Engineering Connection: Create a Better Soil

Students play the role of agricultural engineers, trying to create a soil that retains as much moisture as possible for plants to grow. They test sand, woody material (bark), and clay (vermiculite) to see which will absorb the most water. They place each ingredient in a plastic cup with holes in the bottom and pour in a fixed amount of water. How much water leaks out? (Be sure to catch the water in containers below to compare the amount that flowed through). They weigh each cup before and after to figure out how much water was retained. Over the next few days, they record how quickly the soil dries out (by measuring the weight). They get to blend ingredients together to get the optimum mixture and test it (2-PS1-2; K–2-ETS1–3). *(This engineering connection could be completed during IS4 when students explore the needs of plants in more detail.)*

Engineering Connection: Create a New Toy with Old Parts

Teachers can ask parents to bring in old electronics and appliances that students can disassemble. With a briefing about proper safety precautions for sharp edges (and with a few parent volunteers), the students use screwdrivers and pliers to dismantle the devices. In their engineering notebooks, students make a list of the different parts they find and their material properties. They **ask questions [SEP-1]** about what each part does. Then, they try to reassemble the parts to **design [SEP-6]** a new toy with the existing materials. They make a sketch of their toy and document why they chose particular materials (2-PS1-3).

IS3 Grade Two Instructional Segment 3: Landscape Changes

Students apply their understanding of material properties to figure out which natural forces affect landscapes. Every rock records a story. Earth scientists look out on a landscape and **ask questions [SEP-1]** about both the processes that are actively shaping it today and the specific sequence of events in the past that led up to the present-day. What makes the mountains tall? Why are some mountains steeper than others? How are mountains and volcanoes related? Scientists **plan and conduct investigations [SEP-3]** to answer those questions using what geologists often refer to as their natural laboratory—Earth's present-day landscape.

GRADE TWO INSTRUCTIONAL SEGMENT 3: LANDSCAPE CHANGES

Guiding Questions

- What evidence do natural processes leave behind as they shape the Earth?
- How do the material properties of rocks affect what happens to them in landscapes?

Performance Expectations

Students who demonstrate understanding can do the following:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly. [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly, and erosion of rocks, which occurs slowly.] [*Assessment Boundary: Assessment does not include quantitative measurements of timescales.*]

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water and different designs for using shrubs, grass, and trees to hold back the land.]

K–2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

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-2] Developing and Using Models [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering) [SEP-8] Obtaining, Evaluating, and Communicating	ESS1.C: The History of Planet Earth ESS2.A: Earth Materials and Systems ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution	[CCC-6] Structure and Function [CCC-7] Stability and Change

CA CCSS for ELA/Literacy Connections: RI.2.1, 3

CA ELD Standards Connections: ELD.PI.2.6, 11

How long is "a long time"? When it comes to the Earth, some changes take so long that they are difficult for adults to fathom, let alone students in grade two. But not all Earth processes are slow: an entire mountainside that took millions of years to be thrust up might collapse in a few minutes during a major landslide or volcanic explosion. The San Andreas Fault, which has been active for more than 20 million years, can move an entire city more than 30 feet in a single lurch lasting just a few seconds. Each of these processes

leaves evidence behind by the way it **changes [CCC-7]** the shape of landscape. Students have some familiarity with different processes occurring on different time **scales [CCC-3]**: their hair may grow so slowly that they don't notice, but it can be cut in just a few seconds causing a major **change [CCC-7]** in their hair style.

Before students can understand the different timescales of Earth processes, they must have some familiarity with the processes that shape the landscape. In IS1, they documented the shapes of landforms and now they are ready to start **asking questions [SEP-1]** such as, "What **caused [CCC-2]** this landform to be shaped this way?"

Students begin by making observations of landforms that display different and interesting shapes (using local examples when possible). Much like sculpting a statue out of stone, certain natural forces had to break off pieces of rock and move them away to create each landform. On Earth, wind and water are the most common natural forces that accomplish these tasks. Students plan investigations of each. They pour water onto the top of a stream table (a container or tray filled with sand propped up on one end to represent a sloping mountain side), a **physical model [SEP-2]** that simulates a river. They **investigate [SEP-3]** the **effects [CCC-2]** of different amounts of water, steepness, or adding different materials to the riverbed. Within a given scenario, which changes happened rapidly and which changes happened slowly? Why? Which scenarios produce the most rapid changes overall? How would the results differ if the stream table were filled with a material that was stronger or less absorbent? The material properties of rocks have a strong effect on how quickly the rocks erode in real landscapes. In a different experiment, students blow into straws as a physical model of the wind. The landforms that are created by the wind often have very different shapes than landforms created by moving water. Students can learn to recognize these differences, and teachers ask students to use the shapes of the landforms as evidence to **argue [SEP-7]** that either wind or water was responsible for sculpting a given landform in a sandbox. Professional geologists use this same strategy of looking at landform shape to infer the history of the landform and the processes that shaped it.

