## IS4 Grade One Instructional Segment 4: Patterns of Motion of Objects in the Sky

Students will make observations of the Sun, Moon, and stars and develop ways to record, describe, and organize their patterns of motion. At this stage of their learning, it is more important for students to use their own observations to recognize predictable **patterns [CCC-1]** of **change [CCC-7]** than to learn through lecture or texts. Note that the crosscutting concept of cause and effect is not highlighted in this segment because the cause of these patterns is not addressed until later grades.

### GRADE ONE INSTRUCTIONAL SEGMENT 4: PATTERNS OF MOTION OF OBJECTS IN THE SKY

**Guiding Questions**

- What objects are in the sky and how do they seem to move?
- When will the Sun set tomorrow?
- How does the Moon's appearance change over each month?

**Performance Expectations**

Students who demonstrate understanding can do the following:

**1-ESS1-1.** Use observations of the Sun, Moon, and stars to describe patterns that can be predicted. [Clarification Statement: Examples of patterns could include that the Sun and Moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our Sun are visible at night but not during the day.] [*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]

**1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]

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<br>[SEP-4] Analyzing and Interpreting Data | ESS1.A: The Universe and its Stars<br>ESS1.B: Earth and the Solar System | [CCC-1] Patterns |

**Highlighted California Environmental Principles and Concepts:**

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

**GRADE ONE INSTRUCTIONAL SEGMENT 4:**
**PATTERNS OF MOTION OF OBJECTS IN THE SKY**

**CA CCSS Math Connections:** 1.MD.3

**CA CCSS for ELA/Literacy Connections:** RI.1.2, 4, 7, 10.a; L.1.4, 6; W.1,2

**CA ELD Standards Connections:** ELD.PI.2.5, 6, 7

Students build on what they learned about how light travels in IS3 to **develop models [SEP-2]** they can use to predict motions of the Sun, Moon, or stars. Students will need to have recorded data about the amount of daylight throughout fall, winter, and spring so they can draw comparisons between observations at different times of the year. Data on sunrise and sunset times and the locations of planets and stars can be found in a number of sources, including local newspapers and online resources.

Students' observations of the time of sunrise or sunset over multiple days across the year are analyzed using the same point of reference to develop a model for the pattern of change students observe. Students use this pattern to predict whether the time of sunset or sunrise will be later or earlier than the previous day for the next few days. They can **communicate [SEP-8]** their prediction using a graph of times of sunset for several days or a clock face marked with sunset times for successive days, an example of a pictorial **model [SEP-2]**. Other students should be able to use their pictorial model to predict the time that the Sun rises, but first-grade students are not expected to develop a conceptual model that can explain or justify what causes these differences. Other visual representations could also be used, such as pictures of the same landscape or outdoor feature that have been taken at the same time of the day but during different times of the year. Class discussions and reading should include children's stories from their own experiences and literature that emphasize how the length of day is different at different times of the year.

## GRADE ONE VIGNETTE 3.2: PATTERNS OF MOTION OF THE SUN

**Performance Expectations**

Students who demonstrate understanding can do the following:

**1-ESS1-1.** Use observations of the Sun, Moon, and stars to describe patterns that can be predicted.

| Highlighted Science and Engineering Practices | Highlighted Disciplinary Core Ideas | Highlighted Crosscutting Concepts |
|---|---|---|
| [SEP-4] Analyzing and Interpreting Data | ESS1.A: The Universe and Its Stars<br>PS4.B Electromagnetic Radiation | [CCC-1] Patterns<br>[CCC-2] Cause and Effect<br>[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:** 1.MD.3

**CA CCSS for ELA/Literacy Connections:** W.1.2

**CA ELD Standards Connections:** ELD.PI.1.10

### Introduction

Mrs. H is planning an instructional segment in which students observe the patterns of motion of objects in the sky, specifically the Sun. She wants her students to observe and then describe the movement of the Sun in the sky throughout a school day. The observation of these regular patterns of movement across multiple days will provide students a foundational understanding of disciplinary core idea ESS1.A: The Universe and Its Stars. This instructional segment also allows a strong connection between the CCC of **patterns [CCC-1]** and the SEP of **analyzing and interpreting data [SEP-4]**. She considers this instructional segment to be a natural link to what the students have learned in mathematics about time, and she plans to include concepts related to time measurement to integrate mathematical concepts.

#### Day 1: Shadows

**Anchoring phenomenon:** Shadows come in different shapes and sizes.

Mrs. H began her instructional segment on Groundhog Day (traditionally celebrated on February 2). As the school day began, she took students outside and asked them to find as many shadows as they could, and to explore them. How many could they find? What was making each shadow? What made the biggest and smallest shadows? What discoveries did they make as they explored? What questions did they have about shadows? They returned inside and she read a story about the groundhog and its shadow to engage the students. She told them that they would be observing their shadows over the next few days.

