced in the “engage the learner” phase of the series of activities and provide a connection to learning and a purpose for trying to figure things out.

RED: COMMON CORE STATE STANDARDS—The Common Core State Standards for English Language Arts and the Common Core State Standards for Mathematics are identified in red throughout the unit. Alignment with the CCSS indicates an opportunity for teachers to integrate their science, ELA, and math lessons and give students the opportunity to develop and apply their reading, writing, language, and math skills within the science content.
Fourth-grade life science builds on the previous grade life science with a direct connection to the first-grade unit *Plant and Animal Traits*. Students come with an understanding that plants and animals have traits that help them to get food, water, and shelter, and that provide protection. The fourth-grade unit builds to explore the sensory organs that help animals and plants perceive their surroundings.

“Learners come to new situations with preconceived notions; they are not blank slates. As children develop, and long before they enter formal education, they need to make sense of the natural world about them. So they begin to construct sets of ideas, expectations, and explanations about natural phenomena. Through their own activities, children construct knowledge and make it their own. Since these ideas are frequently quite different from the ones held by scientists, we sometimes refer to them as naive conceptions.”

What to do about students’ naive conceptions or misinformation? “You can figure out what it really means to the child and what the child really means by it. Then, if you decide it is appropriate and important, you will find a way to correct the information, not the child, through the child’s own experience.”

An example of this follows:

Robert and Gladys were watching the fish in the aquarium tank.

“Look, the fish has three mouths,” said Gladys.

“Just that big fish, though,” added Robert.

The teacher, Ms. Martinez, came up to the tank. “Where?”

The children pointed to the large swordtail. “What do you mean about mouths?” asked Ms. Martinez.

“Well, there’s that one in front that goes like this,” and Gladys opened her mouth up and down. “And there’s one here and one here.” She held her hands near her ears, clamping her palms on and off her head.

“You explain well. I know just what you mean,” said Ms. Martinez. “Let’s see how the fish eats.”

Ms. Martinez got food from the cupboard. The children fed the fish, observing the swordtail and other fish in the tank. After some discussion, the children decided the one in front was the mouth since all the fish ate only there. Ms. Martinez said the other two openings were gills: they were really more like noses since that is how fish get oxygen, which we get from air. The aquarium had a bubbling filter, so the children could see air passing through the water. Later, they decided it must be water that went in and out the gills. Ms. Martinez encouraged them to clasp their hands together, dunk them in a sink full of water, and see if they could hold air when they simulated gill action by pushing their palms together, swishing water out.
“We are not fish,” she explained. “We can’t get the oxygen out of the water. We get our oxygen by breathing in air directly like this.” She took a deep breath in and out. She thought she would add that, but did not expect the children to understand it completely now.

Naive conceptions or misinformation may be set right by planned individual experiences over time. Your observation of mistaken concepts may indicate to you a whole new set of experiences for the students. Guide them through, one step at a time. Respect their ideas. At no time are children told they are wrong. At no time are they immediately corrected; their experience can be arranged to be self-correcting.

Adapted from:


Students’ instructional experiences and, ultimately, what they learn are greatly influenced by the knowledge they bring to a learning situation. Learning with understanding in science often requires that students change certain aspects of their prior knowledge. Instruction that fails to acknowledge students’ entry-level conceptions and understandings can leave students’ misconceptions unchanged. In order to bring about change in students with respect to a concept, several circumstances must exist:

- The students are confused or dissatisfied with their existing views.
- The new concept appears understandable and makes sense.
- The new concept can be explained, and students can make predictions regarding this concept.

The Conceptual Change Model encourages students to confront their misconceptions or naive ideas and then work toward understanding and applying the newly learned concept. The model consists of six stages:

Stage 1: Students become aware of their own ideas about a concept by thinking about that concept and making predictions before any activity begins.

Stage 2: In small groups and then with the entire class, students express their beliefs.

Stage 3: Students then confront their beliefs by testing them and discussing the results in small groups.

Stage 4: Students work toward resolving the conflict between their ideas and their observations from the “test” in Stage 3.

Stage 5: Students further understand the concept by trying to make connections between the concept and other situations that they have experienced.

Stage 6: After students have established some permanency regarding the concept, they are encouraged to pursue additional questions and problems related to the concept.
Sources of students’ confusion and misconceptions or naive ideas:

- Personal experiences at home and on the playground, rather than the abstract concepts taught, are used as a basis for understanding. Personal experience and common sense can lead to students’ misconceptions.
- In instruction, the emphasis is often on scientific vocabulary, rules, and formulas rather than on dealing with students’ views.
- Textbook definitions may be confusing, incomplete, or inaccurate because it is felt that younger learners are not capable of understanding the whole story.
- Traditionally, these topics are taught using a lecture and demonstration format. Students are passive and never experience a conflict between their views and those being taught.

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POSSIBLE PRECONCEPTIONS AND NAIVE IDEAS

- Eyes will eventually “adjust” to complete darkness.
- Light shines out from the eye to illuminate objects.
- All animals have eyes that are the same as humans’ eyes.
- Backyards and cities are not habitats.
- Living things do not depend on others for survival.
- A change in one link of a food web will not significantly affect the rest of the web.
- Animals can significantly change their behavior to live in a variety of habitats.
- Animals are not influenced by their surroundings.
- Further, students may be unaware that the brain processes information from the sensory organs.
LEARNING PERFORMANCE OUTCOMES

**Students will need to understand:**
- Light is necessary for sight.
- Eyes will respond to different intensities of light and allow more light into the eye when the light is dim and less light into the eye when the light is very bright.
- If there is no light at all, the eyes will not be able to see.
- The eye picks up reflected light from the surface of objects.
- Light travels in a straight path and is reflected off or absorbed by objects.
- Plants and animals have internal and external structures that help them in growth, survival, behavior, and reproduction.
- Animals receive information through sense receptors.
- Sense receptors send information to the brain and the animal responds.
- Plants and animals have needs for life: food, water, and shelter/or space; plants also need sunlight.
- Predators have structures that help them hunt for food, and prey have structures that help them avoid predators.

**Students will need to be able to:**
- Use models to explain their thinking about phenomena.
- Revise models when new information is uncovered.
- Share information with others.
- Critique the information of others.
- Gather and use evidence when explaining phenomena.
- Recognize the cause-and-effect relationship between stimuli and animal responses.
### DISCIPLINARY CORE IDEAS

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<td><strong>LS1.A: Structure and Function</strong></td>
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<tr>
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<tr>
<td>4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</td>
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### SCIENCE AND ENGINEERING PRACTICES

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<tr>
<td>• Develop a model to describe phenomena.</td>
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<tr>
<td>• Use a model to test interactions concerning the functioning of a natural system.</td>
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### CROSSCUTTING CONCEPTS

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**Allow for local, regional, Michigan-specific contents or examples in teaching and assessment.**
**SCIENCE AND ENGINEERING PRACTICES**

**Engaging in Argument from Evidence**
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct an argument with evidence, data, and/or a model.
- Construct an argument with evidence.
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
  - How can we use data and evidence to determine the merit of a conclusion as to how animals use different structures (internal and external) to support survival, growth, and behavior?
  - How can we use data, evidence, and models to determine the effect of light on the ability to see?
  - How can we use data, evidence, and models to determine how animals receive information through their senses?

**Developing and Using Models**
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop models to describe phenomena.
  - How can we use models to explain how light is necessary for sight?
  - How can we use models to explain how light reflected off objects enters the eye and enables animals to see?
  - How can we use models to explain how animals receive information through their senses and the brain interprets the messages so they can react?

**DISCIPLINARY CORE IDEAS**

**PS4.B: Electromagnetic Radiation**
- An object can be seen when light reflected from its surface enters the eyes.
  - How do we provide evidence that light reflects off objects and enters the eyes so we can see?
  - How do different materials react to light?

**LS1.A: Structure and Function**
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
  - How do animals’ internal and external structures function to help them survive?

**LS1.D: Information Processing**
- 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.
  - How do animals use sense receptors to send messages to the brain?
  - How do animals react to stimuli from their senses?
# NEXT GENERATION SCIENCE STANDARDS—GUIDING QUESTIONS

## CROSSCUTTING CONCEPTS

### Systems and System Models
- A system can be described in terms of its components and their interactions.
  - How can we determine the internal and external structures of an animal and how they interact to help in survival?

### Cause and Effect
- Cause-and-effect relationships are routinely identified, tested, and used to explain change.
  - How can we determine the cause-and-effect relationship between internal and external structures and how an animal reacts to its environment?
  - How can we determine the cause-and-effect relationship between the amount of light and our ability to see objects?
## COMMON CORE STATE STANDARDS—READING

### Reading Standards for Informational Text—Grade 4

<table>
<thead>
<tr>
<th>Key Ideas and Details</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.</td>
<td>3,4,5</td>
</tr>
<tr>
<td>RI.4.2: Determine the main idea of a text and explain how it is supported by key details; summarize the text.</td>
<td>3,4,5</td>
</tr>
<tr>
<td>RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.</td>
<td>3,4,5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Craft and Structure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RI.4.4: Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.</td>
<td>3,4,5</td>
</tr>
<tr>
<td>RI.4.5: Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.</td>
<td>3,4,5</td>
</tr>
<tr>
<td>RI.4.6: Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Integration of Knowledge and Ideas</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.</td>
<td>3,4,5</td>
</tr>
<tr>
<td>RI.4.8: Explain how an author uses reasons and evidence to support particular points in a text.</td>
<td>3,4,5</td>
</tr>
<tr>
<td>RI.4.9: Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.</td>
<td>3,4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range of Reading and Level of Text Complexity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RI.4.10: By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.</td>
<td>3,4,5</td>
</tr>
</tbody>
</table>
### COMMON CORE STATE STANDARDS—WRITING

#### Writing Standards—Grade 4

<table>
<thead>
<tr>
<th>Text Types and Purposes</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>W.4.1:</strong> Write opinion pieces on topics or texts, supporting a point of view with reasons and information. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which related ideas are grouped to support the writer’s purpose.</td>
<td>1,3,4</td>
</tr>
<tr>
<td>a. Provide reasons that are supported by facts and details.</td>
<td></td>
</tr>
<tr>
<td>b. Link opinion and reasons using words and phrases (e.g., <em>for instance, in order to, in addition</em>).</td>
<td></td>
</tr>
<tr>
<td>c. Provide a concluding statement or section related to the opinion presented.</td>
<td></td>
</tr>
<tr>
<td><strong>W.4.2:</strong> Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</td>
<td>1,2,3,4,5</td>
</tr>
<tr>
<td>a. Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.</td>
<td></td>
</tr>
<tr>
<td>b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.</td>
<td></td>
</tr>
<tr>
<td>c. Link ideas within categories of information using words and phrases (e.g., <em>another, for example, also, because</em>).</td>
<td></td>
</tr>
<tr>
<td>d. Use precise language and domain-specific vocabulary to inform about or explain the topic.</td>
<td></td>
</tr>
<tr>
<td>e. Provide a concluding statement or section related to the information or explanation presented.</td>
<td></td>
</tr>
<tr>
<td><strong>W.4.3:</strong> Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.</td>
<td>4</td>
</tr>
<tr>
<td>a. Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally.</td>
<td></td>
</tr>
<tr>
<td>b. Use dialogue and description to develop experiences and events or show the responses of characters to situations.</td>
<td></td>
</tr>
<tr>
<td>c. Use a variety of transitional words and phrases to manage the sequence of events.</td>
<td></td>
</tr>
<tr>
<td>d. Use concrete words and phrases and sensory details to convey experiences and events precisely.</td>
<td></td>
</tr>
<tr>
<td>e. Provide a conclusion that follows from the narrated experiences or events.</td>
<td></td>
</tr>
<tr>
<td>Writing Standards—Grade 4</td>
<td>Activities</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Production and Distribution of Writing</strong></td>
<td></td>
</tr>
<tr>
<td>W.4.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)</td>
<td>1,2,3,4,5</td>
</tr>
<tr>
<td>W.4.5: With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.</td>
<td>2,4,5</td>
</tr>
<tr>
<td>W.4.6: With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting.</td>
<td>4,5</td>
</tr>
<tr>
<td><strong>Research to Build and Present Knowledge</strong></td>
<td></td>
</tr>
<tr>
<td>W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.</td>
<td>2,3,4,5</td>
</tr>
<tr>
<td>W.4.8: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.</td>
<td>2,3,4,5</td>
</tr>
<tr>
<td>W.4.9: Draw evidence from literary or informational texts to support analysis, reflection, and research. Apply grade 4 reading standards to literature (e.g., “Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text [e.g., a character’s thoughts, words, or actions].”). Apply grade 4 reading standards to information texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text.”).</td>
<td>3,4,5</td>
</tr>
<tr>
<td><strong>Range of Writing</strong></td>
<td></td>
</tr>
<tr>
<td>W.4.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</td>
<td>1,2,3,4,5</td>
</tr>
</tbody>
</table>
### Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

### 4.OA Operations and Algebraic Thinking

Use the four operations with whole numbers to solve problems.

1. Interpret multiplication equations as a comparison, e.g., interpret
   \[ 35 = 5 \times 7 \] as a statement that 35 is 5 times as many as 7 and 7
   times as many as 5. Represent verbal statements of multiplicative
   comparisons as multiplication equations.
2. Solve multi-step word problems posed with whole numbers and
   having whole-number answers using the four operations, including
   problems in which remainders must be interpreted. Represent these
   problems using equations with a letter standing for the unknown
   quantity. Assess the reasonableness of answers using mental
   computation and estimation strategies including rounding.

### 4.NBT Number and Operations in Base Ten

Generalize place value understanding for multi-digit whole numbers.

1. Read and write multi-digit whole numbers using base-ten numerals,
   number names, and expanded form. Compare two multi-digit
   numbers based on meanings of the digits in each place, using \( >, =, \)
   and \(<\) symbols to record the results of comparisons.
2. Use place value understanding to round multi-digit whole numbers to
   any place.
### COMMON CORE STATE STANDARDS—MATHEMATICS

<table>
<thead>
<tr>
<th>Mathematics—Grade 4</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Use place value understanding and properties of operations to perform multi-digit arithmetic.</td>
<td></td>
</tr>
<tr>
<td>4. Fluently add and subtract multi-digit whole numbers using the standard algorithm.</td>
<td></td>
</tr>
<tr>
<td>5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.</td>
<td></td>
</tr>
</tbody>
</table>

#### 4.MD Measurement and Data

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

1. Know relative sizes of measurement units within one system of units, including km, m, cm; kg, g; lb, oz; l, ml; and hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems that require expressing measurements given in a larger unit in terms of the smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature measurement.

Represent and interpret data.

1. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots.

#### 4.G Geometry

Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Draw points, lines, line segments, rays, angles (right, obtuse, acute), and perpendicular and parallel lines. Identify these in two-dimensional figures.
## UNIT AT A GLANCE

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time to Complete</th>
<th>Questions</th>
<th>Phenomena</th>
<th>Summary: Students Will…</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light and Sight</strong></td>
<td>Preparation: 35 min. Activity 1: 5 days Lesson 1A: 45–50 min., 2 days Lesson 1B: 45–50 min. Lesson 1C: 45–50 min. Lesson 1D: 45–50 min.</td>
<td>How is light necessary to see objects?</td>
<td>Outside/Inside: ability to see when going from a very bright light to a dim light.</td>
<td>• Collaborate to develop models of what happens to our eyes when we go from very bright sunshine outside to a dimly lit room inside. • Collect data on the ability to see objects with no light, some light, and bright light. • Make and use models to demonstrate how light travels in a straight path and illuminates objects in its path. • Conduct an investigation to find out how light reflects off different materials.</td>
</tr>
<tr>
<td><strong>Our Eyes in Bright Light and Darkness</strong></td>
<td>Preparation: 35 min. Activity 2: 2 days Lesson 2A: 45–50 min. Lesson 2B: 45–50 min.</td>
<td>How does the eye react to bright light and darkness?</td>
<td>Outside/Inside: ability to see when going from a very bright light to a dim light.</td>
<td>• Conduct an investigation to find out how the human eye reacts to light and darkness. • Collect data based on observations. • Compile class data from their investigations to explain the phenomenon. • Develop a model of the reaction of the eye to light and dark, based on data from their investigation. • Evaluate and critique each other’s models based on evidence from their investigations.</td>
</tr>
</tbody>
</table>
| **Animal Eyes**        | Preparation: 40 min. Activity 3: 4 days Lesson 3A: 45–50 min., 2 days Lesson 3B: 45–50 min., 2 days | How and why do some animals have eyes that shine in the dark? How do animals use their sense of sight to aid them in survival? | Eyeshine: animal eyes that shine or glow in the dark | • Role play as predator and prey to find out the importance of eyesight in animal survival. • Compare different animals to the role of the mountain lion (predator) and the role of the rabbit (prey). • Determine how the shape and position of the eyes in predators and prey differ to help each survive. • Read two different texts about different animals and their eyes.
<table>
<thead>
<tr>
<th>Students Figure Out How To:</th>
<th>Practices</th>
<th>Performance Expectations (PE) at Lesson Level and Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Develop and use a model to explain what happens to our eyes when we move into and out of different light conditions.</td>
<td>Asking Questions And Defining Problems</td>
<td>PE at Lesson Level: Develop and use models to explain how light travels in a straight path, illuminates objects in its path, and is necessary for sight.</td>
</tr>
<tr>
<td>• Raise questions based on observations.</td>
<td>Developing and Using Models</td>
<td>Frommative Assessment  initial models, Science Talk, adjusted models, handout, Journal Entry</td>
</tr>
<tr>
<td>• Analyze and interpret data to make sense of how the eyes need light for sight.</td>
<td>Analyzing and Interpreting Data</td>
<td>Summative Assessment revised models, Science Talk, Journal Entry</td>
</tr>
<tr>
<td>• Revise model based on new information.</td>
<td>Constructing Explanations and Designing Solutions</td>
<td></td>
</tr>
<tr>
<td>• Construct an explanation, based on evidence from investigations, to explain how light is necessary for sight.</td>
<td>Planning and Carrying Out Investigations</td>
<td></td>
</tr>
<tr>
<td>• Plan and carry out an investigation into the reaction of the eye when going from very bright to very dim or dark.</td>
<td>Developing and Using Models</td>
<td>PE at Lesson Level: Plan and carry out an investigation into the reaction of the eye when going from dark to light conditions.</td>
</tr>
<tr>
<td>• Obtain evidence from investigations to find out how the eye reacts to bright light and dim light.</td>
<td>Constructing Explanations and Designing Solutions</td>
<td>Summative Assessment revised models, revisions to probe in Student Journal, final model, Science Talk, Activity Page, Respond to Text</td>
</tr>
<tr>
<td>• Revise models and thinking based on evidence from investigations.</td>
<td>Engaging in Argument from Evidence</td>
<td></td>
</tr>
<tr>
<td>• Relate their findings from their investigations to the Outside/Inside phenomenon.</td>
<td>Planning and Carrying Out Investigations</td>
<td></td>
</tr>
<tr>
<td>• Share and evaluate each others’ models.</td>
<td>Analyzing and Interpreting Data</td>
<td></td>
</tr>
<tr>
<td>• Make comparisons of animal eyes to determine how the shape and position of the eyes help the animal to survive.</td>
<td>Asking Questions And Defining Problems</td>
<td>PE at Lesson Level: Obtain, apply, and share information about animal eyes and how they help in survival.</td>
</tr>
<tr>
<td>• Obtain information from text to find out the different traits of eyes and how they help animals sense their surroundings.</td>
<td>Developing and Using Models</td>
<td>Frommative Assessment  Science Talk, Activity Page, group models</td>
</tr>
<tr>
<td>• Share and compare information from two different texts on animal eyes.</td>
<td>Constructing Explanations and Designing Solutions</td>
<td>Summative Assessment Journal Entry, final models</td>
</tr>
<tr>
<td>• Systems and System Models</td>
<td>Engaging in Argument from Evidence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Planning and Carrying Out Investigations</td>
<td></td>
</tr>
</tbody>
</table>
# Unit at a Glance

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time to Complete</th>
<th>Questions</th>
<th>Phenomena</th>
<th>Summary: Students Will . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (On One Flower)</td>
<td>Preparation: 25 min. Activity 4: 6–8 days Lesson 4A: 45–50 min., 2 days Lesson 4B: 45–50 min., 2–3 days Lesson 4C: 45–50 min., 2–3 days</td>
<td>What plants and animals live in the schoolyard? How do the plants and animals in the schoolyard use their senses to survive?</td>
<td>On One Flower/ stinkbug</td>
<td>• Develop a model of a goldenrod blossom as a habitat for different animals. • Read about one flower plant as a habitat for a variety of animals. • Write about their own experiences in making observations of different plants and animals. • Plan and build a classroom habitat for plants and animals that live in the schoolyard. • Make observations and collect specimens of plants and animals that live in the schoolyard. • Explore the Project Noah website. • Share research and data entry to find patterns in structure and function of animal and plant traits.</td>
</tr>
<tr>
<td>5 (Animal Defenses)</td>
<td>Preparation: 15 min. Activity 5: 6 days Lesson 5A: 45–50 min., 2 days Lesson 5B: 45–50 min., 2 days Lesson 5C: 45–50 min., 2 days</td>
<td>How do different structures function to help the animals defend themselves?</td>
<td>The tail of the blue-tailed skink and how it functions to help the skink defend itself.</td>
<td>• Observe a video of the blue-tailed skink. • Draw and label a model that explains how the structures of the skink help it to survive. • Research the structures and function of the blue-tailed skink. • Share research and findings. • Create a class chart that categorizes the different kinds of animal defenses and if memory is important in that defense.</td>
</tr>
</tbody>
</table>
## Students Figure Out How To:

- Develop a model of a goldenrod blossom as a habitat for different animals.
- Obtain and apply information from text to their own schoolyard observations and specimens.
- Determine the needs for survival of specimens collected in the schoolyard and placed in the classroom habitat.
- Make careful observations of collected specimens to determine the internal and external structures they have that function in survival.
- Record and upload information to the Project Noah website.
- Look for patterns in observations and research to determine the structure and function in the traits of different plants and animals.

