

Core Knowledge Science Program—Domain Map

Science Content

Light

- Objects can be seen if light is available to illuminate them or if they give off their own light
- Light travels from place to place
- Transparent, translucent, and opaque objects:
Some materials allow light to pass through them, others allow only some light through, and others block the light and create shadows on any surface on the other side where direct light cannot reach
- Mirrors and prisms can be used to redirect a light beam

Sound

- Sound can make matter vibrate
- Vibrating matter can make sound
- Introduction to sound waves

This unit contributes to meeting or exceeding the following Next Generation Science Standards:

Grade 1 Topic [Waves: Light & Sound](#), for example:

[1-PS4-1](#). Plan and conduct investigations to provide evidence that **vibrating materials can make sound and that sound can make materials vibrate. AND**

[1-PS4-3](#). Plan and conduct investigations to determine **the effect of placing objects made with different materials in the path of a beam of light.**

This unit will support students as they develop early understandings of the core ideas [PS4.B](#) (Electromagnetic Radiation), [PS4.A](#) (Wave Properties), and [PS4.C](#) (Information Technologies). This unit “bundles” these core ideas as found in this Grade 1 Topic from the NGSS. For example, the idea that light travels from place to place, which is an early progression of PS4.B, will be developed through experiences with light sources, mirrors, and shadows cast by various objects.

This unit offers the opportunity to foreshadow learning that will support the following Next Generation Science Standards:

Grade 4 Topic [Waves](#), for example:

[4-PS4-1](#). Develop a model of waves to describe patterns in terms of **amplitude and wavelength and that waves can cause objects to move.**

[PS4.A](#), [PS4.B](#), and [PS4.C](#) will each be studied further in Grade 3 during Units 3 and 4, *Light* and *Sound* respectively. This early study of these core ideas in Grade 1 will prepare students with the vocabulary and background knowledge so that they can build upon and apply their understandings of waves during upper elementary activities and assessments.

Potential Skills & Cross-Curricular Integrations

The connections listed below are intended as ideas for possible integration across this unit. Finding connections in math, in language arts, and in works of poetry, art, and music, may help you as you create meaningful learning experiences for your students. Connections such as these can help your students make links between various disciplines and deepen the understanding of this domain.

POTENTIAL CCSS Math Connections

MP.5 Use appropriate tools strategically. (1-PS4-4)

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1-PS4-4)

1.MD.A.2 Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps. (1-PS4-4)

POTENTIAL CCSS ELA Connections

W.1.2 Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. (1-PS4-2)

W.1.7 Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions). (1-PS4-1, 1-PS4-2, 1-PS4-3, and 1-PS4-4)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1, 1-PS4-2, and 1-PS4-3)

SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. (1-PS4-1, 1-PS4-2, and 1-PS4-3)

POTENTIAL Cross-Curricular Connections

Potential Links:

Visual Art: Elements of Art—Color; review from Kindergarten the idea of “warm” and “cool” colors. Know that red, yellow, and blue are commonly referred to as the “primary colors,” and that combinations of these colors can produce green, orange, and purple. Observe the use of color in:

- Claude Monet’s *Tulips in Holland*
- James A. McNeill Whistler’s *Arrangement in Black and Gray* (also known as *Whistler’s Mother*)
- Diego Rivera’s *Piñata*

Music: Elements of Music—Discriminate between obvious differences in pitch: high and low. Discriminate between loud and soft (volume/intensity). Become familiar with the families of instruments in an orchestra: strings, brass, woodwinds, percussion.

Prior Knowledge

Core Knowledge Preschool Sequence

Scientific Reasoning and the Physical World

Goal: Demonstrate an initial understanding of the living world

- Observe, describe and record some basic properties of light, its presence and its effects in the physical world

Core Knowledge Kindergarten Sequence

V. Seasons & Weather

- The sun: source of light and warmth

Core Knowledge Science (Previously taught units in the CK Science program)

Kindergarten Unit 4 Seasons & Weather

- Describe how the sun affects the temperature
- Describe how sunlight affects materials on Earth (K-PS3-1)

CKLA Grade 1 Objectives—Not Applicable

The Core Knowledge Language Arts program (CKLA), which builds students' background knowledge in certain [domains of literature, science, and history](#), does not include the study of light and sound at this grade level. In order to prepare students to meet or exceed the NGSS Grade 1 Topic [Waves: Light & Sound](#), this CK Science unit is critical to advance students' understanding of the physical sciences. To learn more about how and why the Listening & Learning Strand of CKLA approaches certain science content through read-alouds and ELA instruction, [read more about the CKLA program](#).