## GRADE ONE VIGNETTE 3.2: PATTERNS OF MOTION OF THE SUN

**Investigative phenomenon:** Shadows change direction and length during the day.

Immediately after reading the story, Mrs. H took the students back outside to a paved section of the school grounds. The students would return to this location to observe and measure their shadows during the week. The students worked with partners to trace their shadows. One student drew two chalk Xs to mark the position of the feet where her partner was standing while the other traced the shadow on the pavement. Then they traded roles and traced the second student's shadow. They were amazed at the length of their shadows! Just before lunch they returned to their traced shadows, placed their feet on the Xs, and traced the new positions of their shadows in a different color. They're so short! Mrs. H asked the students to predict where and how long their shadows would be in a few hours. At the end of the school day, the students returned one more time to trace the new position of their shadows. Before they left school for the day, the students compared their predictions with the actual positions and lengths of their shadows.

### Days 2–3: Observations and Patterns

**Investigative phenomenon:** Shadows follow a similar pattern each day over the course of a week.

The students observed the position of their shadows and measured the length of the shadows from the position of their feet to the head of the shadow at the same three times each day for three days during the week. With assistance from Mrs. H, the students recorded the lengths and positions on charts she had prepared for them. The chart had places for students to write the date, the time, and the length of their shadow and to draw a picture of the position of the shadow. By recording the time of their observations, students practiced telling and writing time by the hour and half hour, a connection to mathematics (CA CCSSM 1.MD.3).

Mrs. H could have also worked with the expanded learning program at the school so that some students measured shadows during the late afternoon to provide the whole class with more opportunities to identify **patterns [CCC-1]** based on additional observations and recorded information.

When the students **analyzed the data [SEP-4]** in their charts, they could see that there was a pattern between the length of the shadow and the time of day, and that the pattern repeated each day that week. Mrs. H had them create a table that summarized their findings:

| | Morning | Lunch | Afternoon |
|---|---|---|---|
| **Shadow direction** | west | north | east |
| **Shadow length** | long | short | long |
| **Shadow darkness** | dark | dark | dark |

## GRADE ONE VIGNETTE 3.2: PATTERNS OF MOTION OF THE SUN

The students noticed the differences among the ways these three features changed. The darkness of the shadow did not change at all, the shadow direction moved in one direction (a trend) and the length went up but then came back down (a pattern).

### Day 4–5: Creating and communicating models

**Investigative phenomenon:** The arrangement of objects and light sources in the classroom affects the length and direction of shadows.

Mrs. H wanted students to **create a model [SEP-2]** of a **system [CCC-4]** that made a similar pattern. She asked them what objects they would need to create a shadow (What components does the system need?). She gave the students a light source and an object to block the light and told them, "I want you to perform an 'exploriment' with these materials, moving them around so that you can see what causes the shadows to change. In five minutes, your goal is to be ready to describe the changes you can make to the shadow using the sentence *When I _____, it causes _____*." Mrs. H circulated around the classroom trying to harness the students' playful energy. She encouraged them to try to shine the light at the object from crazy places like right up above it (Where did its shadow go?) and from across the room (It doesn't work). At the end of the time, she asked students to **communicate [SEP-8]** one finding to the class. She asked the rest of the students to identify and separate the **cause and the effect [CCC-2]** in each student's contribution.

Mrs. H then gave students the challenge to move their light so that it reproduced the trend in shadow direction, the pattern in shadow length, and the lack of change in shadow darkness. Would they start with the flashlight close to the object in the morning and move steadily away? No! She circulated helping students reflect on whether or not their model accurately reproduced all three features they had recorded on the data table. Students then converted their physical model to a **pictorial model [SEP-2]** by drawing a diagram that they could share with others.

## Vignette Debrief

This vignette is anchored in a phenomenon that students experience every day, the rising and setting of the Sun. Rather than observing the Sun directly, they observe shadows and then relate the shadows to the apparent motion of the Sun across the sky using a classroom model.

**SEPs**. Students **conduct an investigation [SEP-3]** but play only a minimal role in the planning at this stage. On days 4–5, students develop a physical model that reproduces the patterns they observe.

**DCIs**. This vignette builds on students' understanding of shadows and light (PS4.B) from IS3. At the grade one level, students observe and describe patterns in the apparent movement of the Sun, Moon, and stars (ESS1.A). They do not, however, explain how Earth's rotation is the **cause [CCC-2]** of the pattern. Although teachers can certainly respond to students who

### GRADE ONE VIGNETTE 3.2: PATTERNS OF MOTION OF THE SUN

have background knowledge about Earth's rotation, it is not part of the grade one performance expectation because many early elementary students do not have the spatial reasoning to develop a complete physical model of the Earth-Sun system. As part of the developmental progression, they will extend their observations of these patterns in grade five (5-ESS1-2) and finally develop a model of the Earth-Sun system in the middle grades (MS-ESS1-1).