## Practices

**Asking Questions and Defining Problems**

**Obtaining, Evaluating, and Communicating Information**

**Developing and Using Models**

**Planning and Carrying Out Investigations**

**Systems and System Models**

## Performance Expectations (PE) at Lesson Level and Assessment

### PE at Lesson Level:

- **Make observations of the diversity of plants and animals in the schoolyard to find out how their internal and external structures help them to survive.**

### Summative Assessment:

- models, Respond to Text, Science Talk, Journal Entries, Activity Page

### Formative Assessment:

- group models, Science Talk, Activity Page, Journal Entry

### Summative Assessment:

- final models, Journal Entries, Activity Pages
Dear Parent:

Your child is beginning a unit created at the Battle Creek Area Mathematics and Science Center. This unit was designed by area teachers to promote inquiry-based science and is complete with materials to accompany the activities. During the next twelve weeks, your child will be actively involved with the unit *Structure, Function, and Information Processing*. This unit is designed for fourth-grade students and focuses on how plants and animals sense and react to their surroundings. Students focus on:

- How do we provide evidence that light reflects off objects and enters the eyes so we can see? How do different materials react to light?
- How do sensory organs and internal and external structures help plants and animals obtain information, react to stimuli, and survive in an ecosystem?

During this unit of study, your child will begin to explore how plants and animals use their senses to find food, sense danger, build shelters, and protect themselves. Your child will be given the opportunity to observe, compare, and contrast different organisms and how they react to their surroundings. The class will research a variety of habitats, change in habitats, and related topics to obtain and share information.

We hope you enjoy discussing the concepts involved in *Structure, Function, and Information Processing* with your child. Suggestions for activities to do at home are included with this letter. These activities will reinforce the concepts taught during this unit instruction. Let us know if we may be of assistance.

The Outreach Staff

Battle Creek Area Mathematics and Science Center

(269) 213-3904 or (269) 213-3905
1. Take this opportunity to explore ecosystems within your backyard, neighborhood, and local parks. Turn over a rock or log and see how many organisms make it their home. Discuss the different physical traits of the organisms. When your child observes an animal, ask what they think it is doing and what internal and external structures help it to complete the task.

2. Take a close look at the plants in your home and garden. Help your child to identify the different plant parts: roots, stems, leaves, flowers, seeds. Discuss how the different structures function to help the plant take in water, make food, capture sunlight, and reproduce.

3. Find a closet or bathroom without windows or cracks around the door and have your student experience how, no matter how long they try, they are unable to see when there is no light available. If a small amount of light is let into the dark room, they will begin to see outlines of images. Full light allows them to see colors and details.

4. Discuss with your student when they have seen animal eyes that appear to shine in the dark. If you have a pet dog or cat, use a flashlight when they are out in the yard in the dark and observe how their eyes shine. Explain that eye shine is a characteristic that helps them to see better in the dark.
Activity 1: Light and Sight

Teacher Background Information
Some objects emit light and are light sources. Examples of light sources are the sun, a lamp, or a lightning bug. Other objects do not emit light, and they can only be seen when they are illuminated by light from some source. Examples are the moon, the page of a book, and a lightning bug during the day when it is not flashing its light. Light strikes an object and is reflected off it to our eyes. Most objects are textured so light striking them is diffused, or sent in all directions. Diffusion of light allows us to define the objects. If all surfaces reflected light like a smooth, shiny surface does, all we would see would be a reflection of the light source, such as when you shine a flashlight into a mirror.

One misconception students may have is that the moon produces light. The moon’s surface reflects the light from the sun and the reflected light reaches Earth.

Engage the Learner
This phase of the learning encourages students to think about how we use our sense of sight and the connection between light and our ability to see. Students are encouraged to make their initial thinking about the phenomenon visible through the development of models. They raise questions that drive the following lessons.

Advance Preparation
Prepare a What We Think About Light and Sight chart.

<table>
<thead>
<tr>
<th>What We Think</th>
<th>Questions We Have</th>
<th>How Can We Find Out?</th>
<th>What Do We Conclude?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Preview the Outside/Inside card set. Be prepared to read the phenomenon with expression and drama.

The investigations into light are best performed in a darkened room. Be prepared to draw curtains or blinds and block as much light from entering the room as possible.

Duplicate copies of the Pre and Post Assessment for your class. See Assessment Section (3) for assessment and rubric.

Duplicate copies of the unit Parent Letter and Activities to Do at Home to be sent home.

ESTIMATED TIME
Lesson 1A: 45–50 minutes, 2 days
Lesson 1B: 45–50 minutes
Lesson 1C: 45–50 minutes
Lesson 1D: 45–50 minutes

OBJECTIVE
Develop a model that explains how light enables animals to see objects.

KEY QUESTION
How is light necessary to see objects?

PRE ASSESSMENT
• Give the Pre Assessment to assess the students’ prior knowledge of the topics included in this unit.
• Additional time may be necessary beyond the estimated lesson time.
• This same assessment will be given at the end of the unit so the students’ Pre and Post Assessment responses can be compared.
• Be consistent in administering the Pre and Post Assessment.
• The assessment and rubric are located in the Assessment section of the unit.

PS4.B: ELECTROMAGNETIC RADIATION
• An object can be seen when light reflected from its surface enters the eyes.
**LESSON 1A**

**MATERIALS NEEDED**

For each student:
- student page

For each group of four:
- Outside/Inside cartoon strip, card set

Teacher provides:
- chart paper
- markers

**LS1.D: INFORMATION PROCESSING**

- 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.

**DEVELOPING AND USING MODELS**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.
- Use a model to test interactions concerning the functioning of a natural system.

**TEACHING TIP**

The students will continue to work in the same groups for several lessons. It is beneficial for the groups to stay together to develop the initial model that explains the phenomenon and the final model that shows their conceptual shifts in thinking.

**Lesson 1A: Turn On the Lights!**

**Procedure**

*Engage the learner.*

Project the Outside/Inside card set. Read the captions (dialog balloons) to the class. As a class, discuss the phenomenon the children in the cartoon are experiencing and allow time for students to share their own experiences with the phenomenon. Record the students’ initial thinking about what causes the phenomenon. Accept all ideas at this time.

Divide the class into groups of four students. Distribute one Outside/Inside card to each group. Ask the groups to discuss the phenomenon from the cards and develop a model that explains why it is so difficult for the child to see when he came inside. Remind the students that this model represents their initial thinking and they will have the opportunity to revise as the unit progresses. Ask students to use their Student Journal for brainstorming their models.

*Use the space below to draw and label a model that explains what is happening to the children in the Outside/Inside cartoon. Include arrows to help show how light travels. Write questions you have as you develop your model.*

Facilitate the group activity by circulating among the students and listening to their initial ideas. To help students communicate their current understanding, ask:

- Can someone tell me what you have discussed so far?
- Did someone record that idea in the Student Journal?
- How does your model explain why it was difficult for the children to see when they went from the bright sunlight to the dim inside light? What do you think caused that?
- Tell me more about how light interacts with our eyes. Do the rest of you agree? Why or why not? Does your model represent your ideas about light?
- What do you mean when you say...?
- What more do you think you need to know to complete your model?
- What questions do you have? Can someone write down the questions to share with the rest of the class?
After the groups have had the opportunity to complete their initial models, distribute markers and chart paper to each group. Have them draw a group consensus model on chart paper and display their models around the room. Ask each group to discuss their models and as a class look for common ideas and unique ideas. Ask the class if the development and presentation of the models gave them more ideas and questions to add to the What We Think chart. To help the students elaborate on their explanations of their models, ask:

- ____________, I heard you use the term ____________. Can you tell us more about that?
- What does ____________ represent on your model? What makes you think that?
- Tell us more about what you mean when you say ____________.
- How can we make our wonderings into questions we can investigate? What more do you think you need to find out to figure out the problem of sight when going from the bright outdoors to indoors?

Take this opportunity to develop the driving questions for following lessons by building on students’ initial ideas. Help students to turn wonderings into questions that can be answered in future activities. Driving questions should include:

- How are we able to see objects?
- How does light affect how we see objects?

Ask students for their ideas of how they can find out more information about the cause-and-effect relationship between light and our ability to see. Record their ideas on the What We Think chart.

Listen for ideas that relate to eyes adjusting to the light, inability to see detail in limited light, and that light is necessary for sight.

**Assessment: Formative**

Use the initial models to assess the students’ initial ideas and ability to describe how light reflects from objects and enters the eye, allowing objects to be seen.
Lesson 1B: No Light! No Sight!

Teacher Background Information
Students may continue to have mixed ideas about their ability to see without light. Many students have the idea that, given enough time, their eyes will “adjust” and they will be able to see objects in a completely dark room. This lesson is intended to help students recognize that light is necessary for sight and that the amount of light available has an effect on the details they are able to see.

Explore the concept.
This phase of the learning provides students with the opportunity to explore their questions and understandings about the relationship between light and the ability to see objects. Students will be engaged in exploring the properties of light and planning investigations into how light illuminates objects.

Advance Preparation
Cut 8 pieces of black construction paper in 3” x 4” size.

Materials for preassembled box: 1 box, 1 plastic figure, 1 cardboard tube.

Assemble the eight boxes. Open the boxes. For each box, tape a plastic figure inside on the bottom section of the box.

Close the lids on the boxes. Place a tube halfway into each box.

Procedure
Explore the concept.
Review the driving questions and What We Think About Light and Sight chart developed in the previous lesson. Review student-generated models that exhibited ideas about how light sources illuminate objects, how light is reflected off objects, or how the reflected light enters the eye, allowing us to see the objects. To further assess students’ thinking about light and the ability to see, have students complete the probe in the Student Journal.

Imagine you are sitting in a room, looking at a new toy. Your friend doesn’t know you are in there and turns out the light and closes the door. It is totally dark in the room. There are no windows or cracks around the door. No light can enter the room.

Choose the answer that describes how you would see the toy.
A. Your eyes will adjust to the darkness and you will eventually see the toy.

MATERIALS NEEDED
For each student:
student pages

For each group of four:
1 preassembled box (see Advance Preparation)

Teacher provides:
chart paper
markers
Post-It Notes
masking tape

PS4.B: ELECTROMAGNETIC RADIATION
• An object can be seen when light reflected from its surface enters the eyes.

TEACHING TIP
Your unit is supplied with a light box to help students test their predictions. If you have access to a totally dark room (no windows or cracks around the door), allow students to take an object into the dark room to test their predictions.
B. Your eyes will adjust to the darkness so you can see the outline of the toy, but not the colors of the toy.

C. You will see the faint outline of the toy after your eyes have had time to adjust.

D. You will not see the toy, regardless of how much time you wait for your eyes to adjust.

E. You will see the shadow of the toy after your eyes have had time to adjust.

Write why you chose that answer.

Allow sufficient time for students to complete the probe. Make a bar graph on the board or chart paper. When students have decided on an answer to the probe, have them place a sticky note on the graph above their answer. Allow sufficient time for students to justify their predictions.

Sample Chart

Explain the concept and define the terms.

Ask students for ideas of how they can test their ideas about the ability to see in the dark room. Have students return to their groups of four from the previous lesson. Distribute the boxes to each group. Darken the room. Ask students to look through the cardboard tube into the box. Tell students to keep their observations to themselves until each person in the group has had the opportunity to look in the hole. After each group member has had a turn, tell them to discuss what object they saw in the box and record their observations in the Student Journal.

Describe the object in your box:

<table>
<thead>
<tr>
<th>Position of lid</th>
<th>Closed lid</th>
<th>Lid slightly raised</th>
<th>Lid open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Have students repeat the observations and recording with the lid slightly raised and then finally with the lid open.

**Science Talk**
Take this opportunity to help students think through, discuss, and engage in argument on their explanations. Return to the class bar graph from the probe and ask students if their observations with the box gave them evidence to support or dispute their choices. Have students reconcile what they believed would happen and their actual findings. Ask students to share any new ideas they have about the probe and their models from Lesson 1A. Ask:

- What conclusion can we draw from our observations using the light box?
- What can we say about light and the ability to see?

Return to the What We Think chart and make additions and revisions as explained by the students. Review with the class the driving questions. Ask: Now that they have an understanding that we need some light to be able to see, what other information do we need to confirm our models that explain the Outdoor/Indoor phenomenon? Look for students to recognize - no light, no sight!

**Assessment:**
Use the Science Talk and students’ adjustments to the class charts to assess the students’ ability to present an argument from evidence about their understanding that light is necessary for sight.

**TEACHING TIP**
Student responses and discussion may indicate that students have the common misconception that pupils “adjust to the dark” by dilating or getting bigger, rather than understanding that the pupils get bigger to allow more light to go into the eye, even if there is no light.

**TEACHING TIP**
Science Talk is a conversation among students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. Allow sufficient time for each student to express ideas and opinions. Encourage student-led conversation in the classroom.
Lesson 1C: How Light Travels

Teacher Background Information
The experience with the light box in the previous lesson provides an ideal time to introduce the role of light reflecting off an object and entering our eye to explain how we see. In this lesson, students explore the path a light source travels and what happens to our ability to see the object when illuminated.

Advance Preparation
Place an object in a dark corner or under the desk. Prepare to darken the room.

Procedure
Elaborate on the concept.
Turn on a flashlight and direct the light at the object 2 to 3 yards (2 to 3 meters) from the flashlight. Ask students to observe the path the light travels from the flashlight to the object. Tell the class:

This makes me wonder how we are able to see the object.

Ask two student volunteers to take the piece of string and “map” the path of the light. Have one student hold the string at the center of the light source and the other pull the string along the light path until it lands on the object. Ask students to describe the string.

Shine the flashlight on a second object within the same range. Ask different students to map the path of the light from the flashlight and then describe their observations of the string. Ask another student to shake the powder, using the cotton balls, along the students’ mapped beam of light to make the path more visible. (Note: The particles of powder will become illuminated along the path of light, demonstrating the straight path.)

Ask students to draw their findings from mapping the light in their Student Journals. Have students work in pairs and then share with their group of four.

1. Your teacher used a flashlight to see an object in a dark place. Draw and label a model of how you were able to see the object.

2. Write how mapping the path of light from the flashlight to the object provided evidence of how light travels.

Science Talk
Discuss the findings from the mapping of the light from the source to the object. Ask groups to share their responses in the Student Journal and explain how they were able to see the object. Use the demonstration with the object and flashlight in orchestrating discourse to help students revise their original

MATERIALS NEEDED
For each student:
student page

For the class:
string, 3 meter length powder (talcum)
1 cotton ball
flashlight with batteries

Teacher provides:
chart paper
markers
masking tape

PS4.B:
ELECTROMAGNETIC RADIATION
• An object can be seen when light reflected from its surface enters the eyes.

DEVELOPING AND USING MODELS
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
• Develop a model to describe phenomena.
• Use a model to test interactions concerning the functioning of a natural system.
models and further develop their conceptual understanding. After the groups have presented their ideas, ask:

• What information did we gain from the light demonstration? Did any patterns in information come through after sharing our Journal Entries?
• What do you think about what ________ said about the way light travels?
• Do the rest of you agree? Why or why not?
• Can someone summarize our conclusions from the light demonstration?
• How does this relate to the outdoor/indoor problem?
• Do we have sufficient information to explain the phenomenon?
• What more do we need to know?

Add any new or revised information to the What We Think chart from Lesson 1A. At this point in their learning, students may not yet have the idea that the object reflects light, which travels to the eye. Their understanding should include that light travels from the light source in a straight path going out in different directions from the source and illuminates objects that are in its path.

Allow time for groups to make adjustments to their models from Lesson 1A and their responses in the Student Journal. Ask students to collaborate with their group and discuss if their original responses in the Student Journal included a representation of the light source, light traveling in a straight path, and light illuminating objects. Then ask if the new information would help in their models from Lesson 1A. Facilitate the groups’ revision and revisiting activity by circulating among the students and listening to their ideas. To help students build confidence and rely on their new understandings of how light travels, ask:

• Have you considered the light source in the demonstration and the light sources in the outdoor/indoor phenomenon? Are they represented on your models?
• How does considering the light source help us to figure out the phenomenon?
• How does that relate to our ability to see?
• Can you think of an example of when something like the outdoor/indoor phenomenon might happen in a different situation?

Ask groups that feel they have completed their revisions to share with another group.

**Assessment**

Use the revised Student Journal models and revisions to models from Lesson 1A to assess the students’ ability to use models to represent understanding and their understanding of how light travels in a straight path and illuminates objects in its path.
Lesson 1D: Reflecting Light

Teacher Background Information
In the previous lessons, students gathered evidence that light travels in a straight path and illuminates objects in the path of light. This lesson provides students with information about the reflection of light and how objects are illuminated and reflect light. It is the reflected light from objects that enters the eye and enables us to see them.

When the students shine light through a comb onto black paper, they should see beams of light traveling in straight lines. When the light hits the mirror, they should see that the lines of light change direction in other straight paths. When they shine the light through a comb onto white paper, they should see the same thing. The difference between the white and black paper is that the reflection of the light will be more clear with the white paper. The black paper actually absorbs some of the light.

Advance Preparation
Make a small slit in the center of the 3” x 5” cards. Prepare one card for each group of four students (see illustration). Tape the card to the end of the flashlight.

Cut a half circle in the center of the 5” x 8” index cards. Prepare one card for each group of four students (see illustration).

Prepare an area on the whiteboard or chart paper to make a class chart that displays the collective observations of the class (see Procedure).

Observations of Light

<table>
<thead>
<tr>
<th>Group</th>
<th>Light traveling through the hole in the index card and comb</th>
<th>Observations using the mirror</th>
<th>Observations of the path of light on the white paper</th>
<th>Observations of the path of light on the black paper</th>
</tr>
</thead>
</table>

MATERIALS NEEDED
For each student:
- student pages

For each group of four:
- mirror
- comb
- index card (3”x5”) with narrow slit
- index card (5”x8”) with half circle cut out
- black paper
- white paper
- pencil
- chalk
- flashlight with batteries
- books (to prop up mirror)

Teacher provides:
- chart paper
- markers
- masking tape
- books (to prop up mirror)
- pencils

PS4.B: ELECTROMAGNETIC RADIATION
- An object can be seen when light reflected from its surface enters the eyes.
CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

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

- Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
- Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.
- Identify the evidence that supports particular points in an explanation.

Procedure

Elaborate further on the concept.

Divide the class into their groups of four. Distribute one flashlight with narrow slit, one comb, one mirror, black paper, white paper, one 5” x 8” index card with a half circle cut out, and two pieces of tape to each group. Have each group tape the 5” x 8” index card to the comb with the teeth of the comb covering the half circle. Review the Activity Page with the class before they begin their exploration.

1. Write and draw your observations with the comb, flashlight, and mirror. Draw how you used your materials and what you observed.

Ask a student volunteer to explain what they are to record in their Student Journals. Tell students that they will refer to their drawings and observations to explain what they discovered to others. Show the class chart that they will use to collectively display their observations.

Give the groups sufficient time to “mess about” with the materials and make observations and discoveries on their own before introducing a common set of procedures for the groups to follow. Facilitate the exploration by circulating among the groups, observing their activity and listening to their explanations. To check student progress, ask:

- What have you tried so far? Can someone explain what you observed?
- Can you think of another way to use the materials? What happens when you shine the light straight through the half circle and the comb? What are the dark lines? What are the light lines?
- Have you tried it at an angle? What happens if you hold the mirror at an angle?
- Does it look different on the white paper than the black paper? Why do you think that?
- What have you recorded on your Activity Page so far? How would you explain what you observed to someone else?

When groups appear to be concluding their exploration with the materials, have them join another group to share what they discovered and combine materials for further exploration. Have the groups prepare and discuss what they will present to the class.

Science Talk

Ask each group to share their observations with the rest of the class. Provide a document projector and have students display their work.
Organize and record each group’s observations by entering their findings on a class chart. The chart will also help to guide the students in their presentations.

Record common language the groups use to describe their observations. Groups that present later will demonstrate the common observations. Validate their findings with a check mark or tally mark.

After all groups have had the opportunity to present their findings, discuss the observations recorded on the class chart. Ask students what they can conclude from the class observations. Review each column and ask the class to make a statement based on the data. Look for responses that include:

Column 1: The observations from the light traveling through the hole in the index card and comb provide evidence that light travels in a straight path.

Column 2: The observations using the mirror provide evidence that light bounces off the mirror and changes direction and travels in a straight path in the new direction.

Column 3: The observations of the path of light on the white paper were more difficult to see; both colors of paper provided evidence of light traveling in a straight path. (Listen for ideas about reflected light.)

Column 4: The observations of the light on the black paper show the path of light more clearly than the white paper. (Listen for ideas about light that is absorbed.)

*Evaluate the students’ understanding of the concept.*

As a class, make a statement supported by the student findings. (Light travels in a straight path until it strikes an object. Light reflects or bounces off a mirror and then continues to travel in a straight path in a different direction.) Write the class statement on the board and have students write the statement in their Student Journals.

