

Grade 4 Science, Unit 4

# How Organisms Process Information

## Overview

### Unit abstract

In this unit of study, fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. The crosscutting concepts of cause and effect and systems and system models are called out as organizing concepts for these disciplinary core ideas. In the fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models. Students are expected to use these practices to demonstrate understanding of the core ideas.

### Essential question

- How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals?

## Written Curriculum

### Next Generation Science Standards

<b>4. Structure, Function, and Information Processing</b>		
Students who demonstrate understanding can: <b>4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.</b> <i>[Clarification Statement: Emphasis is on systems of information transfer. ] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]</i>		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>  <b>Developing and Using Models</b> 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. <ul style="list-style-type: none"> <li>▪ Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)</li> </ul>	<b>Disciplinary Core Ideas</b>  <b>LS1.D: Information Processing</b> <ul style="list-style-type: none"> <li>▪ 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. (4-LS1-2)</li> </ul>	<b>Crosscutting Concepts</b>  <b>Systems and System Models</b> <ul style="list-style-type: none"> <li>▪ A system can be described in terms of its components and their interactions. (LS1-2)</li> </ul>
<i>Connections to other DCIs in this grade-level: N/A</i>		
<i>Articulation of DCIs across grade-levels: <b>1.LS1.D</b> (4-LS1-2); <b>MS.LS1.A</b> (4-LS1-2); <b>MS.LS1.D</b> (4-LS1-2)</i>		
<i>Common Core State Standards Connections:</i> <b>ELA/Literacy</b> – <b>SL.4.5</b> Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2)		

<b>4. Structure, Function, and Information Processing</b>		
Students who demonstrate understanding can: <b>4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.</b> [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]		
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts</b>
<b>Developing and Using Models</b> 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. (4-PS4-2)	<b>PS4.B: Electromagnetic Radiation</b> ▪ An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)	<b>Cause and Effect</b> ▪ Cause and effect relationships are routinely identified. (4-PS4-2)
<i>Connections to other DCIs in this grade-level:</i> N/A		
<i>Articulation of DCIs across grade-levels:</i> <b>1.PS4.B</b> (4-PS4-2); <b>MS.PS4.B</b> (4-PS4-2); <b>MS.LS1.D</b> (4-PS4-2)		
<i>Common Core State Standards Connections:</i> <i>ELA/Literacy</i> – <b>SL.4.5</b> Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-2) <i>Mathematics</i> – <b>MP.4</b> Model with mathematics. (4-PS4-2) <b>4.G.A.1</b> Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2)		

## Clarifying the standards

### *Prior learning*

The following disciplinary core ideas are prior learning for the concepts in this unit of study.

By the end of Grade 1, students know that:

- 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.
- Objects can be seen if light is available to illuminate them or if they give off their own light.
- Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light).

### *Progression of current learning*

#### **Driving question 1**

How do animals receive and process different types of information from their environment in order to respond appropriately?

##### Concepts

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

##### Practices

- Describe a system in terms of its components and their interactions.
- Use a model to test interactions concerning the functioning of a natural system.
- Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
  - Emphasis is on systems of information transfer.
  - Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.

**Driving question 2**

What happens when light is reflected from objects and enters the eye?

**Concepts**

- Cause-and-effect relationships are routinely identified.
- An object can be seen when light reflected from its surface enters the eyes.

**Practices**

- Identify cause-and-effect relationships.
- Develop a model to describe phenomena.
- Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works).

*Integration of content, practices, and crosscutting concepts*

In this unit of study, fourth graders use the concept of systems to understand that every animal has internal and external structures that allow it to take in information from the environment in which it lives, process that information, and respond in ways that increase its chances to grow, reproduce, and survive.

The way in which an organism gathers information will depend on the organism and the body structures that pick up signals from the environment. Many animals, like humans, have sense organs that gather information from the environment through seeing, hearing, feeling, smelling, and tasting. Some animals have sensory receptors or other mechanisms that allow them to sense such things as light, temperature, moisture, and movement. Students need to understand that all animals pick up information from their environment through senses or sensory receptors. In many animals, nerves or neurons then transfer that information to a centralized place (the brain) where it is processed; then, through reflex reactions or learned behaviors, the organism responds in ways that will help it survive and reproduce. In addition, animals often store this information in their brains as memories and use these memories to guide future actions. As students observe animals, either through direct observation or using text and digital resources, they should use models, such as drawings, diagrams, and pictures, to describe the ways that animals (and humans) receive, process, store, and respond to information from the environment in order to survive, grow, and reproduce.