**CCCs**. This lesson focuses on observing and describing **patterns [CCC-1]**. Students begin to recognize patterns that recur over time (instead of simply patterns in what they can see in a given moment) and use them to make predictions. Students **investigate [SEP-3]** how changes in the position of a light in a simple **system [CCC-4]** that includes a flashlight and an object **cause [CCC-2]** the shadow to change length and position.

**EP&Cs**. The pattern of shadows is one of many important natural cycles that humans depend upon (EP&C III).

**CA CCSS Connections to English Language Arts and Mathematics**. Students use information they collected and recorded to write informational/explanatory text to accompany their models. This connects to CA CCSS for ELA/Literacy W.1.2. As they recorded their observations of their shadows, they wrote down the time of their observations (CA CCSSM 1.MD.3).

**Resources:**
Teacher-selected book on Groundhog Day

Like the Sun, the Moon also has several **patterns [CCC-1]** of change that students can discover by direct **investigation [SEP-3]**. Students can focus on describing a single pattern and using it to make predictions (1-ESS1-1). Students often ask, "How can we study the Moon at school because we aren't here during the night?" Storybooks usually use the Moon as a symbol of the night, but students will discover that it is actually visible just as often during the day as the night. Students can record which days it is visible during the school day, taking careful note of the time of their observations (CA CCSSM 1.MD.3). Students will record similar data in grade five and then represent it more precisely using graphs (5-ESS1-2). In grade one, students' **data analysis [SEP-4]** should answer questions about how many days the Moon was visible and whether it was more often visible or hidden during the day (CA CCSSM 1.MD.4). Since the Moon can be hard to spot during the day, teachers might need to direct student attention to the proper location in the sky (teachers can consult an online almanac or app to help them). Students might **ask questions [SEP-1]** about why the Moon looks so dim during the day. Teachers can return to the idea that we see objects only when they are lit (by having light shined

on them or by glowing themselves, as they learned in IS3), but students are not ready to develop a full model of phases of the Moon until the middle grades (MS-ESS1-2).

Students can draw or photograph the shape of the Moon over several weeks; however, only some of the Moon phases are visible during school hours. As a home–school connection, children observe the Moon at night with their families (especially during winter months when darkness comes before first grade bedtime). Students can search through a selection of picture books and notice how the illustrator chose to draw the Moon. They can arrange pictures from different books so that they reveal the **pattern [CCC-1]** in the Moon's apparent shape. Students should be able to use this pattern to make simple predictions. How long does it take for the pattern to repeat? What will its shape look like next week?

## Opportunities for ELA/ELD Connections

Student can become familiar with the different phases of the Moon through a series of read-aloud books such as *The Moon Book* by Gail Gibbons; *Faces of the Moon* by Bob Crelin; *Phases of the Moon* by Gillian M. Olson; and *The Moon Seems to Change* by Franklyn M. Bradley. The words *full, half*, *rising,* and *setting* are all high-utility words that are worth introducing. Many books also emphasize names for each phase of the Moon, and focusing on these terms can distract from the more important goal of recognizing a consistent pattern in the Moon's appearance.

**CA CCSS for ELA/Literacy:** RI.1.2, 4, 7, 10.a; L.1.4, 6

**CA ELD Standards:** ELD.PI.2.5, 6

Students can also collect data about how the Moon moves across the sky over the course of a single day by direct observation. How long does it take to get from one place to another in the sky? Is it the same pattern each day? Where will the Moon be at the same time tomorrow? How does the Moon's motion compare to the Sun's? Students can complement direct observations with other sources such as the sequence of illustrations of the rising Moon in *Goodnight Moon* by Margaret Wise Brown (and the clocks in the illustrations record the time).

## Sample Integration of Science and ELD Standards in the Classroom

Students use observations and daily firsthand recordkeeping of the Sun (where it is in the sky at different times of the day, the changes in a shadow throughout the day) and Moon (where it is in the sky in relation to different parts of the schoolyard); and use media and observations about the stars to describe patterns that can be predicted (1-ESS1-1). They share the recorded information, via charts, pictures, and writings, to compare predictions and analyze the patterns of these phenomena. They use sentence frames to analyze the patterns, for example, "Today at ___, the Sun will be ____ in the sky." As students report patterns of motion of the Sun, Moon, and stars in the sky, they select specific language needed for clarity, and can analyze other writers' use of language. For example, students can describe the choice of verbs in a statement describing what happens when the Sun and the Moon move across the sky: they appear to rise in one part of the sky, and move across the sky, to set in another part of the sky. To support students at the Emerging level of English proficiency, the teacher selects key verbs and spends time teaching the meaning of these verbs in vocabulary lessons. The teacher also asks students specific questions, such as, What verbs does the author use? and, when necessary, verbally supports students when they respond.

**CA ELD Standards**: ELD.PI.1.7
*Source*: Lagunoff et al. 2015, 218–219