2. **Write the class statement based on the observations of each group.**

In their groups of four, distribute a flashlight, index card with narrow slit, mirror, black paper, white paper, pencil, chalk, and large book to prop up the mirror. The bottom rim of the flashlight and bottom of the index card should be able to rest on the table or desk. (See illustration in Advance Preparation.) Have the students refer to the illustration in their Student Journals to set up their materials.
1. Use the illustration below to set up your materials.
2. Turn on the flashlight and observe the path of light in three different positions of the light (straight in front, angle to left, and angle to right).
3. Draw the path of the light from the flashlight and mirror on the white and black paper.
4. Draw and write your observations.
5. Straight in front, angle to left, angle to right

Facilitate the group activity by circulating among the students, observing their procedures and listening to their observations and ideas. At this stage provide little assistance with their procedure and thinking. Assess the groups’ ability to apply what they have learned to the slightly different materials and state what they have learned about how light travels and interacts with a mirror.

To check for understanding and help students elaborate on their explanations, ask:

- What have you observed so far? What do you think caused that to happen?
- How is this investigation with the slit in the card similar to the investigation with the comb? How is it different?
- Tell me more about the effect of the flashlight at an angle. What did you draw on the paper? What do you think would be the effect of increasing the angle of the flashlight to the mirror? Decreasing the angle? What causes the difference in the path of light?
- Do you think if you repeated the procedure you would get the same results?

**Evaluate the students’ understanding of the concept**

**Summary Discussion/Science Talk**

Discuss any new information students discovered from the investigation with the comb, flashlight, mirror, and flashlight with slit. Listen for ideas that include that they gained evidence that light travels in a straight path and can be reflected off objects (mirrors) and change direction.

Return to the object that was illuminated by the flashlight in Lesson 1C. Ask students to discuss the connection between how the light traveled to the object and how the light traveled to the mirror. Write the term *reflected light* on the board or chart paper and ask students to explain the importance of reflected light and our ability to see. Review how we have evidence that light reflects off mirrors from their investigation. Ask students if light reflected off the object in Lesson 1C. Encourage students to engage in discourse over the idea of light reflected off of all objects and not just shiny objects like mirrors. Help students to make the
connection between light reflecting off objects and the reflected light they observed on the white and black paper using the comb and mirrors. Ask students to explain how they were able to see the streaks of light on the paper.

As a class, develop a working definition of the terms reflected light and absorbed light. After the class has reached a consensus for their definition of the terms, have students write them in the Key Terms of the Student Journal.

Ask students how this new information might be helpful in explaining how we see things and the outdoor/indoor phenomenon. Allow sufficient time for students to regroup and make revisions and additions to their models. Facilitate the revision making by circulating among the groups and listening to their ideas. To help groups that may be stuck and to check group progress, ask:

• How would you describe the problem we are trying to solve by revising our models?
• What new information have we learned that is not represented in your original model?
• Would it be helpful to begin again with a new model? Would it be helpful to make a model that represents outdoors and indoors similar to a before and after?
• What about putting things in order when we look at an object? What has to happen for us to see it?

Take time for groups to share their new/revised models of the outdoor/indoor phenomenon.

Assessment
Use the revised models and Science Talk to evaluate the students’ understanding of how light reflected off objects makes it possible for us to see things.
Activity 2: Our Eyes in Bright Light and Darkness

Teacher Background Information
The eye is the light-sensitive organ of the body. It enables us to see. Light enters the eye through the pupil. The pupil is the opening that looks like a black circle in the center of the eye. The colored area surrounding the pupil is called the iris. The iris is a muscle that allows more or less light into the eye. When the light is dim, the iris opens the pupil to allow more light to enter the eye. When the light is bright, the iris closes the pupil, decreasing the amount of light that enters the eye.

The retina is on the inside back of the eyeball. It acts like a light sensor and is sensitive to light waves. When the image focuses on the retina, it is upside down and smaller than the actual object. When the light on the retina is too great, the brain automatically sends an impulse to control the iris, which in turn closes the opening of the pupil.

Fourth-grade students are not expected to know the names of the parts of the eye and how the eye functions. Students should have an understanding of how our eyes react to bright light and darkness.

Advance Preparation
Make a class chart to tally results of the student investigations (see Procedure/Science Talk).

Check areas in your school and schoolyard that may have unusually bright or dim light for students to conduct their investigations.

Lesson 2A: Bright Light/No Light

Procedure
Engage the learner.

Divide the class into their groups from Lesson 1A. Revisit the scenario from Lesson 1B.

Imagine you are sitting in a room looking at a new toy. Your friend doesn’t know you are in there and turns out the light and closes the door. It is totally dark in the room. There are no windows or cracks around the door. No light can enter the room.

Choose the answer that describes how you would see the toy.

A. Your eyes will adjust to the darkness and you will eventually see the toy.
B. Your eyes will adjust to the darkness so you can see the outline of the toy, but not the colors of the toy.

ESTIMATED TIME
Lesson 2A: 45–50 minutes
Lesson 2B: 45–50 minutes

OBJECTIVE
Obtain evidence to explain how the eye reacts to bright light and dim light or no light.

KEY QUESTION
How does the eye react to bright light and darkness?

MATERIALS NEEDED
For each student:
student pages
For each group of four:
Outside/Inside cartoon strip, card set mirror
Teacher provides:
chart paper
markers

PS4.B: ELECTROMAGNETIC RADIATION
• An object can be seen when light reflected from its surface enters the eyes.

LS1.D: INFORMATION PROCESSING
• 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.
TEACHING TIP
Students may continue to struggle with the concept that light is reflected off objects and the reflected light enters the eye, enabling us to see.

It may be helpful to use the moon as an example of something that shines brightly but does not produce its own light. The moon reflects light from the sun, and the reflected light illuminates the dark night.

C. You will see the faint outline of the toy after your eyes have had time to adjust.
D. You will not see the toy, regardless of how much time you wait for your eyes to adjust.
E. You will see the shadow of the toy after your eyes have had time to adjust.

Write if you made a change to your answer from Lesson 1A. Tell what new information changed your response.

Ask students to use their new information and reevaluate their initial responses. Allow time for students to make adjustments to their previous ideas. Encourage students to share their ideas and reasoning within their groups. Facilitate the group discussions by circulating among the students and listening to their ideas. To help students collectively make sense of the concept and make connections among ideas and applications, ask:

• What do you think about what ______ said?
• Do the rest of you agree? Why or why not?
• How does this relate to our findings about how light travels and what happens when light strikes an object?
• What is the effect of total darkness on your ability to see? What makes you think that?
• What happens after light strikes an object?
• What have we investigated that will help us select the correct response to the prompt? How could you prove your response?
• Do you understand what __________ is saying?
• Can you explain why your answer makes sense?

Review the outside/inside phenomenon with the class.

Redistribute the Outside/Inside cartoon strip to each group and have them discuss how their models reflect an explanation for the phenomenon and what is still needed to fully explain the difficulty in seeing when entering the house. Ask student volunteers to explain how we see the objects around the room. Listen for ideas that include that light from the light source strikes objects in its path, illuminating the objects, and the objects reflect light to our eyes, enabling us to see.

Allow sufficient time for students to make adjustments to their models or redraw and design models based on new information.

Review the What We Think chart from Lesson 1A and discuss questions the class has answered and what questions still need to be answered. Explain that students now have information that explains how we see things, but our evidence does not explain the difficulty in seeing when going from a brightly lit area to a dimly lit area that was presented in the phenomenon in Lesson 1A.
Refer to the What We Think chart and student models that made reference to “eyes adjust” to or “get used” to the light. Ask students to explain what they mean by that. Ask students to share their experiences with too little light and too much light. As a class, develop the question they are asking.

Explore the Concept
Write the driving question on the board (sample):

*How does the human eye react to bright light and darkness?*

Assist the students in planning a procedure that will provide evidence that the eyes change when they go from a dark place to a bright place or a bright place to a dark place. The amount of light your classroom gets, the ability to darken the classroom, the availability of a dark closet or bathroom, and the ability to go outside into the bright sunshine will play a role in the procedure your students decide on. Ask students to explain what part of the eye they will be observing as they go from light to dark.

After the class has completed a brainstorming session of ideas, have the groups of four divide into teams of two students. Have the teams decide how they are going to make observations of each other’s eyes in the dark and in the light and record any changes they see. Distribute a mirror to each team so they can also make observations of their own eyes. After teams have decided on a plan for their investigation and a method of recording their observations, have them present their plan to you before they begin.

Have groups use the prompts in the Student Journal to set up their investigations.

1. Write the question you are investigating.
2. Write what you already know about light and sight.
3. Write what you think you will find out. Write why you think that.
4. List the materials you will use.
5. Draw and write how you will set up your investigation.
6. Make a data table to record your observations.
7. Write what you found out.

Facilitate the team activity by circulating among the students and listening to their ideas. To check for student progress and to help teams that are stuck, ask:

- Can someone explain what question we are investigating? What information do you already know?
- What do you think or predict you will find out? What do you think causes that to happen? How can you find out?

**CAUSE AND EFFECT**

- Cause-and-effect relationships are routinely identified, tested, and used to explain change.

**PLANNING AND CARRYING OUT INVESTIGATIONS**

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

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Evaluate appropriate methods and/or tools for collecting data.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- Make predictions about what would happen if a variable changes.
ANALYZING AND INTERPRETING DATA

Analyzing and interpreting data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.
- Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computations.

TEACHING TIP

Integrate mathematics and have students make a graph from their data.

- What ideas have you already discussed? What do you think you will learn from that procedure? Can you think of another way to find out?
- How will you record your observations in the Student Journal? What will you be looking for in your observations? What will you use to compare the eye in the light and the eye in the dark?

Give the teams sufficient time to carry out their investigations and record their findings on the Activity Page in the Student Journal.

Take this opportunity to evaluate the students’ understanding from the previous activity that light is necessary for sight. Ask students how they are going to make their observations in a completely darkened room.

Look for student ideas that include the following procedure:

- Make and record observations of the eye with the available light in the room.
- Make and record observations of the eye immediately after exposure to a darkened room or covering the eyes to block out light.
- Make and record observations of the eye when exposed to a bright room or outdoors in the sunshine.

Science Talk

* Explain the concept and define the terms.

After students have completed their investigations, conduct a whole-class sharing of their results. Make a whole-class chart to record their findings. Create a data table or tally chart on the board that helps to record the students’ observations of the changes of the eye. Have students refer to their data in their Student Journals to collect their observations.

<table>
<thead>
<tr>
<th>Pupils got larger in the dark</th>
<th>Pupils got smaller in the dark</th>
<th>Pupils stayed the same in the dark</th>
<th>Pupils got larger in the bright light</th>
<th>Pupils got smaller in the bright light</th>
<th>Pupils stayed the same in the bright light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tally student responses</td>
<td>Tally student responses</td>
<td>Tally student responses</td>
<td>Tally student responses</td>
<td>Tally student responses</td>
<td>Tally student responses</td>
</tr>
</tbody>
</table>

Help the students to interpret their findings and write a conclusion about what they learned from their investigation.

* Write a conclusion from your observations and class data about how eyes react to light and dark.*
Explain that the eye adjusts to the amount of light in a room by opening and closing the pupil. When there is very little light the pupil will open wider to let more light into the eye so we can see images, but when it is very bright, the pupil of the eye will get smaller to block out some of the light.

Ask a student volunteer to explain what happens to our eyes when someone suddenly turns on the light when we are sleeping or in bed in a dark room.

Ask students what new information or conclusions they could add to the What We Think chart. Ask if any other revisions are necessary at this time.

Read the Journal Entry as a class. Ask students to describe in their own words what they are asked to do. Students may benefit from working in pairs or groups to develop a solution to the problem. Allow sufficient time for students to share, compare, and evaluate one another’s solutions.

Journal Entry
1. Relate the class findings to the problem of having a hard time seeing when moving from a bright light to a dim light. Write and draw one solution to the problem.
2. How can the problem of the effect of going from bright light to dim light be solved? Explain how your solution solves the problem. Explain what science ideas you used to solve the problem.

Assessment
Use the revised models, revisions to the probe, Activity Page, and Journal Entry to assess the students’ ability to explain the connections between the amount of light and our ability to see.
Lesson 2B: Send a Message to Your Brain

Teacher Background Information
The final lesson in understanding how the eye reacts to light provides the opportunity for students to develop and present their final models. At this level students are not expected to know and understand the parts of the eye or the nervous system that sends messages to the brain so the eye can respond. Fourth-grade students understand that the information received by the eye is interpreted in the brain and the eye responds to the messages from the brain.

Explain the Concept and Define the Terms
This phase of student learning provides time and opportunity for students to explain their thinking about the phenomenon based on their new information. Useful science terms can be introduced and used as students present their ideas both orally and in written form.

Advance Preparation
Have chart paper and markers available for students to develop a final model that explains both how light reflecting from objects enters the eye and allows objects to be seen and the outdoor/indoor phenomenon.

Prepare an area to do a gallery walk as students present their explanations.

Write the following headings at the top of four pieces of chart paper:
- Asking Clarifying Questions
- Asking a Probing Question
- Adding to an Idea
- Respectfully Disagreeing with an Idea

Procedure
Elaborate on the concept.
Explain that each group will be given the opportunity to share their model that explains the outdoor/indoor phenomenon from Lesson 1A with the rest of the class and that they will be analyzing and critiquing one another’s explanations. In order to conduct a friendly, nonthreatening critique, establish as a class some guidelines and rules for their critiquing methods. Ask students to create four anchor posters that will guide the class throughout the unit when sharing ideas.

MATERIALS NEEDED
For each student:
- student pages
For each group:
- models from previous lessons
Teacher provides:
- chart paper
- markers
- sticky notes

PS4.B: ELECTROMAGNETIC RADIATION
- An object can be seen when light reflected from its surface enters the eyes.

LS1.D: INFORMATION PROCESSING
- 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.

TEACHING TIP
It is important for the students to develop their own set of norms rather than following the suggestion of the teacher.
TEACHING TIP
The charts will be used throughout the unit to help students interact with one another when sharing, comparing, constructing explanations, and engaging in argument. The charts help to prepare students for the scientific practice of engaging in argument from evidence.

Keep the charts visible to reference throughout the unit.

ENGAGING IN ARGUMENT FROM EVIDENCE
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
• Construct an argument with evidence, data, and/or a model.
• Construct an argument with evidence.
• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Display the four charts with the questioning and critiquing categories. As a class, have students suggest how they might start a question that asks a group to clarify, probes or digs deeper, disagrees, or adds to an idea. It is important for success in student-to-student interactions for the anchor charts to be developed by the students.

Example Charts:
Respectfully Disagreeing With an Idea
I agree with … but…
I disagree with… because…
I agree with part of your model but disagree with this part…
I respectfully disagree because…
I understand where you are coming from, but I have a different idea.
I agree with you but also think…
I see your reasoning, but I disagree with some of the ideas because…

Asking a Clarifying Question
What do you mean by…?
Can you be more specific about…?
What makes you think that?
What evidence do you have that supports that?
How do you know?
Can you tell us more about…?
What do you mean by…?

Asking a Probing Question
What do you mean by…?
What makes you think that?
If that were true, then wouldn’t _________ be true?
Where did you get this idea?
How did you come up with…?

Adding to an Idea
I agree with you, but also…
I would like to add …
I agree but also think…
I agree with this part, but could you add…?
Do you think adding _____ would make it more clear?
I agree but have an idea that might add more clarity or information.
Would it make it more clear if you added…?
Allow sufficient time for the groups to discuss, revise, and develop their final models that explain the outdoor/indoor phenomenon from Lesson 1A. Facilitate the development of the final model by circulating among the groups and observing their progress. To help students build confidence and rely on their own understanding, ask:

- How is that true? What evidence did the class obtain that makes you think that?
- Does that make sense?
- How does your model relate to the effect of going from very bright light to dim light? What causes that to happen?
- Can you explain the change using cause and effect?
- Would it help to write down what you know in order to make your model?
- Would it help to make an “in bright light” diagram and an “in dim light” diagram and explain what happens when going from one kind of light to another?

After the groups have completed their final models, have them display the models around the room and allow time for students to do a gallery walk and make comments on the models using the sticky notes. Encourage students to ask questions and post comments on the models and to use the suggestions on the anchor charts to communicate with one another. Remind the students that scientists and engineers share their ideas with others to add new ideas and improve their models.

At the conclusion of the gallery walk have the groups retrieve their models and discuss the comments and questions that were posted on their models. Allow sufficient time for students to respond to suggestions if warranted.

**Evaluate the students’ understanding of the concept.**

**Science Talk**

After all groups have reviewed the suggestions and questions posted on their models, have students gather in a circle to make meaning and connections to the focus questions from Lesson 1A:

- How are we able to see objects?
- How does light affect how we see objects?

Begin the Science Talk by choosing a comment or idea that was conveyed in one of the models. To start the conversation and make connections among ideas and applications, ask:

- ____________, I heard you say _______________. How does that information help us to understand our questions about light and sight?

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**TEACHING TIP**

Check for understanding reflected in students’ models that demonstrates that light illuminates objects, and objects reflect light that enters the eye that allows us to see. Some students may have made a reference to the eye sending a signal to the brain. Make a note to have that group explain their thinking.

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**DEVELOPING AND USING MODELS**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.
- Use a model to test interactions concerning the functioning of a natural system.

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**TEACHING TIP**

Science Talk is a conversation among students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. Allow sufficient time for each student to express ideas and opinions. Encourage student-led conversation in the classroom.
CAUSE AND EFFECT
• Cause-and-effect relationships are routinely identified, tested, and used to explain change.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
• Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
• Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.
• Identify the evidence that supports particular points in an explanation.

• Did anyone else have a similar finding? Do you think that is true for all cases? Why or why not?
• I heard many groups use the term reflected light when describing how we are able to see. What evidence do you have that makes you think light is reflected? Do the rest of you agree? Why or why not?
• How does this information relate to our questions: How are we able to see objects, and how does light affect how we see objects?
• I noticed that __________ model had a reference to the eye sending a message to the brain. Can you explain what you mean by that?
• What causes the ability to see objects? What is the effect when that changes?
• In _______ group we discussed the cause-and-effect relationship between light and the ability to see to explain the change when going from bright light to dim light. Can someone explain that relationship?

Review with the class how the light reflected from an object enters the eye and focuses on the light-sensitive retina of the eye. From the retina, nerve pulses pass through the optic nerve, sending messages to the brain, and the brain interprets what is being seen.

At the conclusion of the Science Talk, revisit the What We Think chart from Lesson 1A and the probe in the Student Journal from Lesson 1B. Allow time for students to check their initial ideas against their new understanding of how humans see objects.

Assessment
Use the final model and Science Talk to assess the students’ ability to develop a model that explains how light is necessary for sight and how we are able to see objects.
Activity 3: Animal Eyes

Teacher Background Information
The class has been learning about their own eyes and how light is necessary for sight. In this activity, students continue their exploration into sight through how other animals see and their dependence on a keen sense of sight for survival. The lesson is introduced with the phenomenon of eyeshine, or animal eyes that appear to glow at night. Most nocturnal creatures exhibit eyeshine. To understand eyeshine, it’s helpful to know just what makes a nocturnal animal. All eyes contain light receptors; some are rods and some are cones. We humans are diurnal (meaning we’re most active during the day) and therefore have far more cones, allowing us to see color and detail in order to function better in the daytime. Nocturnal animals have many more rods, which function better at night, helping the eyes to gather light and see the motion of potential prey or predators.

But not all nocturnal animals demonstrate eyeshine. Eyeshine is primarily caused by the mirror-like membrane at the back of the eye, known as the tapetum lucidum—Latin for “bright tapestry.” As light makes its way into the eye, it passes through the retina and is then reflected from the tapetum lucidum cells. The tapetum lucidum cells reflect light back through the retina and deliver twice the amount of light as normally available. Thus, when a bright flashlight is shined into the eyes of an animal with tapetum lucidum, the eyes appear to glow!

A common pattern of interdependence and interrelationships that help living things to survive is that of predator animals and prey animals. Predators are animals that catch and eat other animals. Prey are animals that predators catch and eat. These terms describe a feeding relationship between these two types of animals. The predator depends on its prey for food. The prey depends on its defense characteristics to keep from becoming food.

In this activity, the primary focus of predator and prey characteristics is their well-developed sense of sight. We often assume that animals experience the world in the same way as we do through our senses. In reality, the world experienced by other animals goes beyond the basic five senses. Some animals are more sensitive in using the basic five senses. Other animals are sensitive to environmental conditions, such as solar radiation, pressure, electricity, and magnetism. These sensory abilities are characteristics that each animal has developed to survive in its environment.

ESTIMATED TIME
Lesson 3A: 45–50 minutes,
2 days
Lesson 3B: 45–50 minutes,
2 days

OBJECTIVE
Obtain information to determine how animals’ eyes and other sense organs aid them in survival.

KEY QUESTIONS
How and why do some animals have eyes that shine in the dark?

How do animals use their sense of sight to aid them in survival?

MATERIALS NEEDED
For each student:
2 pieces of paper,
8½ x 5½”
student page
For each team of two:
1 hand mirror
For each group of four:
1 set of Animals’ Eyes Cards (8 cards per set)
Handout: Mountain Lion/ Rabbit
For the class:
2 compound lens eye pieces
1 mountain lion mask
1 rabbit mask
1 ball of yarn
Teacher provides:
masking tape
blindfold
paper, 8½” x 11”
Predatory animals require extremely accurate vision, both near and far away from their prey. Many predators have eyes that are placed in the front of their heads. This arrangement allows for wide *binocular*, or “two-eyed,” vision in front of the animal. The fields of vision of the two eyes overlap considerably so that both eyes see the same objects but from slightly different angles. The two pictures received by the eyes are combined in the brain to create depth perception. A hunting lioness often has just one chance to swipe a swiftly running antelope and must be able to determine when she is close enough to take aim.

