Grade One Snapshot 3.4: "Sounds Wild" Engineering Challenge

animal that vibrated to produce sound and could locate the sound-producing body part on pictures of the animal.

Investigative phenomenon: How do we create a device that simulates a baby animal crying out loud enough to communicate with its parents?

Mr. K connected music to science with an engineering design challenge: students were to design and build their own sound device emulating a baby animal. Mr. K asked students to close their eyes and makes a very quiet chirp. Would that be loud enough? Students **define their challenge [SEP-1]** by agreeing about a few guidelines: (1) instruments must be loud enough so that an imaginary parent animal on the opposite side of the playground could hear the device cry out for help, and (2) students must be able to communicate the difference between a cry of hunger and a cry of being in danger. Would they use a different pitch for each need? Or a different number of drum beats? Students needed to **develop a solution [SEP-6]** to both create the sound and use it to communicate over a long distance (1-PS4-4). The shakers, scrapers, and string instruments they created demonstrate the students' understanding of the processes animals use to create sound and that vibrations cause sound.

Opportunities for Mathematics Connections

When students design and test their animal sound devices (or even simple paper cup and string communicators), they can measure distances on the schoolyard. Students in grade one do not use standard units of measure, but they understand the concept of reiterated units to measure length. For example, students could choose among a paper clip, a craft stick, or a yardstick as a unit of measure.

CA CCSSM: MP.5; 1.MD.1–2

Grade One Instructional Segment 3: Shadows and Light

IS3

By conducting hands-on investigations, students will build the foundation of a **model [SEP-2]** of how people see. In grade one, this model only includes the fact that light is necessary for vision and that light interacts with different objects in different ways. Since shadows are one piece of evidence of that interaction, this segment flows into IS4 during which students will notice patterns in the shadows cast by the light of the Sun.

GRADE ONE INSTRUCTIONAL SEGMENT 3: SHADOWS AND LIGHT

Guiding Questions

- What causes shadows?
- What happens when there is no light?

Performance Expectations

Students who demonstrate understanding can do the following:

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

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

The bundle of performance expectations above focuses on the following elements from the NRC document *A Framework for K–12 Science Education*:

Highlighted Science and Engineering Practices	Highlighted Disciplinary Core Ideas	Highlighted Crosscutting Concepts
[SEP-3] Planning and Carrying Out Investigations [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)	PS4.B: Electromagnetic Radiation	[CCC-2] Cause and Effect: Mechanism and Explanation [CCC-4] Systems and system models

Highlighted California Environmental Principles and Concepts:

Principle III Natural systems proceed through cycles that humans depend upon, benefit from and can alter.

CA CCSS Math Connections: MP.5; 1.MD.1–2

CA CCSS for ELA/Literacy Connections: 1.W.3

CA ELD Standards Connections: ELD.PI.1.9, 10, 12; ELD.PII.1.5

Opportunities for ELA/ELD Connections

To transition into this instructional segment and give students direct experience with shadows, students write a story about a sequence of events that happens to a baby animal from the previous instructional segment and then act it out as shadow puppets by placing their hands in front of the light on a projector screen and describing the sequence using words.

CA CCSS for ELA/Literacy Standards: 1.W.3
CA ELD Standards: ELD.PI.1.9, 10, 12; ELD.PII.1.5

Recognizing the value of play and motor development in solidifying learning for early elementary children, teachers can introduce concepts of light and shadows through a game of shadow tag on the schoolyard. Selecting a particularly sunny day shortly before beginning the instructional segment, students play tag, but with the twist that they never actually touch—one shadow needs to tag another person's shadow. No matter which direction the children run or turn, students notice the **pattern [CCC-1]** that their shadow always points the same direction on the schoolyard during the short game (such as toward the soccer goal). Teachers can highlight that it always points directly away from the Sun. By playing the game at a different time of day, students see that all their shadows point to a different landmark on the schoolyard (such as toward the library). Students can **construct an argument [SEP-7]** that their shadows are a marker that allows them to track the moving position of the Sun throughout the day or year; they will use this argument in IS4. But what causes a shadow?

The shadow tag game also helps students begin to **develop a model [SEP-2]** that light travels in a direction (such as from the Sun toward them in the shadow tag game). Students do not generally think about light as something that moves from place to place, but rather as something that fills a space and is either off or on. In this instructional segment, they will collect evidence that supports the idea that light travels from a source to an object and is either absorbed by or bounces off the object. Students learn that they see the object because light bounces off of it and reaches their eyes. This understanding requires conceptual development through step-by-step **investigation [SEP-3]** of different scenarios (1-PS4-3).

Many light sources emit light in all directions. This is an important idea for explaining how the whole room seems to be full of light. However, it is useful to start with light sources that emit a narrow a beam, such as a laser pointer or a flashlight with a narrow beam, to **refine the model [SEP-2]** that light travels in a direction. In a darkened classroom,

students look around and observe things are dim and harder to see. They are able to see things clearly when they shine a narrow light on them, but not as clearly without that light. The teacher shows video clips of explorers in caves where it is much darker. Cave explorers are only able to see things where they shine their flashlight. Students use this **evidence to support the argument [SEP-7]** that objects can only be seen when they are illuminated (1-PS4-2), an example of **cause and effect relationship [CCC-2]**. Students can construct a class cave for students to explore, covering desks with heavy blankets so that students can gather more evidence that they can only see when light is present.

Students then **plan an investigation [SEP-3]** to compare the effect of placing different types of objects in the path of the light (1-PS4-3), much like they placed their bodies in the path of the Sun to make shadows. The collection of objects should include opaque (cardboard), transparent (glass or clear plastic), translucent (plain white paper, black construction paper, wax paper, young plant leaves, their own hands), and reflective materials (a mirror, foil, or Mylar—the shiny plastic of some birthday balloons), though the teacher should not introduce these distinctions prior to the investigation. It will be the job of students to identify these differences. Students will need to decide how they can describe the differences between the various materials. What will they have to notice and record about each material? By using a mirror and a sheet of glass as examples, teachers can guide students to a plan to observe the amount of light traveling through to the other side, the amount of light that goes back toward the light source, and the light that seems to cause the object itself to glow. These observations are data, which provide the opportunity for age-appropriate **analysis of the data [SEP-4]**, using comparisons such as the following: (1) the amount of light that goes through this object is more than the light that reflects back, or (2) more light shines through the white paper than the black paper. Students can group the materials into categories based on **patterns [CCC-1]** about the amount of light that travels through them. Only after students have constructed these categories based on their own experience should teachers introduce labels such as *opaque* and *transparent* to help develop children's academic vocabulary. Like many categories in science, these categories are not rigid and absolute; glass reflects some light, allows other light to travel through, and absorbs a small amount of light (which is why it heats up in the sun). So, is glass transparent, reflective, or translucent? During this investigation, students constructed a simple **model [SEP-2]** that tracks the path of light from one place to another. They will build on this model in grade four (4-PS4-2). Students revisit the focus question for this instructional segment and **construct an explanation [SEP-6]** about how different materials block light and therefore **cause [CCC-2]** shadows.