To continue the progression of learning, fourth graders focus on the sense of sight, using models to understand and describe that light reflects from objects and enters the eye, allowing objects to be seen. In first grade, students learned that objects can be seen only when illuminated, and they determined the effect of placing different materials in the path of a beam of light. In this unit, students need opportunities to develop a conceptual understanding of the role that light plays in allowing us to see objects. Using a model can help with this process, which might include the following steps:

- To review prior learning, ask students to describe what happens to our ability to see objects in a room with no light, and what happens when different types of materials are placed in the path of a beam of light. (If necessary, demonstrate using flashlights and a variety of transparent, translucent, and opaque materials).
- Using penlights, a variety of lenses, mirrors, and pieces of cardboard, allow students to explore the behavior of light when it comes into contact with these objects. Have students draw and describe what they observe.

- Using a cardboard shoebox with a 1-cm. slit at one end, shine a flashlight into the box through the slit, and ask students to describe what they see. Place a clear plastic cup of water in the path of the light, and ask students to describe what they observe.
  - Students should first observe that light travels in a straight line. Lenses and water allow the light to pass through; however, the beam of light is refracted (bent). Mirrors do not allow the light to pass through, but do reflect light, sending the beam in a different direction. The cardboard does not allow any light to pass through, and the beam of light is no longer visible in the same way.
- Next have students observe a large object, such as a book. Ask them to describe what they see. Place a sheet of transparency film or clear plastic wrap in front of the book, and ask students to again describe what they see. Ask, “How are you able to see the book even though I have placed something in between you and the object?”
  - Take away the clear plastic wrap and place a sheet of dark construction paper in front of the book, and ask student to describe what they see. Ask, “Why are you no longer able to see the book?”
- To help students as they try to understand the role that light plays in allowing us to see objects, tell them that they will be using a model that demonstrates how we see objects.
- Have students use pinhole viewers. (If possible, make these ahead of time. You can find a variety of models and types that are easy to build on the Internet. YouTube has a number videos that show pinhole viewers made from a variety of materials such as a Pringles tube or black poster board.) Show students how the pinhole viewers are constructed and what is inside each. Then have students go outside and view objects using the pinhole viewers. As students make observations, they should document what they observed.
  - As a class, discuss what students observed, then draw a model on the board that depicts the phenomenon. (Light bounces off of an object, travels through the pinhole, and is visible—upside down—on the tracing paper inside the pinhole viewer.)
  - Tell students that this is what happens with our eyes. Light bounces off objects, similar to the way in which it bounces off a mirror, and that light travels into the eye, enabling us to see the objects. We could see the book through the clear plastic wrap because the light that bounces off the object is able to travel through the transparent material and still reach our eyes. We could not see the book through the dark construction paper because the light that was bouncing off the object could not travel through the paper, so our eyes did not receive that light. Therefore, we did not see the book.
  - With guidance, as needed, have students draw models/diagrams of the pinhole viewer and the human eye, and have them describe what they observed.

### Integration of DCI from other units within this grade level

In Unit 4, Structures and Function, students are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. These concepts are foundational to the content in this unit of study.

### Integration of English language arts and mathematics

#### *English language arts*

To support integration of the CCSS for English language arts in this unit, students should use text and online media resources when appropriate to help them understand how animals receive and process information they receive from the environment, and to develop a conceptual understanding of what happens when light reflects

off objects and enters the eye. They should also use visual displays to enhance their observations and explanations of the concepts in this unit of study.

### *Mathematics*

In this unit of study, students will address the CCSS for mathematics by modeling with mathematics as they draw points, lines, line segments, and angles to describe how light behaves when coming into contact with lenses, mirrors, and other objects. Students will also use points, lines, and angles when drawing pictures and diagrams that show how light reflects off objects and into the pinhole viewer or into the human eye.

### *Future learning*

The following disciplinary core ideas are future learning related to concepts in this unit of study.

In middle school, students will know that:

- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.
- In multicellular organisms the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.
- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves.

## **Number of Instructional Days**

*Recommended number of instructional days: 9 (1 day = approximately 45–60 minutes)*

**Note**—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.