Prey animals are always on the lookout for predators. Prey must be able to spot approaching danger early enough to escape. Prey, such as rabbits, deer, and zebras, need a wide field of vision in order to see predators approaching from any direction. Usually bulging eyes are located on the sides of their heads, giving prey a complete view of their surroundings. Each eye sees almost half of the landscape around the animal, with very little crossing in front. This is termed *monocular*, or “one-eyed,” vision.

Once danger has been spotted, the prey animal can turn its flexible neck to focus both eyes on the predator and determine if it is close enough to require a quick escape. Even while running, the rabbit is able to see how close the predator is because the eyes are far apart on the sides of its face. Many cannot see what is directly under their noses. Their food source, plants, remains relatively still, however, and a rabbit’s sense of smell and touch is enough to allow it to eat what it is unable to see.

Many insects have relatively enormous compound eyes that are made up of thousands of parts. Each part gathers light and processes visual information through its lens and nerve system. Compound eyes give butterflies and other insects excellent perception of color and motion in a wide range. They can see up, down, forward, backward, and to their sides at the same time, but they are not very good at judging distance and perceiving patterns. The images are not united into one continuous picture. Animals with compound eyes apparently see the world as a series of still photos rather than a movie. They perceive polarized light, which, some scientists say, could allow them to move around their habitat and to migrate.

**Advance Preparation**

Preview the website https://www.npr.org/templates/story/story.php?storyId=96414364

Queue the first part (0:00–0:50) of the narration of Jack London’s book *White Fang*. Stop the narration with the question “Why do animals’ eyes glow at night?”
Additional animal eye web addresses:

- https://www.youtube.com/watch?v=RtrRZmH9bG8
- https://www.youtube.com/watch?v=hnI-1VQUYno
- https://www.youtube.com/watch?v=ZLb8AVHU5M

Duplicate copies for each group of four of the Mountain Lion/Rabbit handout, found in Handouts section of the Teacher Guide. Attach a string to the mountain lion and rabbit masks.

Plan for a large area to play the Mountain Lion/Rabbit game, such as the gym, playground, or cleared area in the classroom.

Make a What We Think About How and Why Some Animal Eyes Glow in the Dark chart.

### How and Why Some Animal Eyes Glow in the Dark

<table>
<thead>
<tr>
<th>What We Think and Questions We Have</th>
<th>How Can We Find Out?</th>
<th>What Do We Conclude?</th>
</tr>
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<tbody>
<tr>
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</table>

**Lesson 3A: Animal Eyes**

**Procedure**

*Engage the learner.*

**Phenomenon:** Animal eyes glow in the dark—eyeshine.

Queue the first part of the narration of Jack London’s book White Fang (0:00–0:50). Stop the narration with the question “Why do some animals’ eyes glow at night?”

Discuss the students’ initial reaction to the narration and question. Invite students to share their experiences with eyes glowing or shining in the darkness. Display the What We Think chart and record students’ ideas and questions about how and why some animals have eyes that shine in the dark. Ask students what animal was in the narration and why they think the animal has eyes that glow. Include a list of animals that students know about or think have eyes that glow in the dark. Ask students for their ideas of how they can find out.

Tell the class that they are going to focus on why some animals have eyes that shine in the dark and how it might help the animals to survive. To begin, the class will role-play to experience the importance of sight for animals.
Have the students form a large circle. Explain that the class is going to role-play the interaction between a mountain lion and a rabbit in the forest. Ask two student volunteers to be inside the circle. One student will pretend to be a mountain lion and wear the mountain lion mask. The other student will pretend to be a rabbit and wear the rabbit mask.

Tell the students to put on their masks and close their eyes. Tell them to use their sense of hearing to detect where the other student is as the “mountain lion” attempts to catch the “rabbit” and the rabbit tries to get away. (If you have “peekers” you may have to use a simple paper-towel blindfold under the mask). Tell the students in the circle that they are the trees of the forest and must stand very quiet and still.

After a minute, give other students an opportunity to act out the two animals. Ask the students what the mountain lion will do with the rabbit if it gets caught. Ask students to identify the role of the mountain lion and rabbit in the ecosystem. Discuss how the game was made more difficult for both animals without the use of their sense of sight. Ask students why they think sight is important for both the mountain lion and the rabbit. Ask students if either animal, the mountain lion or the rabbit, has eyes that glow in the dark. Record new and additional ideas on the What We Think chart.

Ask students to identify the senses they had to rely on to catch their prey or escape their predator. Discuss how animals use the sense of hearing and relate it to the shape and size of their ears. Ask students which animals have a hearing advantage and why.

Ask the class to sit very quietly as you say something very softly from the front of the room. Then have the students cup their hands around their ears as you repeat what you said. Ask students to use what they know about sound and how sound travels to explain the difference in hearing with their hands cupped around their ears.

Discuss the sense of smell and if they have ever witnessed an animal’s nose twitch or an animal tip its nose up to sniff the air and wind.

Explore the concept.
Divide the class into groups of four. Have the groups discuss the importance of the senses of sight, hearing, and smell for the mountain lion and rabbit. Ask them to explain what the mountain lion was listening for when it was hunting the rabbit. What was the rabbit listening for as it tried to get away? What other senses and characteristics would help the mountain lion catch...
the rabbit? What other senses and characteristics would help the rabbit get away? Why does the group think the ears of the rabbit are larger than the ears of the mountain lion?

Ask one student in each group to be the “recorder” and write the group’s ideas on the Mountain Lion/Rabbit handout. Have the group think about other animals that act like the mountain lion and the rabbit.

Facilitate the group discussion by circulating among the students and listening to their ideas. To help students build confidence and rely on their own understanding, ask:

- Why do you think that is true?
- What have you seen or experienced to make you think that?
- Does that make sense in terms of the animal’s ability to survive?
- Tell me more about this animal. Where does it live? What does it eat? How does it depend on its sight to get food?
- What do you mean when you say . . . ?
- Can someone explain what you have discussed so far? What animal have you chosen that is similar to a mountain lion?
- Tell me more about why that animal is like a mountain lion. What makes you think that?
- Do the rest of you agree? Why or why not?
- Would it help to make a list of animals that you know and then categorize them? In which column would you place a polar bear? Is it like the mountain lion or the rabbit? What makes you think that?
- What similarities do the animals in the “Animals that act like the mountain lion” column have? How are they all alike?
- What about the animals you listed in the “Animals that act like a rabbit” column? How are they alike?

Provide considerable time for groups to talk about their experiences and ideas, allowing them to verbalize their own ideas and understand the ideas of the other members in the group. Ask students to be prepared to share their ideas of at least one animal that acts like a mountain lion or a rabbit.

Science Talk

*Explain the concept and define the terms.*

Conduct a whole-class sharing of ideas from their group discussions. Ask students to bring their Mountain Lion/Rabbit handouts and sit in a circle. Have one student from each group share an example of an animal that acts like a mountain lion and an animal that acts like a rabbit. Record the groups’ animal ideas on a t-chart as they list their ideas of animals that act like the mountain lion or rabbit.

**TEACHING TIP**

Listen for students who begin to use the terms predator or prey, or meat eater and plant eater. Make note of the discussion around the role the animals play to refer to during the Science Talk. Students will be looking for a pattern in their categories that will help them recognize a predator and a prey animal.

**CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS**

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

- Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
- Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.
- Identify the evidence that supports particular points in an explanation.
As students present their ideas, ask them to explain why they categorized the animal with the mountain lion or the rabbit. Listen for suggestions that the animals that are in the mountain lion column are predators and hunt other animals for food and the animals in the rabbit column are prey and food for other animals. Students may also find that some animals fall into both categories.

Write the terms *predator* and *prey* on the board or chart paper. As a class, develop a definition of the terms. Discuss the role of predators and prey in an ecosystem. After the class has reached a consensus for the definitions, have them write the definitions in the Key Terms of the Student Journal.

Have the groups look at their *Mountain Lion/Rabbit* handout. Ask them to identify their animal ideas as prey and predator. Explain to the students that the animals have different characteristics that help them to survive as predators or as prey.

Discuss the time of day or night that the mountain lion and rabbit might be out in their habitat. Ask:

- What do we know about the rabbit and when rabbits are out foraging for food?
- What about the mountain lion?
- Do you think either animal would benefit from the trait of eyes that glow in the dark?
- What makes you think that?
- What about the rest of the animals on our charts?

Have students write their initial ideas of how animals use their senses and why some animals have eyes that glow in the dark.

**Journal Entry**

1. *Choose one animal that has eyes that glow in the dark or eyeshine. Animal ____________________*
2. *Draw and label a model of how you think the eyes glow in the dark.*
3. *Explain how you think the eyes glowing in the dark help the animal survive.*

**Assessment: Formative**

Use the Science Talk, handout, and Journal Entry to assess the students’ initial ideas of how and why some animals have the trait of eyeshine.
Lesson 3B: Animal Eyes and Survival

Advance Preparation
Cut the 8½” x 11” paper into two 8½” x 5½” sheets for each student.

Procedure
*Elaborate on the concept.*
Have the students recall about eyes on different kinds of animals and how some animals’ eyes glow in the dark. Review the What We Think chart from the previous lesson. Invite students to share their entries in the Student Journal. Tell the students that they are going to continue to explore how the animals’ sight helps them to survive. Ask students to relate how it felt to try to hunt or get away without their sense of sight in the game from the previous lesson. Give each group one set of the Animals’ Eyes Cards. Have each group match the eye cards to an animal card. Have students discuss with each other the similarities and differences in the eyes and how the location of the eyes on the heads of different animals can help the animals to find food. Have the groups identify each animal and tell whether it is predator or prey.

Ask the students why the eyes of the rabbit (prey) are different than the eyes of the mountain lion, raccoon, and owl (predators). Allow the students to discuss their ideas within their group. Have the groups share their ideas with the class. Have them tell how they think the location and shape of the eyes will help the rabbit.

Introduce the books *What If You had Animal Eyes* and *Eye to Eye* to the class. Explain that half the class will read one book and the other half will read the other book. The purpose of the reading is to learn more about different animal eyes and how they help animals to survive, and why some animals’ eyes glow in the dark. Start the reading with a teacher read-aloud and read the introductory pages of the first three pages of *Eye to Eye* to the class. Discuss the information related to the four kinds of eyes and have students be on the lookout for different kinds of eyes in their assigned reading.

Divide the class into reading groups of two to three students and distribute one of the books to each group. Read the Respond to Text in the Student Journal as a class and discuss the purpose of the reading. Allow sufficient time for the groups to complete their reading and record the main idea and supporting details in their Student Journals. Inform the groups that they will be asked to share their findings from the reading with the rest of the class.

MATERIALS NEEDED

- **For each student:**
  - student page
- **For each group of four:**
  - 1 set of Animals’ Eyes Cards (8 cards per set)
- **For the class:**
  - 8 compound lens eye pieces
  - book: *What If You Had Animal Eyes*, 6 copies
  - book: *Eye to Eye*, 6 copies
- **Teacher provides:**
  - chart paper
  - marker
  - paper, 8½” x 11”

TEACHING TIP
The books are laid out with one or two animals on each page or spread of pages. To help with time issues and to avoid overwhelming students with reading the entire book, assign 3–4 animals per group. Have students read and discuss the information about their assigned animals and prepare to share information with the class.

LS1.D: INFORMATION PROCESSING
- 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.
Read about the animal eyes in your book. Discuss the traits of each animal’s eyes and how they use them to find out what is going on around them. Complete the chart for each animal your group read about. Book title _________________________________

<table>
<thead>
<tr>
<th>Animal name</th>
<th>Eye traits</th>
<th>How it helps the animal to sense its surroundings</th>
<th>Other comments</th>
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After the students have completed their Activity Pages, have them work together to complete the Journal Entry.

**Journal Entry**

Draw and label a model of a made-up animal that explains how its special eye traits help it to survive.

**Summary Discussion/Science Talk**

Evaluate the students’ understanding of the concept.

Have the students gather for a sharing of their findings from the reading and their models of a created animal with special eyes. Review the anchor charts for making comments and asking questions about each other’s ideas. Have students display their models in the center of the circle and allow sufficient time for students to do a gallery walk around the models.

Conduct a whole-class sharing of ideas. Ask students to comment on what they liked about some of the models. Encourage students to probe further about one another’s animals and ask questions. At the conclusion of their presentations, ask students if there was a pattern in how the animals in the book and the created animals used their eyes for survival. Listen for ideas that link to how the animal uses its sense of sight for finding food, avoiding predators, locating a mate, and communicating. Students may also recognize diversity of animals, animal eyes, and how they use them.

Revisit the cat description in *Eye to Eye* and clouded leopard in *What If You Had Animal Eyes*? Reread the description of the special lens that reflects light, aiding the ability to see in the dark, as described by the two authors. Ask students how the description relates to what they understand about how humans see objects. Review the What We Think chart and their models of how humans see. Take this opportunity to have students look through the compound lens to experience how some insects view the world. Make connections between human eyes and animal eyes that glow in the dark. To help the students collectively make connections and sense of the concept, ask:
• Can someone review how humans are able to see objects?
• How is that different from the special eyes of animals like the cat and clouded leopard?
• Do you agree with what __________ said? Why or why not?
• Can someone rephrase or explain what __________ said in a different way?
• Do you think we have answered our driving questions, How and why do some animals have eyes that shine in the dark?
  How do animals use their sense of sight to aid them in survival?

Assessment
Use the Journal Entry to assess the students’ ability to develop a model that explains how animals use their sense of sight to aid in finding food, communicating, avoiding predators, and locating mates.

DEVELOPING AND USING MODELS
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
• Develop a model to describe phenomena.
• Use a model to test interactions concerning the functioning of a natural system.
Activity 4: On One Flower

Teacher Background Information
Opportunities for nature walks and outdoor exploration by the students in your classroom may range from very seldom to very often. Some children in your classroom may have had many opportunities to explore a variety of environments, ranging from beaches to forests. Other children may have had few chances to really look closely at animals they find underground or on a nearby plant. Students also have a tendency to think of only mammals when they are asked to think about the variety of animals that they know. This activity gives students the opportunity to get up close to insects, insect larva, worms, slugs, and spiders, to mention only a few animals they may encounter.

Learners build understanding of life-science concepts through direct experience with living things, what they need to survive, and their habitats. Students are naturally curious about the nature of their world and eagerly ask questions, such as: What do different animals eat? Where do they live? What do they do all day? Questions such as these, along with students’ natural interest, lead to an understanding of the characteristics of living things and the complex interactions among all organisms. The best place to hunt for animals is near a garden. Any planting of flowers or vegetables attracts scores of flies, beetles, ants, spiders, caterpillars, and butterflies.

The purpose of this activity is to lay the foundation for exploration into animals and an understanding that animals have basic needs such as air, water, food, and habitat, that all animals are a part of a food web, and that the individual differences in characteristics help animals to survive in their habitats.

The following lessons are enhanced through the use of the Project Noah website. Project Noah is a nonprofit that connects citizen scientists (students and adults) and lets them locate, share, and research their observations of different plants and animals from across the globe. Students use technology to collaborate with one another and with students around the country and the world. Students are able to compare their observations of plants and animals that live in their schoolyard to plants and animals that live in different climates. They become a contributing part of a global science community tracking nature around the world.

ESTIMATED TIME
Lesson 4A: 45–50 minutes, 2 days
Lesson 4B: 45–50 minutes, 2–3 days
Lesson 4C: 45–50 minutes, 2–3 days

OBJECTIVES
Observe and collect animal specimens from habitats in the schoolyard.

Make long-term observations of and conduct research on plants and animals to obtain information about how their internal and external structures help them to survive.

KEY QUESTIONS
What plants and animals live in the schoolyard?

How do the plants and animals in the schoolyard use their senses to survive?

LS1.A: STRUCTURE AND FUNCTION
• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
Elaborate on the Concept
This stage of learning encourages students to expand their understanding to how different animals and plants use their sense receptors to receive information and react to their surroundings. This stage provides opportunities for students to explore different traits of plants and animals beyond the different types of eyes from previous lessons.

Advance Preparation
Find a location in your classroom where you will be able to keep a schoolyard habitat. It should not be in direct sunlight for long periods of time, nor should it be in the dark or near a heater.

Moisten the soil by mixing 1/2 cup of water into the bag of soil and then mixing thoroughly. The soil provided by the Cereal City Science has been in storage for several months. To ensure a soil rich with nutrients and microorganisms, add 1–2 cups of soil from the schoolyard to enrich the soil in the habitat.

Be prepared to place the first small piece of fruit or vegetable in the habitat. Bring in a bit of carrot, potato, or apple for initial observations of what the animals may eat.

Make a quick survey of the schoolyard. Look for areas with trees, bushes, and gardens where students may find an abundance of plants and animals for the classroom habitat.

Preview the book *On One Flower*. Use sticky notes to mark pages and passages that will spark questions and conversation about the traits and sense receptors the different animals have that help them to survive.

Preview a website with footage of the stink bug. If you conduct a Google search for “stink bug” you will find many sites that describe their damage to crops and how to get rid of them. The sites below have footage of just a stink bug crawling on a leaf.

- https://www.youtube.com/watch?v=pN67D3Au0Xc

Create a free teacher account on the website Project Noah. http://www.projectnoah.org/

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**MATERIALS NEEDED**

**For each student:**
- student pages

**For the class:**
- classroom habitat
- 8 cups soil
- grass seed
- water conditioner
- 1 spray bottle
- book: *On One Flower*, 6 copies
- *Goldenrod Picture*, 1 copy

**Teacher provides:**
- chart paper
- markers
- water
- fresh soil, 1–2 cups
- small pieces of vegetables or fruit

**TEACHING TIP**

During the schoolyard exploration encourage students to try to collect plants that can be transplanted into the classroom habitat. Moss mat is an easy plant to remove and place in the habitat. Gently slide the spoon (trowel) under a section of moss mat and lift off the soil. Keep moist until ready to plant in the classroom habitat.

Students may also find small plants to scoop under the roots and transplant into the classroom habitat.
Register your students under your account. Practice taking and uploading pictures to the site to become familiar with the options and use of the site. Browse the entries and projects on the site and become familiar with different projects that may interest your students and help meet the objectives of the following lessons. (Example: Global Schoolyard Bioblitz, with the purpose of tracking biodiversity in schoolyards.)

**Lesson 4A: Schoolyard Field Trip**

**Procedure**

*Engage the learner.*

Review with the class how they have been exploring how humans and other animals have different eyes that allow objects to be seen and help animals to get food, avoid predators, make shelters, and survive in their habitats. Explain that in the following lessons the class will be exploring a variety of plants and animals that they might find in their backyards or the schoolyard and the ability of the organisms to sense the world around them.

Introduce the lesson by reading the letter from the stinkbug to the reader in the book *On One Flower*. Show the video of the stink bug crawling on a plant as you read the letter.

Ask student volunteers to explain the letter from the stink bug in their own words. Ask them to describe the purpose of the letter to the reader and what the author means by “community of animals.” Ask students to describe the goldenrod flower and where it might grow.

Project the picture of a goldenrod plant. Divide the class into groups of four students and ask them to discuss what they think they might find on a single goldenrod plant. Encourage students to use the Activity Page in their Student Journals to write their brainstorming ideas.

1. *Brainstorm in your group the “zoo” that you might find on a single goldenrod flower.*
2. *Draw and label a model of your ideas of the “zoo” that you might find on a single goldenrod flower.*
3. *Include labels and descriptions of how different animals survive on the plant.*

When the initial models are complete, have the groups display them around the room. Encourage students to discuss one another’s models and explain why they think the different animals might be found on or around the goldenrod.

**TEACHING TIP**

Students may also have experiences with stink bugs in their yards, garages, and homes. Allow time for students to share their experiences with stink bugs they have encountered in and around their homes and yards. Make a note of their thoughts, as this may be a springboard for discussion/research on invasive species.

**DEVELOPING AND USING MODELS**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.
- Use a model to test interactions concerning the functioning of a natural system.

**CROSSCUTTING CONCEPT SYSTEMS AND SYSTEM MODELS**

- A system can be described in terms of its components and their interactions.
Divide the class into six reading groups, distribute copies of *On One Flower*, and have the students read the story. Facilitate the group reading by circulating among the students and listening to their reading and discussion.

To check for understanding in their reading and help students make connections to plant and animal senses and traits, ask:

- ______________, please reread the passage about the ________. What traits does it have that help it to survive? Do the author and illustrator give you any ideas of how it senses the world?
- Why do you think the ________ is attracted to the goldenrod plant? What makes you think that?
- How does the smell of the stinkbug help it to survive? What does that tell you about the predator, the spider?
- If you smell cookies baking in the oven, what are you anticipating?
- If you smell something bad in the refrigerator, what do you do?
- How is that like the behavior of the long-legged spider in the book?
- What sensory trait is the long-legged spider using to stay away from the stink bug? What makes you think that?
- What other animal can you think of that uses odor to ward off predators?
- What is the role of the brain?

Encourage the groups to read the Field Notes section at the end of the book.

Take this opportunity to have the students respond to the text from *On One Flower* in the Student Journal.

**Pre-Writing Strategy**

Model how to write a personal response to the text using a “think aloud.” Relate the experience of the two curious boys to a similar personal experience of discovering different animals that live on or near flowers in your garden. Begin your “think aloud” by telling the students, “This story of the two curious boys reminds me of a time when I was . . . .”