What Students Will Learn in Future Grades

Core Knowledge Grade 3 Sequence

II. The Human Body—Vision and Hearing

Vision: How the Eye Works

- Parts of the eye: cornea, iris and pupil, lens, retina
- Optic nerve
- Farsighted and nearsighted

Hearing: How the Ear Works

- Sound as vibration
- Outer ear, ear canal, and eardrum
- Three tiny bones (hammer, anvil, and stirrup) pass vibrations to the cochlea
- Auditory nerve

III. Light and Optics

- Through experimentation and observation, introduce children to some of the basic physical phenomena of light, with associated vocabulary
- The speed of light: light travels at an amazingly high speed
- Light travels in straight lines (as can be demonstrated by forming shadows)
- Transparent and opaque objects
- Reflection:
Mirrors: plane, concave, convex
Uses of mirrors in telescopes and some microscopes
- The spectrum: use a prism to demonstrate that white light is made up of a spectrum of colors
- Lenses can be used for magnifying and bending light (as in magnifying glass, microscope, camera, telescope, binoculars)

IV. Sound

- Through experimentation and observation, introduce children to some of the basic physical phenomena of sound, with associated vocabulary
- Sound is caused by an object vibrating rapidly
- Sounds travel through solids, liquids, and gases
- Sound waves are much slower than light waves
- Qualities of sound:
Pitch: high or low, faster vibrations = higher pitch, slower vibrations = lower pitch
Intensity: loudness and quietness
- Human voice:
Larynx (voice box)
Vibrating vocal cords: longer, thicker vocal cords create lower, deeper voices
- Sound and how the human ear works
- Protecting your hearing

Core Vocabulary

The following list contains the core vocabulary words suggested for purposeful integration across this Grade 1 unit. **Boldfaced** terms could be introduced and/or reviewed with students using a Word Work activity, as modeled by the [Core Knowledge Language Arts program](#) (CKLA). The inclusion of the words on this list does not mean that students are immediately expected to be able to use all of these words on their own. However, through repeated exposure across the lessons, students should acquire a good understanding of most of these words and begin to use some in conversation.

Light

sunlight, ray, **beam**, path, direction, straight, source, shine, **illuminate**, bright, emit, energy, type, travel, transmit, wave, rainbow, prism, [names of different colors], mirror, surface, **reflect**, refract, absorb, bounce, deflect, bend, angle, reflection, image, **transparent**, **translucent**, **opaque**, obscure, fuzzy, blur, clear, sharp, object, matter, media, shadow, shade, cast, dark, silhouette, eclipse

Sound

wave, **compression**, energy, matter, **medium**, **substance**, quality, characteristic, **description**, **pitch**, frequency, intensity, **volume**, loud, soft, high, low, **vibrate**, vibration, noise, [examples of objects that make noise]

Potential Misconceptions

Students have been shown to learn significantly more science when their teachers demonstrate strong knowledge of potential student errors, and when the teacher plans accordingly (Sadler & Sonnert, 2016). The following incorrect statements serve as a sampling of the “intuitive theories” or “alternative conceptions” that students and teachers may actively use to describe their thinking, and which might interfere with the process of learning. The details following each statement are not intended to imply the scope of instruction for this grade, but instead provide a clearer sense of what students (of all ages) often misunderstand and/or overgeneralize when investigating and describing scientific ideas.

Misconception: “The heat of the sun is transferred to the Earth.”

This is an overgeneralization that students of all ages often repeat and misunderstand. Thermal energy from the sun does not reach the Earth in any significant amount. Instead, it is the electromagnetic radiation emitted from the sun, sunlight, that traverses the expanse of space and provides energy to the Earth and its atmosphere. This includes wavelengths of radiation that are invisible to the eye, such as infrared, ultraviolet

Key points for instruction:

“The majority of elementary students... tend to identify light with its source (e.g., light is in the bulb) or its effects (e.g., patch of light)” (AAAS Atlas of Science Literacy Vol. 1, 2001, pg. 64). These students generally have difficulty explaining reflections, for example color as the reflection of light, and/or the direction and formation of shadows.

(UV), and gamma radiation. This electromagnetic radiation interacts with our atmosphere, and with the Earth, in a [complex system of energy transfer](#), which results in the natural warming of the Earth. For more information, consider watching this short YouTube video (~3-minutes) provided by Duane Friend of the University of Illinois Extension: [How the Sun Heats the Earth](#).