Opportunities for ELA/ELD Connections

Using a cause and effect template [CCC-2] or note-taking guide, students investigate and record the natural processes that cause changes in landforms. Keep in mind that some students may benefit from working and discussing their thinking in pairs or in small groups. Students should address the questions *what*, *where*, *when*, *why*, and *how* when describing the processes that cause changes in landforms.

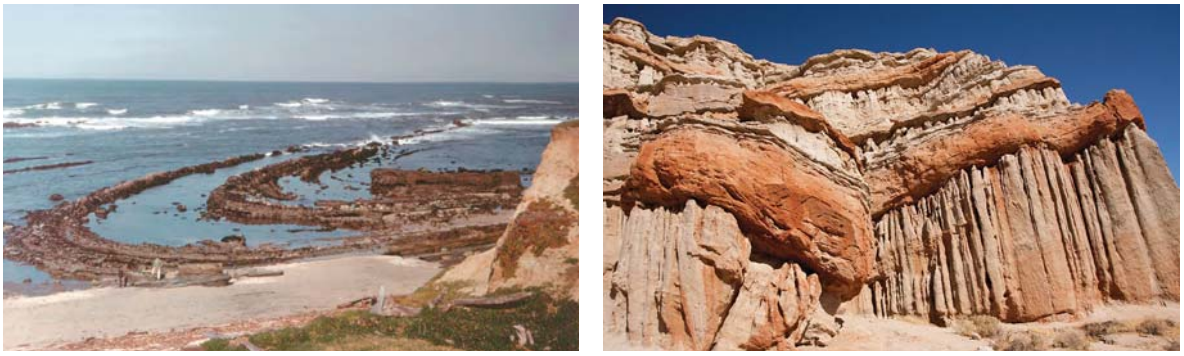
CA CCSS for ELA/Literacy Standards: RI.2.1, 3
CA ELD Standards: ELD.PI.2.6, 11

Engineering Connection: Design a Way to Slow or Stop Changes to the Landscape

Student can turn their investigations of natural processes that change landforms into an engineering design challenge to slow down or eliminate the changes to the landscape by wind or water. They sketch their design and add labels to depict how its shape reduces the effects of the wind or water (K–2-ETS1-2). They explain how the properties of the materials they use help the design accomplish its function. After building and testing their designs, they compare their solution to their classmates', identifying specific advantages and disadvantages of each design (2-ESS2-1).

Building on their firsthand experience with processes that shape landscapes, students **obtain information [SEP-8]** about specific landforms in California and beyond from textbooks or articles appropriate to their grade level. They focus on the processes and timescales in which water and wind shape each landscape. Some of the landforms can reveal the effects of different strength materials, like the hard dark rocks at Moss Beach that remain in curved layers while the waves have eroded the softer rocks around them (figure 3.8).

Figure 3.8. Examples Where Strong Rocks Erode More Slowly Than Weak Rocks



Curved layers of dark rock erode slowly at Moss Beach, California (left) and red layers are stronger and remain massive while white layers are eroded in dramatic vertical lines in Red Rock Canyon State Park, California (right). *Source*: Powell et al. 2007; David~O 2010

To assess their understanding of how different events change the landscape at different rates, each student selects two landforms to compare side-by-side: one that formed slowly and one that formed quickly. Which changes could they witness in a single day and which would take lifetimes? They describe how each one was shaped by different processes working on different timescales (2-ESS1-1).

Sample Integration of Science and ELD Standards in the Classroom

Students read a text comparing time periods (e.g., an instant versus their age versus centuries). They work as a class and in small groups to make observations (firsthand or from media) to construct an evidence-based account for Earth events that occur quickly (e.g., earthquakes) or slowly (e.g., rock erosion) (2-ESS1-1). The students participate in collaborative investigations such as tumbling various types of rocks in plastic tubs with water to see if any changes occur, and compare these investigations to a water-table model of erosion (using different soil types and/or different amounts of water) and/or video footage of mudslides, volcanoes, earthquakes, and beach erosion. Using key academic vocabulary that the teacher has posted on a word wall, students have conversations in which they provide detailed descriptions and analysis of their observations of text and images, as well as class collaborative and individually recorded ideas, to formulate clarification questions, provide summaries, and share results. The teacher provides various supports during these activities for the students at the Emerging level of English proficiency. For example, during the reading activity, the teacher shows pictures and other labeled graphic representations of the concepts to help students understand. After the reading activity during designated ELD time, the teacher works with the students to unpack the meaning of a key complex sentence within the text.

CA ELD Standards: ELD.PI.2.6

Source: Lagunoff et al. 2015, 216–217