Invite three or four students to share similar experiences and ideas they have about the variety of animals that make plants and the flowers of plants their habitat. Write key words students use in their oral descriptions on the board or chart paper, such as names of insects and other animals, flower, stem, leaves, pollen, eating, buzzing, around, etc. Encourage students to refer to the
word list when writing their responses. Create a collaborative writing of responses to a shared reading experience. Using the “think aloud” helps students to know how to respond effectively to the text.

**Respond to Text**

*Write about a time when you were picking flowers, walking in the woods, on a nature walk, or playing in a park or yard when you discovered different an animal that makes its habitat on a plant.*

*Include a drawing of internal and external structures that help it to survive.*

Give sufficient time for students to share their writing with peers and respond to their questions and suggestions. Have students make adjustments to their writing based on feedback to improve and strengthen writing through revising and editing.

When groups complete the writing, have them use the book and their personal experience as references and revise their models of the goldenrod “zoo.” Allow time for students to explain their additions and revisions to their models.

**Science Talk**

Have students gather and sit in a circle. Ask them to display their models in the middle of the circle. Begin the Science Talk by asking students what common themes they see in the different models. Ask:

- What similarities did we recognize in the majority of our models?
- Do the rest of you agree? Why or why not?
- How can we learn more about how the visitors to and residents of a simple flower survive there?
- What internal structures (brain) help it to respond to its environment?
- Can someone recall the question the two boys in the book asked? “I wonder who lives here,” one boy did say. “What could we find on the sunshiny day?”
- Could the class conduct a field study similar to the one in the book in our schoolyard?
- What makes you think that? Why or why not?
- How might we find out?
- What questions do we have about the living things we could observe in the schoolyard?
- What animals from the book might live in our own schoolyard?

**WRITING**

**Text Types and Purposes**

**W.4.3:** Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

- Orient the reader by establishing a situation and introducing a narrator and/or characters; organize an event sequence that unfolds naturally.
- Use dialogue and description to develop experiences and events or show the responses of characters to situations.
- Use a variety of transitional words and phrases to manage the sequence of events.
- Use concrete words and phrases and sensory details to convey experiences and events precisely.
- Provide a conclusion that follows from the narrated experiences or events.

**Production and Distribution of Writing**

**W.4.4:** Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.

**W.4.5:** With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.
Develop a driving question board for students to use as their guide as they conduct a field study in their own schoolyard. Record all questions and keep them posted for the following lessons. Leave space for additional questions that are generated in following lessons.

Explain that in the following lessons, the class will be going out to collect living things for observation in a schoolyard habitat model. Display the schoolyard habitat and ask students to help in assembling the model habitat.

To prepare your classroom habitat layer the moistened soil on the bottom of the habitat to a depth of 6–8 centimeters. Spread grass seed across the soil. Add water to keep the soil evenly moist. Cover the habitat. A spray bottle is provided in your unit to keep the soil moist throughout the lessons.

Review the term habitat with the class. Check for understanding that an organism’s habitat is the place or area where it finds its needs to survive.

Have students complete the Journal Entry in their groups.

**Journal Entry**

1. Draw and label the schoolyard habitat model. Include plants and animals that could live there and how they might interact with one another.

2. Write what internal and external structures one animal has that help it to survive.

**Assessment**

Use the models, Respond to Text, Science Talk, and Journal Entry to assess students’ initial ideas of the internal and external traits that help a diverse population of animals live in the same habitat or area.
Lesson 4B: Schoolyard Exploration

Teacher Background Information
The following lessons are enhanced through the use of the Project Noah website. Project Noah is a nonprofit that connects citizen scientists (students and adults) and enables them to locate, share, and research their observations of different plants and animals from across the globe. Students use technology to collaborate with one another and with students around the country and the world. Students are able to compare their observations of plants and animals that live in their schoolyard to plants and animals that live in different climates. They become a contributing part of a global science community tracking nature around the world.

Advance Preparation
Make a quick survey of the schoolyard. Look for areas with trees, bushes, and gardens where students may find an abundance of plants and animals for the classroom habitat.

Safety:
- Survey the schoolyard for poison ivy and any other plants that may be irritating to students’ skin.
- Be aware of any students who have bee allergies and be sure to be prepared during the outing.
- Be aware of ticks and how to identify them if students find them or they get on students’ clothing or skin.

If you have not created your free teacher account on the website Project Noah, you will need to do it prior to this lesson. http://www.projectnoah.org/

Register your students under your account. Practice taking and uploading pictures to the site to become familiar with the options and use of the site. Browse the entries and projects on the site and become familiar with different projects that may interest your students and help meet the objectives of the following lessons. (Example: Global Schoolyard Bioblitz, with the purpose of tracking biodiversity in schoolyards.)

Make a class copy of the Classroom Habitat Observation Log. Develop a schedule for students to make regular observations of the habitat and record changes and activity in the habitat.

MATERIALS NEEDED
For each student:
- student pages

For each team of 2:
- 1 hand lens
- 1 metal spoon (for hand trowel)
- 1 clear observation container with lid, 16 oz.

For the class:
- classroom habitat
- 1 spray bottle
- baking soda
- handout: Classroom Habitat Observation Log

Class provides (from outdoor exploration):
- small animals (insects, slugs, worms, etc.)
- small rocks
- leaf litter
- small sticks
- 1–2 cups of soil from schoolyard

Teacher provides:
- water
- laptops or iPads or tablets (iPhones will also work)
- flour (optional)
- small piece of vegetable or fruit (see Advance Preparation)

LS1.A: STRUCTURE AND FUNCTION
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
**TEACHING TIP**
To help draw out some animals for students to observe, place a piece of corrugated cardboard over a grassy area and let it stay there overnight. Place a rock or brick on the cardboard to keep it from blowing away. In the morning check for slugs and other critters that have taken shelter there. You can also attract slugs by placing a small, shallow container of beer near or under the cardboard or soak a portion of the cardboard with beer. Since alcoholic beverages are not allowed on school grounds, attract the slugs at home in your own backyard and bring them to class for students to observe.

**TEACHING TIP**
Students may suggest that some of the organisms they find could be invasive species or an endangered species. The population of an organism may also give them information about the soil, climate, changing temperatures, and environmental conditions in the area.

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**Procedure**

*Explore the concept.*

Review the observations of the two boys in *On One Flower* from the previous lesson. Ask students to state the purpose of their outing and describe how the author provided pictures and information about the observations of animals on the goldenrod blossom. Listen for ideas that relate to how the author used a simple outing and turned it into a lesson on the diversity of organisms that live there. The boys in the story became naturalists, learning about how and where things live.

Discuss what it means to be a *naturalist* or a *citizen scientist*. Ask students what they think the terms mean. Explain that the class is going to begin a project that will collect data on the diverse organisms that live in the schoolyard. Ask students how keeping record of organisms in the schoolyard might be helpful to scientists and environmentalists.

Introduce the website Project Noah. Conduct a brief whole-class overview of the Project Noah website and allow time for students to ask questions. Divide the class into teams of students depending on the number of devices available. Allow time for the groups to explore the website on their own.

Tell the class that they are going to work in teams of two students and become naturalists or citizen scientists to plan an investigation into the variety of plants and animals that live in the schoolyard and find out how the organisms’ structures function to help them survive. Part of the investigation will include photographing plants and animals and collecting some plants and animals from the schoolyard to live in a classroom habitat so the students can make observations to learn more about them. Ask students to brainstorm other things that can be added to the habitat to make it more like the animals’ natural habitat. (rocks, sticks, dead leaves, etc.)

Display the classroom habitat. Ask students what they think plants and animals would require to grow and survive in their habitat. Ask students to describe where they might find growing plants, such as moss and ferns, that they might be able to transplant into their habitat. Ask students how plants find what they need to survive in their habitats and how that might differ from animals.

Discuss students’ ideas of what animals they think could survive in the habitat. Ask students to describe where they think the animals live in the wild and their experiences in capturing or collecting bugs. Make a list of animals the students think they will find in the schoolyard that they feel would be suitable for the classroom habitat.
Conduct a whole-class brainstorming session to establish what the class will need to do to maintain the habitat and keep the plants and animals alive. Ask the students what all plants and animals need to live. Make a list of the students’ ideas of the needs of plants and animals. Check for ideas that relate to food, air, water, and space or habitat. Revisit the list of animals the boys in the book discovered and generate a list of animals that students might find in the schoolyard. Ask students which animals on the list the class would be able to collect in the schoolyard and which would survive in the habitat. Post the class ideas near the location where the habitat will be kept.

Discuss the idea of how the class might be able to track nocturnal animals or animals that are active during the nighttime hours. Ask students for their ideas of animals that they know that are active at night. Listen for responses that include moths, raccoons, skunks, opossums, bats, owls, and deer. Students may suggest cameras and nighttime watches to observe the nighttime activity. Suggest that some naturalists find evidence of animals that move about at night by looking for tracks and scat (animal waste).

Show the class the baking soda and flour. Explain that the class could use the flour and/or baking soda to look for animal tracks by spreading the flour in an area and leaving it undisturbed overnight. In the morning students can check to see if any animals have walked through the flour, leaving evidence of their visit through the schoolyard.

Divide the class into their teams of two. Inform the students of the boundaries for the nature observations and animal collection and establish a time limit for their exploration. Distribute the electronic device, a hand lens, trowel (spoon), and collection cup to each team.

Demonstrate how to carefully use the iPad or iPhone to take pictures of different animals and plants. If the students would like to further study an animal they observed, demonstrate how to use the trowel (spoon) or your hands to gently remove an animal from under leaves and or just beneath the soil and place it in the observation cup. Tell the students that it may be helpful to the animal to scoop up some of the soil and leaf matter around the animal and put it in the observation cup.

Have the students review the Activity Pages in the Student Journal prior to going outdoors. Have them complete items 1 to 3 prior to going outdoors. Discuss the importance of recording observations during nature explorations. Give the teams sufficient time to plan and discuss their ideas for exploring, collecting, and recording observations of animals in the schoolyard.

TEACHING TIP
Limit the list of animals collected for the classroom habitat to 4–5 species. Students can add multiple animals from the same species. Ask students why some animals can survive in the habitat and other animals cannot.

Safety: Establish a list of animals that may sting or bite and cannot come into the classroom (ticks, bees, wasps, mosquitoes, etc.).

PLANNING AND CARRYING OUT INVESTIGATIONS
Planning and carrying out investigations in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

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

• Evaluate appropriate methods and/or tools for collecting data.

• Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
1. Write the question(s) the class is investigating in the schoolyard.
2. List the materials you will use.
3. Write what you think you will find.
4. Draw a picture of one animal you observed in the schoolyard in its surroundings. Include in your drawing some of the living and nonliving things that surrounded the animal.
5. Write what you think the animal needs to survive and what traits it has to help it meet its needs.

After the guidelines and boundaries have been set for the schoolyard field exploration, take the class outside. Model being a naturalist while outdoors with the students. Show them how to find, take pictures of, and capture animals and gently place them in the cup. Think aloud so the students can hear your thought process as you scoop the animal up and place it in the cup.

Encourage the students to explore as a team. Facilitate their exploration by visiting the teams. To check for student progress, ask:

- What have you observed so far? Have you taken any pictures of any plant or animal specimens? What interests you about that animal or plant? What information do you already know about your specimen? What questions do you have?
- What would that look like in your Student Journal?
- What animal have you decided to place in the classroom habitat?
- How does your animal interact with the other plants and animals in the schoolyard? Is it food for some other animal? Does it eat plants or animals?
- What role does your animal play in the schoolyard ecosystem?
- What do you think you will need to do to help your animal live in the habitat? Why do you think that?
- What did you observe in the surroundings of the animal?
- How would you describe the natural habitat of your animal? What do you mean when you say…?
- Tell me more about…

As you listen to the students’ ideas, record their comments and any questions the students generate based on their outdoor experience. If some teams are interested in spreading the flour or baking soda in an area, assist them in spreading it about a quarter inch deep over an area of their choosing. Suggest areas around bushes, trees, and shrubs where animals might travel to feed, hide, and stay undercover when moving about.
If your area is prone to raccoons, you may want to spread some flour and baking soda around the dumpster where the cafeteria dumps the lunch waste. Suggest that students take a “before” picture of the flour-dusted area and return the following morning to look for evidence of animal activity.

After students have completed their exploration, photographs, collection, and recording, return to the classroom.

Allow time for students to observe their animals closely in the observation cups. Ask them to look for details they were not able to see in the schoolyard. Encourage teams to use the hand lens and make observations of the physical characteristics of the animal. Have students record their detailed drawings in their Student Journals. Facilitate the team observations by circulating among the students, listening to their comments and observing the recording of details. To help students observe for detail and elaborate on their explanations, ask:

- What have you observed about your animal that you did not notice outdoors?
- How will observing and recording the details of the physical characteristics of your organism help you to learn more about the animal?
- What questions do you have about your animal? What have you observed that makes you ask that question?
- What do you notice about the animals’ outer covering? Legs? Eyes? Mouth?
- What sensory traits or internal structures do you think your animal has that help it to survive? What makes you think that?
- Tell me more about the role of the brain.
- How do you think these characteristics help the animal to survive?
- What do you think your animal will need to live in the classroom habitat? Why do you think that?

6. Make a detailed drawing of the animal you selected from the schoolyard. Include labels on the different internal and external parts of the animal that help it to survive.

After the students have completed their indoor observations of the animals, have each team gently place the animal into the habitat. If your class was overzealous in their collection of animals, decide as a class which animals to keep and observe. Remind students that the habitat is small and you do not want to have an “overcrowded” living situation for the animals. Return the extra animals to their habitat in the schoolyard.

TEACHING TIP
Most of the common animals that live in the schoolyard will find their food in the microorganisms in the soil, the plants growing in the habitat, and perhaps by eating one another. Encourage students to try placing tiny bits of fruits and vegetables in the habitat. (Caution: Do not overfeed or you will have another organism growing in your habitat: mold!)
Make a class list of all the animals living in the habitat and post it so it can be referred to as the students observe the animals in the following weeks. Discuss suggestions for providing food for the animals.

Discuss the science terms that you and the students have been using during their exploration. Write the terms habitat, internal structures, external structures, and requirements for life on the board. As a class, discuss and define the terms. After the class has reached a consensus as to the meaning of the terms, have them write them in the Key Terms section of the Student Journal.

Explain the concept and define the terms.

Science Talk
Ask student volunteers to share their entries on the Activity Pages. Ask them to share the details they observed after bringing the animal indoors. Ask students to describe the surroundings or habitat of the animal and how it interacts with the living and nonliving things in its environment. Look for references to the plants in the schoolyard habitat.

Share responses from your record keeping and questioning during the outdoor and indoor facilitations of student observations and thinking. Ask students to explain what they observed and what they were thinking to the rest of the class. To help students collectively make sense of the experience, ask:

- I heard _________ say __________ when observing the animal outdoors.
- Tell us more about what you observed and were thinking.
- What do you think about what ______ said? Did anyone else observe the same thing or something similar?
- Do the rest of you agree? Why or why not?
- Did anyone else make the same observation but can explain it differently?

To encourage students to generate questions from their observations, ask:

- What would happen if...? If not?
- What are some other possibilities?
- Can you predict what might have been different if ... (e.g., if we had collected animals during a different time of day? After a rain? On a colder day? On a warmer day?)

Ask the students what they think animals need to survive in their habitats, what nonliving things are in habitats, and to describe or name different kinds of habitats. Ask students for their ideas about how the animals will interact with each other and the plants and nonliving things in the habitat. Record their initial ideas about interaction of organisms in the habitat.
Pre-Writing Strategy: Science Talk
Have students return to their teams of two and join another team to form groups of four. Encourage the groups to talk about what they will draw and write in their Student Journals. Give the groups sufficient time to orally express what they are planning on drawing and writing and to listen to each other. Facilitate the group Science Talk by listening to their conversations. To help groups that are stuck or hesitant, ask:

• How would you describe the classroom habitat in your own words?
• What parts will you include in your drawing?
• What do you already know about some of the animals in the habitat? What more would you like to find out?
• How might you go about exploring or investigating more about the animals in the habitat?

Journal Entry
Have the students complete the Journal Entry.

7. Choose one animal that you photographed or chose for the classroom habitat__________________________.
8. Write a question you have about the animal. Explain how you might investigate your question.

Assessment
Use the Science Talk, Activity Page, and Journal Entry to assess the students’ ability to make observations and ask questions about the organisms they observed.

Use the Science Talk, Activity Page, and Journal Entry to assess the students’ understanding of what plants and animals need to survive and the traits that help plants and animals to meet their needs.

ASKING QUESTIONS AND DEFINING PROBLEMS
Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.

• Ask questions about what would happen if a variable is changed.
• Identify scientific (testable) and non-scientific (non-testable) questions.
• Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.

EXTENSION
Language Arts: Have students use the book On One Flower as a model and write a class book about the animals that live in and around the plants in the schoolyard.
Lesson 4C: Research and Data Entry

Teacher Background Information
To focus the lesson on the internal and external structures that help animals and plants to survive, the exploration teams will focus on one organism for their research.

Advance Preparation
Preview the following websites that will help students find out about the insects and other living organisms they discovered on the schoolyard.

https://bugguide.net/node/view/12267
https://www.insectidentification.org/insects-by-state.asp?thisState=Michigan

Collect resources on plants and animals that are common in your area. Check with your resource person or librarian for books on insects and plants.

Select students to make observations and entries in the Classroom Habitat Observation Log.

Prepare a Word Sort Card Set for each group (see Materials Needed).

Procedure
Elaborate on the concept.
As a class, review the Activity Page and review the criteria for research on one of the plants or animals they photographed in the schoolyard.

Group name ________________
Common name ________________
Scientific name ________________

Description and drawing (include labels of observable traits)

Habitat:
Structures for survival:
Behaviors for survival:
Other interesting facts:

Ask the students to rejoin their schoolyard exploration groups and choose one of the plants or animals that they photographed for their research. Help students with the resources they will need to find out more information about their plant or animal from the schoolyard.

Materials Needed
For each student:
student pages
For each team:
Internet access
computer or iPad
Word Sort Card Set (naturalist, citizen scientist, plants, animals, invasive species, populations, environment, structures, function, survival)
For the class:
Internet access
Teacher provides:
electronic devices
Internet access

Teaching Tip
Students with special needs may require support in the writing and reporting of their findings. Have students work in pairs to share creation of writing and illustrations to support students who struggle to finish long-term projects.

Use computers to support writing and for recording their ideas.

Some students may have difficulty reading the information in the research material. Provide research material at a wide range of reading levels. You may want to pair these students with students who are capable or advanced readers.
Allow sufficient time for students to conduct their research and complete the information on the Activity Page. Facilitate the research activity by circulating among the groups and observing their progress. Encourage students to develop a system for taking notes and jotting down important and interesting information as they sift through the research material. To help students organize and sift through information, ask:

- Can someone explain the purpose of the research? What information are you looking for?
- Can someone explain what we are looking for when we say “structures for survival”? “Behaviors for survival”?
- Can someone explain how you decided to organize your findings from your research?
- Would it be helpful to divide your findings into categories?
- The Student Journal page asks for a description of the structures for behavior of your research organism. Could that be your first category? What other categories can you think of?
- Have you considered what structures or traits help the animal to get food? Water? Provide protection?

After the students have completed their research, have them share with another group what they plan to enter on Project Noah. After sharing, have them post their entries on the site.

Evaluate the students’ understanding of the concept.

Science Talk
Have the students gather in a circle to share their entries and discuss the idea of having their work go live on Project Noah for others to see. Ask a group to share their entry and tell how the information might help scientists and other naturalists to understand the diversity of organisms found in your schoolyard. Allow sufficient time for all groups to present their findings. Listen for patterns that may occur in their reporting of traits that help their organisms to survive, behaviors, and interesting facts.

Remind the class that in previous lessons students explored how animals’ eyes and sense of sight help them to survive. Open the discussion by asking students to apply what they know about animal senses to their research organisms. Begin the discussion by referencing an item in a group report.

- ____________, I noticed that in your research you found out that the __________ uses its __________ to __________. How is that similar to what we learned about animal eyes?
- ____________, I noticed that your research animal has antennae. How do the antennae function to help the animal to survive?
• Did anyone else find a similar trait? How can the sense of touch help an animal to survive? What do you think happens after the antennae touch something? What makes you think that?

• We know that when light shines on our retina a signal is sent to the brain to help us react. Do you think a similar mechanism might be in place for our other senses?

Complete the sharing by allowing groups to log in to the Project Noah website and view one another’s entries and post comments. Students may also find comments by others outside of their classmates. Plan for students to check the site for new entries and comments on their entries.

Pre-Writing Strategy
Have students collaborate to complete the Journal Entry. Ask students to join their research team and discuss the prompts. Encourage students to express their own ideas and listen to the ideas of others. Distribute the Word Sort Card Set to help students with language and organizing their responses.

Journal Entry
1. Describe what it means to you to be a citizen scientist. Explain how your research and data on the location of your research organism can help other scientists.

2. You have conducted research on an animal that finds its habitat in the schoolyard. Draw and label your animal. Write a caption that explains how the different structures of the animal function to help it survive in the schoolyard.

Extension
Assign as homework an evening exploration into the habitats in students’ own backyards. Have students make careful observations of animals that are more active in the evening or at night. They may observe an increase in the activity of moths, mosquitoes, and earthworms and a decrease in activity in bees, wasps, pill bugs, and millipedes.

Encourage students to continue to use the Project Noah website in their animal and plant explorations beyond the classroom.

READING
Key Ideas and Details
RI.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

Craft and Structure
RI.4.4: Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.