Key Points for Instruction: (continued)

The focus of this unit is for students to engage in hands-on learning activities and assessments to interact with light and sound as they can experience it in the real world. The [Next Generation Science Standards reference examples](#) such as tuning forks, stretched strings, clear plastics, translucent wax paper, and reflective mirrors be used to engage students in evidence-based discussions about sound and light.

Potential Objectives for this Grade 1 Unit

The organization of the following objectives reflects the order in which they are expected to be addressed. The proposed timing within the unit (“beginning,” “middle,” or “end”) and aligned NGSS are also noted. In addition to daily lessons focused on each objective, days have been built into the unit for review and assessment.

Beginning

- Describe how the presence of light affects objects (1-PS4-2)
- Describe how light travels
- Describe materials that block light and materials that allow light to pass through (1-PS4-3)

Middle

- Identify objects that reflect light (1-PS4-3)
- Compare and contrast light and sound waves (**ongoing**)

End

- Describe the relationship between vibrations and sound (1-PS4-1)
- Design a device that uses light or sound to communicate over a distance (1-PS4-4)

Potential Big Guiding Questions**Essential Questions:**

- **What causes a shadow?**
- **How does light travel?**
- **What causes sound?**

RE: Light

- Why can't we see in the dark?
- Do you think light can travel through water? Why?
- Why do some objects block light, but not others?

RE: Sound

- How are sound waves different from light waves?
- Can sound make an object vibrate?
- Can a vibration make a sound?

Potential Assessment Opportunities

The following assessment tasks serve as a sampling of how students can demonstrate mastery of lesson objectives. Each aligned objective and NGSS is noted in parentheses. In addition, the proposed timing (“beginning,” “middle,” or “end”) is noted in order to indicate the approximate point in time the assessment would take place.

Example #1: (Beginning of Unit 7)

{Evaluates Student Mastery of Objective: Describe materials that block light and materials that allow light to pass through} (1-PS4-3)

Advance Preparation: See example #2 in the next section.

Assessment Task:

Walk students through the investigation steps they established as a class. Provide each group with needed materials (e.g., flashlight, objects, and category cards).

T - At your table you have a flashlight and several objects. When I cue you to begin, I would like you to take turns following the steps of our investigation (e.g., shining your flashlight on each object, looking carefully at the amount of light coming through each object, categorizing the objects).

Dim the lights and allow students time to shine their flashlights on each object.

T - What did you notice? (Students should identify that some objects allow light to pass through and others do not)

As a whole group debrief findings. If students disagree about to which category an object belongs, model for the group, calling students’ attention to the amount of light passing through. You may also want to compare the object with one from another category (e.g., compare a transparent and translucent object).

Ask students to look at the objects that block the light and share what they notice.

T - What are the characteristics of these objects? Why do you think light cannot pass through them? After students share their observations and thinking, explain that these objects are opaque.

Repeat this process with the other two categories (transparent and translucent).

T - So, what happens when objects made of different materials are placed in front of a beam of light?

Potential Activities & Procedures

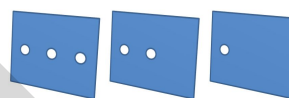
The following activities or procedures serve as a sampling of what instruction could look like in this unit. Each example was specifically designed to contribute to one or more of the aforementioned objectives. In addition, the proposed timing (“beginning,” “middle,” or “end”) is noted in order to indicate the approximate point of instruction where it would be delivered. Aligned NGSS are noted in parentheses.

Example #1: (Beginning of Unit 7)

{Contributes to the Objective: Describe how light travels}

Advance Preparation: You will need the following materials in order to conduct this activity:

- Three pieces of cardstock or large index cards. Layer the cards and punch a hole on the far left side. Remove one card from the pile and punch a hole in the middle of the remaining two. Then punch a hole (on the far right side) in only one of the two cards (see diagram).
- Three balls of playdough or putty. Use the playdough or putty to stand each of the cards up on a table. Position the cards so the holes on the far left of each card all align.
- Flashlight lights for each pair (or small group of students)



Activity: Explain that today you will learning about how light travels.

T - How many of you have ever used a flashlight before? Take a minute and think about what that light looks like (where it goes) when you or another person turns on a flashlight.

Let’s make predictions about how light travels. If students have difficulty describing their ideas, provide prompts (e.g., do you think it moves in squiggly or straight lines? Do you think it remains uniform as it travels or changes shape?).

