6.ESS2.2 How Water Shapes the Earth's Surface

Phenomenon-Based Instructional Task: Wandering Water

Performance Expectation (PE) | 6.ESS2.2
Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Disciplinary Core Idea (DCI) | The Roles of Water in Earth's Surface Processes
Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

Possible Driving Phenomena

Student Observation or Initial Interaction
Students watch two time-lapse videos of glacier ice in motion. To facilitate this activity, have students use the link below to watch the videos: Khumbu Icefall, Mt. Everest; and Sólheimajökull Glacier, Iceland.

Extreme Ice Survey: extremeicesurvey.org/

Phenomenon Explanation for Teachers
A glacier forms when layers of snow and ice accumulate. Over time, the glacier increases in size and mass. Gravity pulls the glacier down, causing it to flow like a river. When glaciers move, they pick up and redeposit debris while causing land erosion. This is how glaciers carve out valleys and reshape the surface of the Earth.

Student Observation or Initial Interaction
Students watch one or more time-lapse videos of ice or water movement over three decades. To facilitate this activity, have students use the link below to watch videos from the menu on the left: Columbia Glacier Retreat (Alaska, USA); Meandering Rivers (Kosi River, Bihar, India); and/or Meandering Rivers (Iquitos, Peru).

Google Earth: earthengine.google.com/timelapse/

Phenomenon Explanation for Teachers
Rivers can change course over time. This often depends on how much water there is or how fast it moves. Because of gravity, water moves downhill. Over time, moving water picks up sediment from riverbanks and redeposits it in new places. When sediment builds up, it causes water to move more slowly in that area, so the river's course may change naturally to create a curve where the water can move faster. This gradually reshapes the Earth's surface.

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How Does the Phenomenon Connect to the DCI or PE?

This phenomenon is one example of how "*water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.*" As students gather evidence to explain how a meandering river changes course over time or how a glacier shapes Earth's surface by moving sediment, they begin to construct an argument to show how water interacts with Earth materials in multiple ways to create a complex pattern of change to Earth's surface. This pattern includes processes involving not only water but also wind, sunlight, gravity, and temperature interacting within the geosphere, atmosphere, and hydrosphere. As students broaden their experience with other phenomena like this one, they learn to use natural phenomena to provide evidence that "*geoscience processes have changed Earth's surface at varying time and spatial scales*." Using models may provide them with a sense of scale that can help facilitate their understanding of how to think about time scales that extend well beyond their own experience.

Gathering Evidence and Using Reasoning to Construct and Refine Explanations

How can students gather evidence using Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs) to help them construct and refine a supported explanation of the phenomenon?

Students construct and then refine explanations (individual or group) for the phenomenon at various times during the task. This could involve an initial explanation after initial observation and then ongoing revision of this explanation after continued exploration.

1. Initial Engagement With the Phenomenon
Students ask questions after observing the phenomenon.

• Overarching question: How do water's movements change Earth's surface?

• Possible question-generating engagement strategy: I Notice, I Wonder using a T-chart.

• What types of evidence could we gather to help answer these questions?

2. Continuing Exploration
Students observe other locations to investigate and collect evidence from different places in the world where rivers, glaciers, and other water formations have shaped the Earth over time. They look for patterns in the observation data they collect to help them determine cause-and-effect relationships.

Guiding Questions

- What similarities and differences do you notice among locations where water is changing the surface of the land?
- Do you see any patterns that might help you determine a cause-and-effect relationship between water movement and changes in surface features?
- Are Earth materials eroded and deposited in similar ways across different circumstances?
- In what ways is energy being transferred in different water–land systems?

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Students use physical models and/or online simulations or videos to investigate the effects of water as it moves over Earth materials. For example, students plan and/or carry out investigations of water movement on various Earth materials, slopes, or water velocities/ amounts using stream tables or glacier models.

- How does this model compare to a real stream, river, or glacier?
- How does this model help us understand interactions that occur on Earth's surface between land and water?

Communicating Understanding Through Final Explanation of the Phenomenon

How might students communicate their understanding of the targeted DCI or PE in an explanation supported by evidence?

Students generate a final explanation of the phenomenon in the form of a final written revision or an alternate type of explanation. This final explanation should be done individually.

Possible Formats for Constructing Explanations of the Phenomenon

• Students write a paragraph using the Claim-Evidence-Reasoning (CER) strategy. They provide an evidence-based explanation in this format. The claim could address a student-generated question or a teacher-provided question, such as:

- How does the movement of water affect Earth's surface?
- What evidence can you provide to support this explanation?

• Students draw and label a model in the form of a diagram that shows how the movement of water can change Earth's surface features. These models can be used as visual aids to help students describe their ideas to others or can be part of a written explanation.

• Students create a physical model that demonstrates the effects of water's movement on Earth's surface. As students demonstrate the model to others, they point out the cause-and-effect mechanisms and the related evidence that shows how water affects and alters Earth's surface.

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