Integration of Knowledge and Ideas
RI.4.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

WRITING
Research to Build and Present Knowledge
W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
Activity 5: Animal Defenses

Teacher Background Information
The final lessons in the unit include a focus on the different structures animals have that help them to defend against predators. The intent of the following lessons is to build awareness of how external and internal structures of animals work within a system to help in defense against predators.

The phenomenon of the blue-tailed skink and its ability to shed its bright blue tail to confuse and escape predators is introduced to raise questions about the function of the blue tail and other structures of the skink.

The blue-tailed skink is a small, shiny-scaled lizard with a bright blue tail. It makes its habitat among the rocks and stones, fallen leaves, sticks, and logs in the western and eastern United States. Its habitat includes rocky areas near streams, grasslands, woodlands, forest clearings, and hillsides.

Blue-tailed skinks are active during the day but are rarely seen. They move about under leaves, between rocks, and around logs. They hunt for beetles, spiders, crickets, and sow bugs.

The body of the lizard is covered in smooth, shiny, rounded scales. Its back is brown, black, and golden yellow or cream, making it well camouflaged in its habitat. The younger blue-tailed skinks have the bright blue tail. The brightly colored tail draws attention away from the body of the lizard and toward the tail. Predators, such as hawks, are attracted to the tail. When a predator grabs onto the tail, the tail detaches and the lizard is able to run away. The blue-tailed skink will grow a new tail in a short period of time!

By the time the blue-tailed skink is an adult lizard, the bright blue tail has faded, although it continues to be able to detach its tail if necessary. The skink grows to be about nineteen centimeters in length from nose to tail.

Elaborate on the Concept
This stage of learning provides students with the opportunity to apply what they have learned about the function of internal and external structures to different defense systems animals have in place to protect themselves.

Advance Preparation
Assign a team of students to make and record on-going observations in the Classroom Habitat Observation Log.

Arrange for each research team or group to have a computer and Internet access.

ESTIMATED TIME
Lesson 5A: 45–50 minutes, 2 days
Lesson 5B: 45–50 minutes, 2 days
Lesson 5C: 45–50 minutes, 2 days

OBJECTIVE
Obtain information to find out how animal structures function to defend animals from predators.

KEY QUESTION
How do different structures function to help animals defend themselves?

MATERIALS NEEDED
For each student:
- student pages
For each group of four:
- Blue-Tailed Skink Card Set (1 card per group)
- computer or laptop
For the class:
- Blue-Tailed Skink Card Set
Teacher provides:
- colored pencils
- Internet access
- computers or laptops

LS1.A: STRUCTURE AND FUNCTION
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
Lesson 5A

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

Preview a video that shows the blue-tailed skink. Select a video for your class that does not give information but instead may evoke questions about the function of the blue tail.

https://www.youtube.com/watch?v=CwFKvoWP2Pc
https://www.youtube.com/watch?v=ziV3Z3BTHFE
https://www.youtube.com/watch?v=2_X5o8kJoUc
https://www.youtube.com/watch?v=BR-GR_dsABQ

Make a Questions We Have About the Blue-Tailed Skink chart or board to record students’ questions about the role the blue tail of the skink.

Websites for students about the blue-tailed skink:
http://www.animalspot.net/blue-tailed-skink.html
http://www.burkemuseum.org/blog/western-skink
http://www.bcreptiles.ca/lizards/westskink.htm

Content? oid=2131194

Video of just the blue-tailed skink tail moving:
https://www.youtube.com/watch?v=caULCslEsdQ

Lesson 5A: Blue-Tailed Skinks Lose Their Blue Tails!

Procedure

Engage the learner.

Review with the class the animal structures and their functions that they have been exploring in the unit. Review the structure and function of the eye, how some animals have eyeshine, and the structures of the research and schoolyard animals that help them to survive. Revisit the rabbit and mountain lion role-play and how students used their eyesight and sense of hearing to escape prey and catch food.

Explain that you would like to introduce an animal that you think has an interesting structure and behavior that helps it to survive.

Show a video of the blue-tailed skink. At the conclusion of the video, divide the class into groups of four and distribute colored pencils to each group. Have them discuss the external structures they observed in the video. Have students sketch a model of the skink in their Student Journals and label the structures, including how the structures function to help the animal defend itself.

1. Draw a model of the blue-tailed skink. Label the structures of the skink and how they help the skink to survive.
2. **Write what internal structures also play a role in the survival of the skink.**

Encourage students to draw and write their initial ideas individually and then come together as a group to share, discuss, and revise their ideas and try to reach a consensus. Remind the groups that these are our initial ideas and that there are no right or wrong answers at this time. Facilitate the group discussions by circulating among the groups and listening to their ideas about the structures and functions of the skink. To help students rely on what they know about structure and function, ask:

- How can you use what you know about animal eyes, the function of the structures in your research animal, and predators and prey that might help you respond to the Student Journal prompts?
- What do you mean when you say...?
- What structures of the skink can you observe?
- What structures of the skink are internal and not observable?
- I see that you labeled the legs of the skink as a structure that functions to help the animal run fast, away from predators. How do the legs know that it is time to run?
- How does the skink sense that there is a predator in the area?
- How can you represent that in your model?
- Tell me your ideas about why the skink has a blue tail. What makes you think that?
- How might the tail give the skink an advantage in survival?

After groups have reached a consensus for their model, have them draw their ideas on chart paper to display and share during Science Talk.

**Science Talk**

After groups have completed their models, allow sufficient time for sharing and raising questions about the skink. Have the students form a circle to share their models and discuss their ideas about the structures that help in the survival of the skink. Have the groups display their models and have students do a gallery walk.

Invite students to comment on one another’s ideas. As a group, discuss patterns in the models and commonalities and any unique ideas. Discuss the different ideas about the purpose of the bright blue tail. Ask:

- Does everyone agree on why the tail is such a bright blue?
- How might that help the skink to survive?
- What makes you think that?

**TEACHING TIP**

Many students may use what they know about other animals, such as brightly colored birds, and consider the bright blue tail as a way to attract a mate. Do not correct their thinking at this time.

**DEVELOPING AND USING MODELS**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.
- Use a model to test interactions concerning the functioning of a natural system.

**CROSSCUTTING CONCEPT SYSTEMS AND SYSTEM MODELS**

- A system can be described in terms of its components and their interactions.

**CROSSCUTTING CONCEPT SYSTEMS AND SYSTEM MODELS**

- A system can be described in terms of its components and their interactions.
**TEACHING TIP**

Students have engaged in online research in the previous lessons and may benefit from incorporating the same skills to answer their new research question. Have students work in different groups to collaborate on how to go about finding the answer to the class question.

**ASKING QUESTIONS AND DEFINING PROBLEMS**

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

- Ask questions about what would happen if a variable is changed.
- Identify scientific (testable) and non-scientific (non-testable) questions.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.

**WRITING**

**Research to Build and Present Knowledge**

W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

W.4.8: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Point out that the class needs further information to find out how the blue tail of the skink and its other characteristics help in its survival. Display the question board that will help drive the students’ exploration into the blue-tailed skink. Ask the class what they need to know to understand the purpose of the bright blue color of the tail. Make a list of student questions and help students turn their wonderings into questions they could research. Examples:

- How does the blue tail of the skink help it to survive?
- What is the purpose of the blue tail on the skink?
- Where does the skink live?
- What predators threaten the survival of the skink?
- What does it eat?
- Do they form groups or are they alone?

Ask students how they can find out more information about the blue-tailed skink and the function of the blue tail. List their ideas for research.

**Explore the concept.**

Divide the class into pairs or research groups. Allow sufficient time for students to select an Internet resource and obtain information about the function of the blue tail. Encourage students to write down other interesting characteristics of the blue-tailed skink. Review the Student Journal page for recording their findings.

*Your class is conducting research to find out the function of the blue tail on the skink. In your research you may find other interesting facts about the skink. Write your research questions and findings below. Be sure to list your references (Internet sites) that you used to learn about the blue-tailed skink.*

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<tr>
<th>Questions:</th>
<th>Findings:</th>
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*List the resources you used to find your information.*

Facilitate the groups’ research by circulating among the students and observing how they organize their search and information that they are recording. To assist groups that are stuck or have gone astray, ask:

- How would you describe the questions we are trying to answer in our research?
• Can you explain what you have done/found so far? How does that relate to the research question?
• What resources are you going to use?
• How might you organize your research? What information will you look for first?
• Would it help to write the questions in the Student Journal and then search for information that will help answer the questions?

Allow sufficient time for students to complete their research.

**Assessment: Formative**

Use the group models, Science Talk, and Activity Page to assess students’ understanding of the function of animal structures for their survival.

Use the Science Talk and Activity Page to assess the students’ ability to raise questions and obtain information from resources.

**OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION**

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

• Read and comprehend grade-level appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.
• Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other science and/or engineering practices.
• Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
• Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.
Lesson 5B: Sharing Our Research Findings on the Blue-Tailed Skink

Teacher Background Information
This lesson provides the opportunity for students to share their research findings and relate what they have learned about how animals use the senses and internal structures that help them to survive. In the initial lessons of the units, students were engaged in exploring how reflected light enters the eye and strikes the retina. The retina sends a message to the brain, and the brain tells us what we see. The main concept for students to understand is that external and internal structures are working together to help animals sense their surroundings. As the students obtain information about the function of the blue tail of the skink, can they make connections to internal structures that are necessary to sense the danger and detach the tail? When the skink sees, smells, and/or hears a predator, a message is sent to the brain and the brain signals for the tail to detach.

Advance Preparation
If students have not completed their research, you will need additional time on computers and Internet access.

Prepare a Word Sort Card Set for each group of four students (see Materials Needed).

Assign a team of students to make and record observations in the Classroom Habitat Observation Log.

Procedure
Explain the concept and define the terms.

Science Talk
Ask the class to gather in a circle for a sharing of their research findings. Have them bring their Student Journals to the circle to use as a reference. Review the anchor charts from Lesson 2B and how to respond to one another’s ideas.

Ask a group to volunteer to start the discussion and choose one of the questions they researched. Encourage students to respond to one another’s findings and add to or question the information. As the students share their information, make a consensus chart that records their conclusions based on one another’s research.

After all groups have shared their information, focus the Science Talk on their findings and consensus about the function of the bright blue tail. Ask a student to recap the function of the tail for the group. Ask if everyone agrees or if someone would like to add any information. Once the class has reached a consensus that the special blue tail of the skink is a defense mechanism and detaches when the skink is in danger, show a video (see examples in Lesson 5A) and ask students if their explanation makes sense.

MATERIALS NEEDED
For each student:
student page

For each group of four:
Blue-Tailed Skink Card Set (1 card per group)
computer or laptop
Word Sort Card Set (skink, tail, senses, message, brain, reacts, predator, defense)

Teacher provides:
Internet access
computer or laptop
chart paper
markers
sticky notes

LS1.A: STRUCTURE AND FUNCTION
• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Research Consensus Chart

<table>
<thead>
<tr>
<th>Group</th>
<th>What We Found Out</th>
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Show the video of the detached tail as it continues to wiggle. Allow for a lively discussion about how the blue tail of the skink is a defense mechanism against predators.

Ask the class to think about the parts of the skink that are responsible for making the tail detach. How does the skink know when to detach its tail? Something must be happening that we cannot see that signals the tail to let go. Review the internal and external structures that allow us to see objects. Ask students to review what they learned about what is going on inside our bodies that tells us what we are seeing. Ask students to use that information to describe what senses and internal structures are necessary for the tail to detach. Write the following question on the board or chart paper:

*What internal and external structures function to detach the blue tail when there is danger in the area?*

Divide the class into their research groups and ask them to brainstorm ideas. Allow time for students to develop a new model of the blue-tailed skink. Encourage them to use their initial model from Lesson 5A as a reference and make adjustments based on their new information. Facilitate the brainstorming session by circulating among the groups and listening to their exchange of ideas. To help students rely on their understandings and reason scientifically, ask:

- Would it be helpful to start with how the skink senses that there is a predator near? What are some possibilities? Would it be just one of its senses or might it be multiple senses?
- What makes you think that?
- What do you think happens after the skink senses (sees, hears, smells, or feels) the presence of a predator?
- How will you represent that in your model?
- What do you mean when you say...?
- Can you draw a model to show that?
- Tell me more about what happens after the skink sees the predator.

Allow time for students to redraw and redevelop their models of the structures of the skink with a focus on the detaching blue tail. When groups have completed their models, have them display the models around the room. Ask students to do a gallery walk and review each other’s models. Encourage students to use sticky notes to post comments and questions on the posters. Allow time for groups to read and discuss the comments posted by their classmates.
Write the term defense on the board. As a class, develop a consensus definition of the term as related to the survival of animals and plants. When the students are satisfied with their definition, have them write the definition in the Key Terms of the Student Journal.

Read the Journal Entry as a class.

**Pre-Writing Strategy: Word Sort Card Set**

Divide the class into groups of four. Encourage the students to orally discuss what they are going to draw and write and listen to the ideas of others. Distribute the Word Sort Card Set for students to discuss the terms and use them in their writing.

**Journal Entry**

The blue-tailed skink has a specialized defense system. It can wiggle its bright blue tail to attract the attention of a predator away from its body. Then, when the predator is close, it can detach its tail and run away, unharmed. The tail remains behind, wiggling, keeping the predator from chasing the skink.

1. Draw and label a model that explains how the skink receives information, processes the information, and reacts by detaching its tail.
2. Write a caption or explanation for your model.

**Assessment**

Use the final models and Journal Entry to assess the students’ understanding that animals have different senses and sense receptors that send messages that are processed by the brain so the animal can respond.

**DEVELOPING AND USING MODELS**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.
- Use a model to test interactions concerning the functioning of a natural system.
Lesson 5C: Animal Defenses

Advance Preparation
Make a class How Animals Protect Themselves chart to display and record student ideas. Sample:

<table>
<thead>
<tr>
<th>Animal</th>
<th>Defense Mechanism</th>
<th>Defense Category</th>
<th>Role of Memory</th>
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Preview the book *Animal Defenses* to determine reading groups and to select sections based on reading abilities in each group.

Assign a team of students to make and record observations in the *Classroom Habitat Observation Log*. This is the final lesson in the unit. Plan for time to review the Classroom Habitat Observation Log and look for patterns in observations to construct explanations in how the organisms survived well or did not survive well.

Procedure
*Elaborate on the concept.*
Review the unique characteristic of the detaching blue tail of the skink. Discuss the lesson the predator learned from trying to catch the skink and being fooled by the blue tail. Ask students if they think that the predator will remember the blue tail and not go after the skink again. Has the predator learned a lesson? Discuss their ideas about animal memory and how it may play a role in survival.

Ask students for their ideas of other ways that animals defend themselves. Display the class chart and ask students to name a familiar animal and some of the ways it defends itself.

After the class has added a few familiar animals to the chart, introduce the book *Animal Defenses*. Read the introduction to the class and discuss how the author begins to categorize the different ways that animals defend themselves. Turn to the table of contents and discuss the titles for each chapter. Ask students in which chapter they might find the blue-tailed skink or any of the animals in the classroom habitat. Ask students what they think the author means by “Let’s stick together.”

Divide the class into six reading groups and assign a chapter to each group. There are eight chapters. Assign two chapters to two of the groups. Distribute a copy of the book to each group.

**LS1.A: STRUCTURE AND FUNCTION**
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
Allow time for the groups to read their assignment and respond to the prompt in the Student Journal.

Your group has been assigned a chapter in the book Animal Defenses to read and report to the rest of the class. After reading, discuss the chapter and complete the chart.

<table>
<thead>
<tr>
<th>Name of chapter(s) read:</th>
<th>Main Idea: (description of the category for all animals described in the chapter)</th>
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<th>Supporting details (examples)</th>
<th>Supporting details (examples)</th>
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<table>
<thead>
<tr>
<th>Does the blue-tailed skink fit into this category of defense? Why or why not?</th>
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<table>
<thead>
<tr>
<th>What sense receptors and internal structures work to help the animals respond to danger?</th>
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<table>
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<tr>
<th>Do you think a predator would remember the defenses you read about? Why or why not?</th>
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<th>What animal in your reading do you think had the most interesting defense? Explain why.</th>
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After all groups have completed their reading and Student Journal entry, have them present their findings to the rest of the class. Ask groups to present in the order that the chapters are presented in the book. Have groups select one member’s Student Journal entry to project for the class to see during the presentation. At the end of their presentations, all students should have an idea of the animals and their defense systems from each category.

Return to the How Animals Protect Themselves chart and make additions and corrections to the chart based on students’ findings in the reading. Discuss how some defense responses may stay in the predators’ memories. Ask students which defense mechanisms might be most memorable. Review the “Copycat” defense category. Discuss how predators that experience the
defense of some animals remember the unpleasant experience and do not attack that prey again. (Revisit the defense of the porcupine, skunk, and poison-arrow frog.)

Relate the information in the book to the students’ observations of the animals in the schoolyard and the animals they chose for the classroom habitat. Ask students if they think the animals in the habitat have senses that help them to defend themselves, get food, and seek shelter. If your students observed pill bugs in the schoolyard, ask how the pill bug reacts similarly to the armadillo in the book.

Evaluate the students’ understanding of the concept.
Divide the class into teams of two students and have them choose one animal from the schoolyard habitat, classroom habitat, or reading and develop a model to explain how the animal receives information through its senses, processes the information, and reacts. Have students include how the memory of the predator and prey may also play a key role in their ability to survive.

Encourage students to use their observations in the Classroom Observation Log as a reference for their models. Review the entries in the log and look for patterns that will help students to construct explanations. Check for an understanding of the role of the organisms senses.

Allow time for students to display, share, and critique their models.

Journal Entry
1. Choose one animal from the schoolyard habitat, classroom habitat, or reading and develop a model to explain how the animal receives information through its senses and reacts to a predator or prey in the area.

2. Write if the animal might use its memory to react if the predator or prey returned to the area at another time.

Assessment
Use the Activity Page to assess the students’ ability to obtain information from text.

Use the Activity Page and schoolyard animal models to assess the students’ understanding that different sense receptors send information to the brain so the animal can respond.
KEY TERMS

absorbed light Absorbed light is light that is taken in and not reflected off a surface or material. Light that is absorbed transfers to heat energy and warms the surface or material.

adaptation Adaptation is any physical or behavioral change in a species of organisms that helps the organism to survive in its habitat.

citizen scientist A citizen scientist is a person who is interested in learning about and helping to protect wildlife and the environment.

constrict Constrict is to make narrower or smaller by drawing together.

data Data is information about something that can be used to find out about different ideas.

defense Defense is the act of protecting from harm or danger.

dilate Dilate is to make or grow larger or wider.

ecosystem An ecosystem is all the living and nonliving things that make up an environment and affect one another.

external structures External structures are parts of the body that are visible, such as limbs, heads, thorax, eyes, nose, and mouth.

environment The environment is the surroundings and conditions in which plants and animals live.

evidence Evidence is what is observed, read, or discovered that supports an idea or fact.

habitat A habitat is where plants and animals live and find what they need to grow and survive.

internal structures Internal structures are parts of the body that are not visible, such as the brain, heart, stomach, and other organs.

light source A light source is any object that produces light.

naturalist A naturalist is a scientist or person that studies the environment, plants, and animals and works to protect wildlife and the environment.

observation An observation is what is noticed when something is looked at closely.

predator A predator is an animal the eats other animals.

prey Prey are animals that are hunted and eaten by other animals.
populations  Populations in an ecosystem are the numbers of each species or kind of plant or animal that lives there.

pupil  The pupil is the opening in the eye through which light enters the eye.

react  To react is to respond to a stimulus or happening.

reflected light  Reflected light is light that bounces off objects or materials.

requirements for life  All living things have requirements for life that include air, water, food, and shelter or space.

species  A species is a group of plants or animals of the same kind.

survive  To survive is to continue to live.

traits  Traits are the physical and behavioral characteristics of a plant or animal. Traits help a plant or animal to survive in its environment.
## A Model for Guided Reading and the Science Content

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria and Strategies</th>
<th>Curriculum Connection</th>
</tr>
</thead>
</table>
| Select Children’s Science Literature   | **Set your literacy and science goals:**  
  - What reading strategies do you want to accomplish?  
  - What writing strategies should accompany the unit?  
  - What oral and presentation strategies do you want to accompany the unit?  
  - What science content do you want to address?  
  - What science process skills can you incorporate?  
  - Are there any other curricular areas that can also be accomplished in the unit?  
  **Select books with the following:**  
  - Scientific accuracy.  
  - Readability for the strategies chosen.  
  - Illustrations that connect to the text.  
  - High interest that makes a connection to the Real World in the here and now.  
  - Content that will lead to questions, observations, and/or investigations.                                                                                                                                                                                                                   | Common Core State Standards  
  Reading Standards for Informational Text:  
  - Key Ideas and Details  
  - Craft and Structure  
  - Integration of Knowledge and Ideas  
  - Range of Reading and Level of Text Complexity  
  Science Content:  
  - Physical Science  
  - Life Science  
  - Earth Science  
  Science Processes:  
  - Science and Engineering Practices  
  - Disciplinary Core Ideas  
  - Crosscutting Concepts                                                                                                                                                                                                                                                                                                                                  |
| Classroom Management/Advance Preparation | **Evaluate groupings of students.**  
  **Familiarize yourself with the text and related science activities.**  
  **Mark passages that may be problematic.**  
  **Create board or chart paper space for mapping ideas.**  
  **Prepare introductory questions.**                                                                                                                                                                                                                                                                                                                      | Common Core State Standards  
  Reading Standards for Informational Text:  
  - Key Ideas and Details  
  - Craft and Structure  
  - Integration of Knowledge and Ideas  
  - Range of Reading and Level of Text Complexity                                                                                                                                                                                                                                                                                                           |
| Before Reading                         | **Introduce the book.**  
  **Read and discuss the title and cover.**  
  **Do a “walk” through the book.**  
  **Activate background knowledge.**  
  **Record students’ initial thinking on chart or concept map.**  
  **Conduct activities/discussions that create interest.**  
  **Invite students to make predictions.**  
  **Stimulate questions; record initial questions.**                                                                                                                                                                                                                                                                                                      | Common Core State Standards  
  Reading Standards for Informational Text:  
  - Key Ideas and Details  
  - Craft and Structure  
  - Integration of Knowledge and Ideas  
  - Range of Reading and Level of Text Complexity                                                                                                                                                                                                                                                                                                           |
## A Model for Guided Reading and the Science Content