Provide each pair (or small group) of students with a flashlight. Review safety directions (e.g., never point the flashlight in someone’s eyes). Position students around the perimeter of the room (between 2 and 3 feet from the wall). Dim the lights in the classroom. Instruct one member from each group or pair to turn on the flashlight and point it at the wall. Ask the remaining students (standing on the side) to look at the beam of light and describe what they see.

T - Look at the light coming from your flashlight. How far does it travel (across the room)? What does its path look like? Where does it stop?

Collect the flashlights and ask students to stand on the sides of the table where you have propped the index cards.

T - I’m going to shine this small flashlight on this first card. I want you to take a close look at how the light travels.

Turn on the flashlight. Students should see one straight beam of light stream through all three cards on the far left, they should see another beam of light travel through the middle and stop at the last card, and observe one beam of light (on the far right) shine through the first card, stopping at the second.

T- Turn to your partner and describe what the light looks like. Provide students with at least 60 seconds to talk and then ask several pairs to share their descriptions. **What are characteristics that we can clearly see here, but may not have been as clear when we shined our flashlights on the wall?** Students should indicate that the light is traveling in a straight line, and that it keeps moving until something blocks it.

Example #2: (Beginning of Unit 7)

{Contributes to the Objective: *Describe materials that block light and materials that allow light to pass through*} (1-PS4-3)

Advance Preparation: You will need the following materials in order to conduct this activity:

- 2 transparent objects (e.g., glasses, plastic wrap, paper protector, or water) for each group of students
- 2 translucent objects (e.g., sunglasses, notebook paper, wax paper, plastic bag, stained glass, a lampshade, or vegetable oil) for each group of students
- 2 opaque objects (e.g., cardboard, book, aluminum paper, carpet/fabric, or metal spoon/knife) for each group of students
- A flashlight for each group of students
- Index cards, paper, post-it notes, and other materials that students may decide to use in order to conduct the investigation.

Activity:

T - What do you think happens to a beam of light if you place an object directly in front of it? Do you think objects made of different materials would cause different results? As you pose each question, allow students think-time to process. Ask them to explain their reasoning.

T - Today we are going to form an investigation to find out what happens when objects made of different materials are placed in front of a beam of light. Write the question on a piece of chart paper, “What happens when objects made of different materials are placed in front of a beam of light?” You may also wish to draw a symbol representing this question.

T - What would we need to conduct this investigation (to answer this question)? Ask students to share ideas with a partner and then call on several pairs to share. List students’ ideas on the chart paper. Guide and prompt students to think of what could act as the “source of light” (e.g., a flashlight), brainstorming an array of objects, and determining how they categorize or organize the objects. If students brainstorm objects in the classroom of which you have multiple sets, use that item instead of one that you already prepared.

Place a set of objects along with a flashlight in front of students. Ask students to describe what they think the steps should be to answer the question. As students list their ideas, capture them on chart paper.

After the class has compiled a list of steps, ask students to assist with reordering/combining steps. Try to limit the list to five to seven steps. Rewrite the steps on a new piece of chart paper. . .

Websites & Media

YouTube video for teachers—How the Sun Heats the Earth:

https://www.youtube.com/watch?v=dg_DOM1OQoo

This short video (approximately 3 minutes) offers an illustrated explanation of how the Earth is actually heated by the Sun.

Science Netlinks Lesson offered free by the AAAS—The Warmth of the Sun:

<http://sciencenetlinks.com/lessons/the-warmth-of-the-sun/>

This model lesson is offered for free download by the American Academy for the Advancement of Science (AAAS) through its Science Netlinks program. This activity can provide additional support to students as they address early learning objectives within this unit (e.g., Describe how the presence of light affects objects, *1-PS4-2*). Students observe and record the relative temperature of water located in three different locations: inside the classroom, outside in the

Supplemental Trade Books

Recommended by the National Science Teachers Association

- *Light: Shadows, Mirrors, and Rainbows* by Natalie M. Roslinsky and Sheree Boyd (Picture Window Books, 2002) ISBN 9781404803329
- *Light and Color* by Lawrence F. Lowery and Muriel Wood (NSTA Kids, 2014) ISBN 9781938946516
- Teacher Resource: *Energy—Stop Faking It! Finally Understanding Science So You Can Teach It* by William C. Robertson (NSTA, 2002) ISBN 9780873552141