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<tr>
<th>Component</th>
<th>Criteria and Strategies</th>
<th>Curriculum Connection</th>
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</thead>
<tbody>
<tr>
<td>During Reading</td>
<td>- Have students read independently or in shared reading groups at their own pace.</td>
<td>Common Core State Standards</td>
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<td></td>
<td>- Assist students with problem solving.</td>
<td>Reading Standards for Informational Text</td>
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<td></td>
<td>- Provide reinforcement and encouragement when appropriate.</td>
<td>• Key Ideas and Details</td>
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<td></td>
<td>- Prompt as necessary.</td>
<td>• Craft and Structure</td>
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<td></td>
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<td>• Integration of Knowledge and Ideas</td>
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<td>• Range of Reading and Level of Text Complexity</td>
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<tr>
<td>After Reading</td>
<td>- Conduct group reading conferences.</td>
<td>Common Core State Standards</td>
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<td></td>
<td>- Draw relationships between background knowledge and content from text in the book.</td>
<td>Reading Standards for Informational Text</td>
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<td></td>
<td>- Ask for evidence from the reading for “new” knowledge.</td>
<td>• Key Ideas and Details</td>
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<td></td>
<td>- Encourage rereadings.</td>
<td>• Craft and Structure</td>
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<td>- Pose open-ended questions.</td>
<td>• Integration of Knowledge and Ideas</td>
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<td>- Assess individual progress.</td>
<td>• Range of Reading and Level of Text Complexity</td>
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<td></td>
<td>- Record science questions generated from the readings.</td>
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<td></td>
<td>- Relate “new” knowledge to previous science activities.</td>
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<tr>
<td>Science Activities</td>
<td>- Provide activities for responding to text.</td>
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<tr>
<td></td>
<td>- Design classroom investigations based on student-generated questions.</td>
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<td></td>
<td>- Set up stations for exploration relating to text and student questions.</td>
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<td>- Relate “new” knowledge from activities to “new” knowledge from reading.</td>
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<tr>
<td>Writing in Science</td>
<td>- Use the Activity Pages and Journal Entry in the Student Journal that accompany the</td>
<td>Common Core State Standards</td>
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<tr>
<td></td>
<td>activities to accomplish the following purposes for writing:</td>
<td>Writing Standards:</td>
</tr>
<tr>
<td></td>
<td>- descriptive writing</td>
<td>• Text Types and Purposes</td>
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<td></td>
<td>- stories</td>
<td>• Production and Distribution of Writing</td>
</tr>
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<td></td>
<td>- letters</td>
<td>• Research to Build and Present Knowledge</td>
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<td>- explanations of processes</td>
<td>• Range of Writing</td>
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<td>- persuasive essays</td>
<td>Language Standards:</td>
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<td></td>
<td>- lab reports</td>
<td>• Conventions of Standard English</td>
</tr>
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<td></td>
<td>- introductions</td>
<td>• Vocabulary Acquisition and Use</td>
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<td></td>
<td>- conclusions</td>
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The 5-Step Learning Cycle (Constructivist Learning)

EVALUATE

ENGAGE

ELABORATE

EXPLORE

EXPLAIN
Learning Cycle Approach

Step 1: Engage the learner.
Activities are introduced that engage students with a problem or phenomenon. Such activities capture students’ interest and enable them to make connections with what they know and can do.

Step 2: Explore the concept.
Next, students participate in hands-on experiences through which they further explore the concept. They receive little explanation or terminology at this point because they are to define the problem or phenomenon in their own words. At this stage in the learning process, students are meant to acquire a common set of experiences so that they can help one another make sense of the concept. Students spend considerable time talking about their experiences, both to articulate their own understanding and to understand one another’s points of view.

Step 3: Explain the concept and define the terms.
Only after students have explored the concept independently are scientific explanations and terms for what they are studying introduced. Students then use the terms to describe what they have experienced and begin to examine how the explanation fits with what they already know.

Step 4: Elaborate on the concept.
Students are given opportunities to apply the concept in new situations, or they are introduced to related ideas that they explore and explain using the information and experiences they have accumulated so far. Interaction between students is essential during the elaboration stage. By discussing their ideas with each other, students gain a deeper understanding of the concept.

Step 5: Evaluate students’ understanding of the concept.
In this stage, students continue to elaborate on their understanding and evaluate what they now know and what they have yet to figure out. Although the key word at this stage is evaluate, this does not indicate finality. Indeed, students will continue to construct their understanding of each broad concept throughout their lives.

From: Science for Life and Living and Inquiry and Learning
The Engineering Design Process provides students with a series of steps to guide them as they solve problems and design and test products, models, and solutions. The process is cyclical, yet steps can be repeated or students can move backward throughout the designing and building portion of the project. Students are encouraged to evaluate as they progress through the process, revisit the mission often, and revise thinking and their plan multiple times as the process unfolds.

Engineers do not always follow the Engineering Design Process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change the design. Engineers must always keep in mind the mission or problem they are trying to solve and the limitations (cost, time, materials, etc.) that are part of the solution to the problem. Two key elements in working as an engineer are teamwork and design-test-and-redesign.

**Mission**
- Defines the problem and what the engineers are trying to design or build.
- Describes the limitations within which the engineers must solve the problem.

**Brainstorm Ideas**
- Imagine, discuss, and sketch possible solutions.
- Conduct research into what has already been done.
- Discover what materials are available, time frame, and other limitations.

**Plan and Design**
- Draw and write a plan.
- Design your solution through drawing and manipulating materials.
- Develop a plan or steps and a schedule.

**Build**
- Construct your engineering device or project.
- Follow your plan.
- Adjust and test along the way.

**Test and Adjust**
- Test your device to see if it solves the problem within the mission and limitations.
- Make your project better based on tests. Test → Revise → Test.
- Improve based on feedback of others.

**Present Your Solution**
- Demonstrate how your solution solves the problem.
- Define problems and limitations.
- Describe the challenges and limitations in solving the problem.
- Describe additional revisions that could improve the device or project.
What is the problem you are trying to solve?

**THE MISSION**

**PLAN & DESIGN**
- Draw a plan
- Design your solution through drawing and manipulating materials
- Develop steps and schedule
- Define problems and limitations

**BRAINSTORM IDEAS**
- Research what has been done
- Research what materials are available
- Imagine, discuss, and sketch possible ideas

**BUILD**
- Construct your engineering device
- Follow your plan
decide
- Imagine, discuss, and sketch possible ideas

**TEST & ADJUST**
- Test your device to see if it solves the problem
- Make your project better based on feedback of others
- Improve based on feedback of others

**PRESENT YOUR SOLUTION**
- Describe the challenges and limitations in solving the problem
- Define problems and limitations

**APPENDIX**

ENGINEERING DESIGN PROCESS

Adapted from the Carnegie Mellon Robotics Academy
Cereal City Science
By Battle Creek Area Mathematics and Science Center

by Battle Creek Area Mathematics and Science Center
SCIENCE TALK

Science Talk is a carefully crafted discussion between students that is an essential part of making meaning and processing discoveries and information. Students who are actively engaged in Science Talk put forth their ideas in a clear, concise form in a nonthreatening environment. Conflicting and complementary ideas are presented, discussed, and debated using evidence. Students are also active, respectful listeners and value the ideas of their classmates. Students consider and evaluate their own and others’ competing ideas. They are intellectually engaged in making sense of their observations and data, and in forming ideas.

Science Talk is not an add-on to science investigations. It addresses important science content and is a critical part of the lesson and learning. Science Talk can be whole group, small group, and teams of two students. Through discussion with one another, students explore their ideas, make comparisons to the ideas of others, use evidence, and develop the skills to critique and prepare academic arguments.

Setting up your class for Science Talk:

• Provide an environment where everyone can see one another. It is important that students be able to make eye contact and see/use gestures when listening and explaining. Students may also draw simple diagrams to make their ideas more clear.
• The discussion is focused on the topic and not allowed to stray.
• Students are motivated to participate. The conversation is not just for the talkers in the class; everyone has a right and responsibility to contribute.
• The teacher has the role of facilitator and record keeper of the students’ ideas. When students participate in Science Talk, they address one another; it is not a back-and-forth discussion between student → teacher → student → teacher.
• Lay the foundation for Science Talk by establishing a clear set of norms and boundaries for the discussion. Your Science Talk norms should include listening to one another and responding to one another respectfully.
• Provide an atmosphere in which there is a feeling of trust and that disagreements are handled respectfully so that ideas and not students are challenged.
• Prior to any Science Talk, make sure that students understand the key concepts that are open for discussion and how they relate to a greater understanding of their explorations and investigations.
• Be prepared with a well-thought-out question to start the discussion, and have a few follow-up questions to keep the conversation going.
• Be prepared with facilitation questions that develop scientific thinking.

Orchestrating Science Talk for meaning making will take time to develop student attitudes and effective participation in speaking and listening. Over time, with a strong set of guidelines and a classroom climate of trust and respect, your students will become more comfortable and better speakers and listeners with the purpose of deep conceptual understanding.
DEVELOPING EFFECTIVE QUESTIONS TO FACILITATE SCIENCE TALK

- To help students build confidence and rely on their own understanding, ask:
  - Why is that true?
  - How did you reach that conclusion?
  - Does that make sense?
  - Can you draw a model to show that?

- To help students learn to reason scientifically, ask:
  - Is that true for all cases? Explain.
  - Can you think of a counterexample?
  - How would you prove that?
  - What assumptions are you making?

- To help students elaborate on their explanations, ask:
  - Why do you think that?
  - How do you know?
  - What do you mean when you say...?
  - Tell us more about...
  - How might you find out or confirm?

- To help students collectively make sense of science, ask:
  - What do you think about the idea that ______ shared?
  - Do the rest of you agree with that idea? Why or why not?
  - Does anyone have the same idea but a different way to explain it?
  - Does everyone understand what ______ said?
  - Can you explain why your idea/discovery makes sense?

- To help when students get stuck, ask:
  - How would you describe the problem we are trying to solve in your own words?
  - What data have the class collected?
  - Would it help to create a diagram or make a data table for the whole group?
  - How does your work compare to the work of other groups?
  - What background information do we have that might help us?

- To make connections among ideas and applications, ask:
  - How does your idea relate to...?
  - What previous concept understanding connects to this question?
  - Can you give me an example of...?

- To encourage reflection, ask:
  - How does your evidence demonstrate an understanding of the concept?
  - Do the data seem reasonable? Why or why not?
  - What are the key concepts that you can use from this investigation?
FIELD TRIPS AND CLASSROOM VISITS

Field Trips

Arrange for the class to visit a “bug house.” Michigan State University has a school field trip program. The program shows the diversity of the bug world. Trained docents guide the students through different characteristics of a variety of animals.

Visit a local zoo. Have the students observe the different characteristics of the animals, looking for physical characteristics, type of motion, and environment. Be sure to notice how the zookeepers build zoo habitats that supply what each different animal needs to survive. Look for different plants at the zoo also. Do the plants differ in each habitat?

Take your class on a field trip to a local forest or arboretum. Check out the plant and animal life and observe organisms in their natural habitat.

Classroom Visitors

Ask a zookeeper or zoomobile to visit the classroom with a diverse selection of organisms for the students to observe. Have the keeper address the unique needs each organism has for life and how those needs are met at the zoo.

Have an entomologist come to the building and talk to the students about insects and how their structures help them to meet their needs. Have the scientist explain how chemicals and other environmental hazards threaten insects.

Have a person from a pet store speak to the class about creating and maintaining habitats for animals, duplicating their natural environment as closely as possible.
Process skills are derived from looking at what a scientist does. In order to teach students these process skills, it is necessary that they actually observe, describe, measure, communicate—in other words, that they act like scientists. This gives students a deeper understanding of the nature of science and enables them to “do” science, which in turn will help them learn the facts and understand concepts of science. The basic process skills provide a foundation for the more complex integrated process skills that follow.

**Basic Process Skills**

- **Classifying**—ordering or grouping objects or events according to an established scheme based on observations
- **Collecting Data**—gathering information about observations and measurements
- **Communicating**—giving or exchanging information orally, verbally, and/or in writing
- **Comparing/Contrasting**—analyzing events, objects, or ideas for similarities or differences
- **Describing**—using specific words or symbols to tell or write about an object, event, idea, or person
- **Estimating**—approximately calculating a quantity or value based on previous experience
- **Inferring**—developing ideas that are based on observations
- **Interpreting**—using observations or information to explain scientific phenomena
- **Making Models**—developing a physical or mental representation to explain an idea, object, or event
- **Measuring**—using a variety of tools, comparing objects to arbitrary units that may or may not be standardized
- **Observing**—using one or more of the five senses to gather information
- **Predicting**—forming an idea of an expected result that is based on inferences, observations, and previous experiences
- **Questioning**—generating reasonable inquiries about the world, based on observation and experience
- **Recognizing Relationships**—having the ability to make connections between science concepts and ideas
- **Record Keeping**—gathering and recording information about observations and measurements in an organized, easy-to-read format
- **Sequence/Ordering**—arranging objects, ideas, or events in a specific order

**Integrated Process Skills**

- **Acquiring and Processing Data**—collecting data and producing data tables and graphs
- **Analyzing Data**—interpreting data and communicating the implications of the data
- **Concluding**—answering the question posed in the experiment and supported by the data collected
- **Constructing Tables of Data**—organizing data in a manner that is efficient and easy to read
- **Constructing Graphs**—presenting or communicating data in the form of a picture
- **Controlling Variables**—keeping all variables constant except the one that is being tested
- **Designing Investigations**—developing a systematic method to test a hypothesis
- **Experimenting**—designing an activity to intentionally solve a scientific problem
- **Formulating a Hypothesis**—constructing a generalization that can be tested and is formulated from observations, questions, and current knowledge and provides guidance as to what data to collect
- **Identifying Variables**—identifying factors that can be changed within an investigation
- **Information Gathering**—retrieving and using both written and verbal communication to solve scientific problems
Cooperative Learning: Group Work in Action

Scientists do not work alone. Collaboration is important in science and in the science classroom. A scientific collaborative group is one in which each member contributes his or her talents to the activity of the group. Research has shown that students learn better and are more successful when they work in pairs or small groups. Working together promotes positive attitudes and self-confidence.

All students need science classes that encourage student interaction and discussion and have a community structure of shared leadership, mutual respect, and trust rather than a hierarchical or authoritarian structure. Dealing with differences and controversy in a science class is difficult for students, especially for underrepresented groups who may already feel vulnerable in this environment. There must be an atmosphere of trust between teachers and students, as well as among students. In this type of environment, students feel comfortable enough to take risks and make mistakes. They can more easily take themselves and their egos out of any controversy that arises, so they can deal logically with the ideas. Sharing in a small group is much easier than in front of an entire class. Being able to say “Our group decided that…” takes the pressure off the individual student.

In this unit, students interact with more than one person at a time as they work in groups of three or four. The activities in this unit are designed to help students develop these cooperative learning skills:

• Explaining their own ideas
• Listening to and accepting the ideas of others
• Learning by observing and using the ideas of other students
• Realizing that it is all right for people to have different ideas and different ways of doing things
• Sharing
• Reaching consensus within the group

Once collaborative groups are in place, the teacher will spend more time being a teacher and less time being an administrator or manager. When students are working in groups, the teacher is free to roam around the room (as compared to being the focal point for the whole class), to observe and listen to students as they work (rather than being the questioner of students), and to interact with individuals and small groups as needed (instead of responding to the whole class).

If students have had no prior experience working in groups, they will need guidance. It may be necessary for you to supply the initial guidance until they are ready to assume responsible roles within their groups themselves. To give students practice in group work, keep the initial work simple and the directions very clear.

Discuss rules for working without controversy and chaos within different groups.

These rules might include:

• Remaining in the group
• Sharing materials
• Talking in a soft voice
• Not bothering other groups
• Allowing group members to complete own task
• Allowing everyone to talk
• Encouraging everyone to contribute

When grouping students, teachers must be cognizant of the makeup of their classes. Gender, minority populations, academic ability, and social behavior are factors that need to be taken into consideration. A grouping method should not inadvertently favor or disfavor one segment over another. Ideally, students should not be aware of the rationale of the grouping, only of the process. This may not be completely possible, as even young children are aware of the personalities of their classmates. Giving roles special names makes them more significant to students. Here are some suggested names or titles:

• Reader: does any required reading, directions, etc.
• Recorder: records data and observations
• Getter: responsible for materials
• Starter: first to work with the materials
• Reporter: gives report of group results
• Consultant: tells teacher if the group has questions or needs help or materials
• Design Engineer: designs and directs how the objects should be used
• Construction Specialist: puts the pieces together

All roles should be assigned randomly and the role assignments changed at the beginning of each activity. Students should be encouraged to seek help from their team members if they are having difficulty. Remind students that this is a team effort.

Brief and clearly stated instructions are very important. Older children can read them for themselves. When giving younger students instructions, ask several individuals to repeat the instructions back as they heard them. This will help you know if your directions were clear.

All materials should be obtained prior to the activity. They should be placed in a location easily accessible to students responsible for obtaining them. A supply of containers should be kept for children to use to carry their materials.

Teams should begin their activities as soon as they have their materials. Move around the room, visiting each team and listening. Comment only when your assistance is needed or wanted. This is students’ time to investigate on their own. Be prepared to meet the needs of groups and individuals as you move from team to team.

When you feel students are ready to discuss what they have been doing, be ready to end the activity.
A prearranged signal, such as ringing a bell, can tell the class that it is time to stop. It is hard to know whether to end an activity if most teams have finished but not all have. Sometimes it seems better to cut the activity somewhat short while interest is still high, rather than when it begins to wane; perhaps let unfinished teams examine results of the other teams. On other occasions it might seem important to let all teams finish, especially if a crucial discussion will take place following the activity. Your experience is the best guide!

Due to the diversity of classrooms, there is no single best model for collaborative learning. Teachers may choose and/or modify the suggested strategies to best fit their individual needs. Teachers familiar with cooperative learning techniques should feel free to use them in the lessons.

Used with permission from Michigan Department of Education, *Constructing Toys and Concepts* Teaching Unit.
Suggestions for Inclusive Education

Science is an excellent vehicle for easing exceptional students into the classroom. Students with disabilities include a wide variety of learner types, probably as divergent as the population of non-disabled students. There are several areas of functioning that inhibit school success for a large number of students with disabilities, regardless of “category” of disability. These areas of functioning interact most specifically with classroom environments and include the following:

1. **Language and Literacy.** Language deficits are particularly common in students with mental retardation, learning disabilities, and hearing impairments. They are also seen in many visually impaired or physically handicapped students who have had more limited experiences in which to develop language, or in severely emotionally handicapped students whose emotional difficulties may have inhibited appropriate language development. Language cards, verbal elaboration, and other vocabulary-enhancing techniques can be helpful with almost all groups of students.

2. **Intellectual and Cognitive Development.** Deficits in these areas are characteristic of all students with mental retardation. Milder intellectual or cognitive deficits are also observed in many students with learning disabilities, emotional handicaps, and physical or sensory impairments. A reading disability is the greatest threat. Tape recording the reading materials and allowing the student to dictate his or her answers to questions would be very helpful. Simplifying concepts and requirements could also be beneficial.

3. **Attention and Memory.** Problems with sustaining attention to task or in remembering procedures, deadlines, or verbal information are characteristic of most disability areas, particularly with students characterized as learning disabled, mentally retarded, or emotionally handicapped. Strategies for increasing attention include direct appeal by coming to an understanding about the nature of the problem and why it needs to improve; standing near the inattentive student; allowing movement needed by that student; using humor and variety in the teaching, teaching enthusiastically; using visual aids; enlisting peers to help; reinforcing attending by offering some type of positive feedback; and teaching self-monitoring strategies to the student. Strategies for increasing memory include increasing attention; promoting the use of external memory (writing notes and providing physical prompts); enhancing meaningfulness; using pictures or imagery; minimizing interfering information; promoting active manipulation and active learning; increasing practice; and using mnemonic techniques.

4. **Social Behavior.** This is a particular problem for students with emotional handicaps; however, most students with disabilities have had at least some problems adjusting to society, and many have had a frustrating history of school failure. Strategies to help students include establishing, posting, and reinforcing rules for class; speaking directly to the student with inappropriate behavior; using positive reinforcement; rewarding attendance; using a group reward system; providing exciting demonstrations and activities; and finding help for troubled students.

5. **Physical or Sensory Functioning.** Physical clumsiness and lack of manual dexterity are often displayed or exhibited by students from many disability areas. Strategies to help students include making yourself visible; acting and speaking naturally; allowing the student to explore the physical environment; using appropriate guiding techniques and promoting their use with classroom peers when necessary; providing easy access in the classroom; using tape recorders; making appropriate adaptations; and being able to implement appropriate medical (and non-medical) considerations. However, students with learning disabilities, mental retardation, or emotional handicaps often also exhibit delays in gross motor or fine motor functioning.
The following are some general, overall recommendations that apply to any student mainstreamed into any regular classroom.

1. Remember that, first and foremost, each student, disabled or non-disabled, is an individual. The student thinks of himself or herself as an individual and not as a disabled kid. He or she has long been used to having a particular characteristic that others see as a handicap. To the disabled student, the handicap is often only one of a variety of his or her personal characteristics.

2. With appropriate support, most students can succeed in at least some mainstreamed settings. For others, the mainstream classroom may not prove to be the optimal instructional environment. However, before any specific decisions have been made, make sure you give the student a good chance to succeed in this new environment.

3. Consult the special education teacher whenever possible. The special education teacher probably has a wealth of information regarding the student’s history, personal characteristics, and effective teaching strategies. Collaboration with the special education teacher will make the task of mainstreaming much easier.

4. Consider IEP objectives. All students included in special education have an IEP, or Individualized Education Program.

5. Keep your expectations high. Most special education students want to participate fully in all class activities; however, they may be shy or unsure of themselves and consequently allow others (including yourself) to do their work for them.

6. Do not single the student out more than necessary. It is important to take a matter-of-fact approach to the student’s disability.

7. Prepare your class for students with disabilities. Discuss the disability with students.

8. Use effective instructional techniques:
   • Provide “wait time” of five to eight seconds after asking a question.
   • Provide cues, like the first letter of the answer, when students are stuck.
   • Call on slower students first.
   • Develop a signal between you and an anxious student that warns that you’ll call on him or her.
   • Use daily and weekly review to be sure that students have retained previously presented information.
   • State your objective clearly.
   • Deliver information clearly and succinctly.
   • Provide guided practice.
   • Provide independent practice.
   • Use formative evaluation.
• Emphasize the critical features of the concept.
• Link the new concepts to ideas students already know.
• Provide both instances and non-instances of the concept.
• Develop strategies to assist students who have difficulty writing.


10. Remember that diversity in the classroom is a positive experience for everyone. Plan your lessons so all students can be successful in your classroom. Anticipate and take care of possible problems before they occur.

11. Be flexible!

Parts used with permission from *A Practical Guide for Teaching Science to Students with Special Needs in Inclusive Settings*, by Margo A. Mastropieri and Thomas E. Scruggs, published by Pro-Ed, Austin, Texas.
ENCOURAGING UNDERREPRESENTED GROUPS

The following strategies will help to encourage females and minorities to choose science careers.

• Use an inquiry-based approach to science instruction, as opposed to mere information delivery or use of worksheets.

• Emphasize hands-on activities that provide students with a wide variety of experiences and opportunities to explore problems whenever possible.

• Insist that the female and/or minority students manipulate the laboratory equipment instead of being the “data recorder” during hands-on science activities. Watching rather than doing science prevents the full development of skills and interests.

• Introduce activities related to everyday life experiences.

• Use cooperative, rather than competitive, small-group work. Encourage peer tutoring. Having students share their ideas or predictions, test and verify those predictions, and then summarize what has been said or done is a very beneficial process.

• Use text, curricular materials, and classroom language that illustrate women, girls, and other minorities, as well as men and boys, carrying out science work and experiments.

• Provide positive experiences in visualizing and manipulating spatial configurations to improve spatial tasks.

• Identify discrimination in curriculum materials.

• Relate what students are learning to their everyday lives.

• Give students accurate information about the contributions of female and culturally diverse scientists.

• Provide illustrations, models, actual science equipment, and other visual aids to improve the effectiveness of verbal instruction.
Structure, Function, and Information Processing

A Fourth Grade Unit supporting the Next Generation Science Standards and the Michigan Science Standards

Name: _____________________
Use the space below to draw and label a model that explains what is happening to the children in the outside/inside cartoon. Include arrows to help show how light travels. Write questions you have as you develop your model.
Imagine you are sitting in a room looking at a new toy. Your friend doesn’t know you are in there and turns out the light and closes the door. It is totally dark in the room. There are no windows or cracks around the door. No light can enter the room. Choose the answer that describes how you would see the toy.

A. Your eyes will adjust to the darkness and you will eventually see the toy.
B. Your eyes will adjust to the darkness so you can see the outline of the toy, but not the colors of the toy.
C. You will see the faint outline of the toy after your eyes have had time to adjust.
D. You will not see the toy, regardless of how much time you wait for your eyes to adjust.
E. You will see the shadow of the toy after your eyes have had time to adjust.

Write why you chose that answer.
ACTIVITY
No Light! No Sight 1B

Describe the object in your box.

<table>
<thead>
<tr>
<th>Position of lid</th>
<th>Closed lid</th>
<th>Lid slightly raised</th>
<th>Lid open</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
1. Your teacher used a flashlight to see an object in a dark place. Draw and label a model of how you were able to see the object.
2. Write how mapping the path of the light from the flashlight to the object provided evidence of how light travels.
1D
ACTIVITY
Reflecting Light

Name:________________________

Date:________________________

1. Write and draw your observations with the comb, flashlight, and mirror. Draw how you used your material and what you observed.
2. Write the class statement based on the observations of each group.

__________________________________________________________________________

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1D ACTIVITY
Reflecting Light

Name: ____________________________

Date: ____________________________

1. Use the illustration below to set up your materials.

2. Turn on the flashlight and observe the path of light in three different positions of the light. (straight in front, angle to left, and angle to right)
3. Draw the path of the light from the flashlight and mirror on the white and black paper.
4. Draw and write your observations.

straight in front:
angle to left:

angle to right:
Imagine you are sitting in a room looking at a new toy. Your friend doesn’t know you are in there and turns out the light and closes the door. It is totally dark in the room. There are no windows or cracks around the door. No light can enter the room.

Choose the answer that describes how you would see the toy.

A. Your eyes will adjust to the darkness and you will eventually see the toy.
B. Your eyes will adjust to the darkness so you can see the outline of the toy, but not the colors of the toy.
C. You will see the faint outline of the toy after your eyes have had time to adjust.
D. You will not see the toy, regardless of how much time you wait for your eyes to adjust.
E. You will see the shadow of the toy after your eyes have had time to adjust.

Write if you made a change to your answer from Lesson 1A. Tell what new information changed your response.
Name: ____________________________

Date: ____________________________

ACTIVITY
Bright Light/No Light 2A

1. Write the question you are investigating.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

2. Write what you already know about light and sight.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3. Write what you think you will find out. Write why you think that.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

4. List the materials you will use.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
5. Draw and write how you will set up your investigation.
6. Make a data table to record your observations.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bright</td>
<td>No Light</td>
<td></td>
</tr>
</tbody>
</table>

7. Write what you found out.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
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__________________________________________________________________
ACTIVITY
Bright Light/No Light

Write a conclusion from your observations and class data about how eyes react to light and dark.
1. Relate the class findings to the problem of having a hard time seeing when moving from a bright light to a dim light. Write and draw one solution to the problem.
2A  ACTIVITY  
Bright Light/No Light

Name: ____________________________

Date: ____________________________

2. How can the problem of the effect of going from bright light to dim light be solved? Explain how your solution solves the problem. Explain what science ideas you used to solve the problem.
1. Choose one animal that has eyes that glow in the dark or eyeshine. Animal __________________________

2. Draw and label a model of how you think the eyes glow in the dark.
3. Explain how you think the eyes glowing in the dark help the animal survive.
Read about the animal eyes in your book. Discuss the traits of each animal’s eyes and how they use them to find out what is going on around them. Complete the chart for each animal your group read about. Book title ______________

<table>
<thead>
<tr>
<th>Animal name</th>
<th>Eye traits</th>
<th>How it helps the animal to sense its surroundings</th>
<th>Other comments</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
Animal Eyes and Survival

Draw and label a model of a made-up animal that explains how its special eye traits help it to survive.
ACTIVITY

Schoolyard Field Trip 4A

1. Brainstorm in your group the “zoo” that you might find on a single goldenrod flower.

2. Draw and label a model of your ideas of the “zoo” that you might find on a single goldenrod flower.

3. Include labels and descriptions of how different animals survive on the plant.
Write about a time when you were picking flowers, walking in the woods, on a nature walk, or playing in a park or yard when you discovered an animal that make its habitat on a plant. Include a drawing of the structures that help it to survive.
1. Draw and label the schoolyard habitat model. Include plants and animals that could live there and how they might interact with one another.
2. Write what internal and external structures one animal has that helps it to survive.
1. Write the question(s) the class is investigating in the schoolyard.

2. List the materials you will use.

3. Write what you think you will find.
### 4B Activity

**Schoolyard Exploration**

Name: ____________________________

Date: ____________________________

4. **Draw a picture of one animal you observed in the schoolyard in its surroundings. Include in your drawing some of the living and nonliving things that surrounded the animal.**

5. **Write what you think the animal needs to survive and what traits it has to help it meet its needs.**

________________________________________________________________________
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6. Make a detailed drawing of the animal you selected from the schoolyard. Include labels on the different internal and external parts of the animal that help it to survive.
Schoolyard Exploration

7. Choose one animal that you photographed or chose for the classroom habitat___________________.
8. Write a question you have about the animal. Explain how you might investigate your question.

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ACTIVITY
Research and Data Entry 4C

Name: ____________________________

Date: ____________________________

Group name ______________________

Common name_____________________ 

Scientific name____________________

Description and drawing (include labels of observable traits).
ACTIVITY
Research and Data Entry

Habitat:

Structure for survival: (external and internal)

Behaviors for survival:
Name: ____________________________

Date: ____________________________

Other interesting facts:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
1. Describe what it means to you to be a citizen scientist. Explain how your research and data on the location of your research organism can help other scientists.
2. You have conducted research on an animal that finds its habitat in the schoolyard. Draw and label your animal. Write a caption that explains how the different structures of the animal function to help it survive in the schoolyard.
1. Draw a model of the blue-tailed skink. Label the structures of the skink and how they help the skink to survive.
2. Write what internal structures also play a role in the survival of the skink.
Your class is conducting research to find out the function of the blue tail on the skink. In your research you may find other interesting facts about the skink. Write your research questions and findings below. Be sure to list your references (Internet sites) that you used to learn about the blue-tailed skink.

Our Research Findings On the Blue-Tailed Skink

<table>
<thead>
<tr>
<th>Questions:</th>
<th>Findings:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

List the resources you used to find your information.

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________________________
The blue-tailed skink has a specialized defense system. It can wiggle its bright blue tail to attract the attention of a predator away from its body. Then, when the predator is close it can detach its tail and run away, unharmed. The tail remains behind, wiggling, keeping the predator from chasing the skink.

1. Draw and label a model that explains how the skink receives information, processes the information, and reacts by detaching its tail.

2. Write a caption or explanation for your model.
Your group has been assigned a chapter in the book, *Animal Defenses* to read and report to the rest of the class. After reading, discuss the chapter and complete the chart.

Name of chapter(s) read:
Main Idea: (description of the category for all animals described in the chapter)

<table>
<thead>
<tr>
<th>Supporting details (examples)</th>
<th>Supporting details (examples)</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Does the blue-tailed skink fit into this category of defense? Why or why not?

What sense receptors and internal structures work to help the animals respond to danger?

Do you think a predator would remember the defenses you read about? Why or why not?

What animal in your reading do you think had the most interesting defense? Explain why.
Choose one animal from the schoolyard habitat, classroom habitat, or reading and develop a model to explain how the animal receives information and reacts to a predator or prey in the area.

Write if the animal might use its memory to react if the predator or prey returned to the area at another time.
Stimulus #1:
1. LaTrina had some friends over to her house to play. It was raining outside so they decided to play hide and seek inside the house. LaTrina and Arielle decided to hide in the coat closet. They closed the door behind them. No light was able to leak into the closet from around the door. They sat down on the floor behind all the coats. “It is so dark in here, I can’t see a thing.” said Arielle.

“Just wait a minute and your eyes will get used to the dark,” answered LaTrina.

Circle the statement that best describes how their eyes will react to the darkness.

a. They will begin to see the outline of the coats and hats in the closet after their eyes adjust.
b. They will not see anything regardless of how long they sit in the closet.
c. They will see the coats after their eyes have had time to adjust to the darkness, but they will not be able to see the color of the coats.
d. They will see the outline of the door, coats, and hats after three minutes.

2. Write why you chose that answer.
3. Draw a model that explains why your answer makes sense.

4. After several minutes Joshua opened the closet door and turned on the light. "There you are!" he exclaimed. "Turn off the light! It is too bright in here, we cannot see," responded LaTrina and Arielle. Circle the statement that best describes why LaTrina and Arielle could not see when the door opened and the light was turned on.
   a. The wattage of the bulb was too high for the small closet.
   b. The light colored coats hanging in the closet reflected the light, making it too bright.
   c. Too much light entered the girls eyes before their pupils could get smaller.
   d. The mirror in the closet reflected the light into the girls eyes.

5. Write why you chose that answer.

________________________________________________________________________

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________________________________________________________________________
6. “Next time I decide to hide in a dark closet, I am bringing a flashlight with me,” commented Arielle. Develop a model to explain how the flashlight helps Arielle to see objects in the dark closet. Include in your model the light source, objects in the path of light, the eye, and brain.

Stimulus #2:

7. Jackson let his dog, Barkley, out into the backyard one night. His dog ran to the base of a large tree and was barking wildly and jumping up the tree trunk. Jackson took the flashlight outside to find out what was making the dog bark. He shone the light up the tree and there on the branch above was a pair of glowing eyes. “Whoa! Barkley, you don't want to mess with that raccoon. Let’s go back inside.” Chose the statement that best describes how the raccoon eyes help it to survive.
   a. The glowing eyes help make the raccoon more visible to cars on the road.
   b. The glowing eyes help the raccoon find food in the daylight.
   c. The glowing eyes help the raccoon see objects in the dark.
   d. The glowing eyes help the raccoon to attract a mate.
8. The raccoon was alerted by the dog’s barking and ran up the tree to safety. Develop a model that demonstrates how the information was received by the raccoon that there was danger and the structures that helped it to escape up the tree. Include internal and external structures that help the raccoon.
9. Animals have a variety of defenses that help them to survive predators, heat, sun, and other hazards. Choose one of the animals below and write how its structures or traits help it to survive.
   a. armadillo
   b. frog
   c. wolf
   d. butterfly
Rubric for Pre and Post Assessment
(Total Possible Points - 24)

Question #1: Circle the statement that best describes how their eyes will react to the darkness. (4-PS4-2)
Elements: (1 point)
Answer: b

Question #2: Write why you chose that answer.
Elements: (2 points)
a. Response includes an explanation that the eyes require light to be able to see.

Question #3: Draw a model that explains why your answer makes sense. (4-PS4-2)
Elements: (4 points)
a. Model includes light traveling in a straight path from the light source to objects in its path.
b. Model includes light reflecting off objects and traveling to the eye.
c. Model includes a signal to the brain and an interpretation by the brain.

Question #4: Circle the statement that best describes why LaTrina and Arielle could not see when the door opened and the light was turned on. (4-PS4-2, 4-LS1-1)
Answer: c (1 point)

Question #5: Write why you chose that answer. (4-PS4-2, 4-LS1-1)
Elements (3 points)
a. Response includes evidence of an understanding that the pupils would be large from sitting in the dark.
b. Response includes evidence of an understanding that the light entering the enlarged pupils would be very bright.
c. Response includes evidence of an understanding that a message is sent to the brain to make the pupils smaller so less light enters the eye.
Question #6: Develop a model to explain how the flashlight helps Arielle to see objects in the dark closet. Include in your model the light source, objects in the path of light, the eye, and brain. (4-PS4-2, 4-LS1-1)

Elements: (4 points)
a. Response includes a representation of the flashlight as the light source.
b. Response includes a representation of objects in the closet.
c. Response includes a representation of the reflected light from the objects to the eye.
d. Response includes a representation of a message from the eye to the brain.

Question #7: Chose the statement that best describes how the raccoon eyes help it to survive. (4-LS1-1, 4-LS1-2)

Elements: (1 point)
Correct response: c

Question #8: The raccoon was alerted by the dog’s barking and ran up the tree to safety. Develop a model that demonstrates how the information was received by the raccoon that there was danger and the structures that helped it to escape up the tree. Include internal and external structures that help the raccoon. (4-LS1-1, 4-LS1-2)

Elements: (4 points)
a. Response includes a representation of the raccoon at night with minimal light.
b. Response includes a representation of the raccoon’s senses that would alert it to the dog (sight, hearing, smell)
c. Response includes a representation of the message sent to the brain.
d. Response includes a representation of the raccoon responding to the message from the brain.

Questions #9: Animals have a variety of defenses that help them to survive predators, heat, sun, and other hazards. Choose one of the animals below and write how its structures or traits help it to find food for survival. (4-LS1-1, 4-LS1-2)

Elements: (4 points)
a. Response includes an accurate drawing of a survival mechanism of one of the listed animals.
b. Response includes an accurate description of how the animals senses alert the animal to danger or hazards.
c. Response includes an accurate representation of the internal and external structures that help the animal respond to its surroundings.
d. Response demonstrates an accurate understanding that animals have senses that send messages to the brain and the animal reacts to the signals from the brain.
<table>
<thead>
<tr>
<th>Scoring</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| **2**   | The response:  
  • gives sufficient evidence of understanding of the structure of animal eyes as predator or prey.  
  • gives sufficient evidence of understanding of how the eyes help the animal to sense its surroundings.  
  • includes an adequate reference to how the eyes help the animal to survive. |
| **1**   | The response:  
  • gives insufficient or limited evidence of understanding of the structure of animal eyes as predator or prey.  
  • gives little or no evidence of understanding of how the eyes help the animal to sense its surroundings.  
  • includes an adequate reference to how the eyes help the animal to survive. |
| **0**   | The response:  
  • gives no evidence of understanding of the structure of animal eyes as predator or prey.  
  • gives no evidence of understanding of how the eyes help the animal to sense its surroundings.  
  • includes an inadequate reference to how the eyes help the animal to survive. |
## Scoring Criteria

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| 2     | The response:  
  - gives sufficient evidence of the ability to relate the observations of the characters in the book to a personal experience.  
  - gives sufficient evidence of an understanding of how a variety of animals make their habitat in one area.  
  - includes an adequate reference to how the animals are able to survive. |
| 1     | The response:  
  - gives insufficient or limited evidence of the ability to relate the observations of the characters in the book to a personal experience.  
  - gives little or no evidence of an understanding of how a variety of animals make their habitat in one area.  
  - includes an adequate reference to how the animals are able to survive. |
| 0     | The response:  
  - gives no evidence of evidence of the ability to relate the observations of the characters in the book to a personal experience.  
  - gives no evidence of an understanding of how a variety of animals make their habitat in one area.  
  - includes an inadequate reference to how the animals are able to survive. |
### Scoring Criteria

#### 2
The response:
- gives sufficient evidence of the understanding of the main idea and defense category of the assigned reading.
- gives sufficient evidence of an understanding of supporting details of the defense mechanism.
- gives sufficient evidence of an understanding of whether the blue-tailed skink defense mechanism fits into the assigned reading category.
- includes an adequate reference to how memory might or might not be a part of the defense in the assigned reading.

#### 1
The response:
- gives insufficient or limited evidence of the understanding of the main idea and defense category of the assigned reading.
- gives little or no evidence of an understanding of supporting details of the defense mechanism.
- includes an inadequate reference to how the blue-tailed skink defense mechanism fits into the assigned reading category.
- includes an inadequate reference to how memory might or might not be a part of the defense in the assigned reading.

#### 0
The response:
- gives no evidence of the understanding of the main idea and defense category of the assigned reading.
- gives no evidence of an understanding of supporting details of the defense mechanism.
- includes no evidence of a reference to how the blue-tailed skink defense mechanism fits into the assigned reading category.
- includes no reference to how memory might or might not be a part of the defense in the assigned reading.
### Mountain Lion/Rabbit Handout

<table>
<thead>
<tr>
<th>Animals that act like the mountain lion</th>
<th>What helps the animal catch its food?</th>
<th>Animals that act like the rabbit</th>
<th>What thing does the animal have that helps it get away?</th>
</tr>
</thead>
<tbody>
<tr>
<td>mountain lion</td>
<td>sight, hearing, smell, fast runner, quiet, sharp claws, sharp teeth</td>
<td>rabbit</td>
<td>sight, hearing, has big ears, fast runner, small, can hide, fur</td>
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</tbody>
</table>
Schoolyard Habitat Observation Log

Completed by:

Date:
### Daily Data

<table>
<thead>
<tr>
<th>Name of observer:</th>
</tr>
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<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Date and time:</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Temperature:</th>
</tr>
</thead>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Conditions: Circle the condition that best describes the moisture in the soil.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
</tr>
</tbody>
</table>

Did you add any water to the soil? __________
How much water did you add? ______________

<table>
<thead>
<tr>
<th>Light Conditions: Circle the condition that best describes the light in the room.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very bright</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plant Observations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of plant: ______________</td>
</tr>
<tr>
<td>Condition of plant (color, dropped leaves, drooping): ______________________________</td>
</tr>
</tbody>
</table>

| Size of moss mat: ______ X _______ |
| Condition of moss mat (color, soft, brittle, dry, moist): __________________________ |

---

### Observations

1. Draw a map of the habitat that includes the location of the rocks, plants, leaves, and twigs. Draw on the map where you observed different animals.

2. Write about your observations of the classroom habitat. Describe any interactions between animals. Compare your observation to the previous observation in the log. Include any differences in the location of the animals.