

Lessons 8–11

Erosion

Prepare

These lessons build on knowledge that wind and water can change the shape of the land and that some events occur very quickly while others occur so slowly humans cannot observe them. In Lesson 8, students create landscapes in stream tables. In Lesson 9, students use their prior knowledge about wind and water to investigate causes and effects of erosion by water, ice, wind, and gravity. In Lesson 10, students plan and conduct an investigation to study the effect of varying rates of erosion on a landscape and conclude that sometimes erosion is a quick process and sometimes it is a slow process. In Lesson 11, students apply their new knowledge of weathering and erosion to a different canyon in a Conceptual Checkpoint and answer the Concept 2 Focus Question: **How are Earth's rock layers uncovered?**

Student Learning

Knowledge Statement

The process of erosion causes changes in landscapes at varying rates.

Concept 2: Weathering and Erosion

Focus Question

How are Earth's rock layers uncovered?

Phenomenon Question

Where does all the weathered rock go?

Objectives

- Lesson 8: Prepare a stream table landscape for investigation.
- Lesson 9: Investigate how sediment is moved.
- Lesson 10: Investigate rates of erosion.
- Lesson 11: Explain how rocks in the Grand Canyon have been changed by weathering and moved by erosion.

Texas Essential Knowledge and Skills Addressed

- 5.2A **Describe, plan, and implement simple experimental investigations testing one variable.** (Introduced)
- 5.2B **Ask well defined questions, formulate testable hypotheses, and select and use appropriate equipment and technology.** (Introduced)
- 5.2D **Analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence.** (Addressed)
- 5.2E **Demonstrate that repeated investigations may increase the reliability of results.** (Introduced)
- 5.2F **Communicate valid conclusions in both written and verbal forms.** (Introduced)
- 5.3B **Draw or develop a model that represents how something that cannot be seen** such as the Sun, Earth, and Moon system and formation of sedimentary rock **works or looks.** (Addressed)
- 5.7B **Recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth's surface by wind, water, or ice.** (Addressed)

English Language Proficiency Standards Addressed

- 2E Use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language.
- 5A Learn relationships between sounds and letters of the English language to represent sounds when writing in English.
- 5C Spell familiar English words with increasing accuracy, and employ English spelling patterns and rules with increasing accuracy as more English is acquired.



Materials

		Lesson 8	Lesson 9	Lesson 10	Lesson 11
Student	Science Logbook (Lesson 8 Activity Guide)	●			
	Prepare Stream Table Landscape (1 per group): 1 clear plastic bin (20" × 12" × 6" or larger) with 1 hole, 1 rubber stopper, 8 cups of soil, 2 cups of sand, 1 9-ounce clear plastic cup, optional other natural materials (e.g., leaves, grass, pebbles, sticks)	●			
	Science Logbook (Lesson 9 Activity Guides A and B)		●		
	Wind Investigation (1 per group): 1 stream table from Lesson 8, 1 straw (per student), safety goggles (per student), 2 cups of pebbles, 2 cups of large rocks, 1 quart-sized bag of grass, 1 bucket (or other plastic container large enough to catch debris and water runoff)			●	
	Water Investigation (1 per group): 1 stream table from Lesson 8; 1 ice cube; 1 9-ounce plastic cup with 7 to 8 small holes; 1 9-ounce plastic cup with 1 hole; 1 hook and loop fastener; water; pebbles, rocks, grass, and bucket (or other plastic container) from Wind Investigation			●	
	Gravity Investigation (1 per group): printed copy of Gravity Investigation Photographs (Lesson 9 Resource)			●	
	Science Logbook (Lesson 10 Activity Guide)			●	
	Rate of Erosion Investigation (1 per group; materials will vary but may include the following): 1 stream table from Lesson 8; 1 9-ounce clear plastic cup with 1 hole; 1 9-ounce clear plastic cup with 2 holes; 1 9-ounce clear plastic cup with 3 holes; 1 hook and loop fastener; water; pebbles, rocks, grass, and bucket (or other plastic container) from Lesson 9			●	
	Science Logbook (Lesson 11 Activity Guides A and B)				●

		Lesson 8	Lesson 9	Lesson 10	Lesson 11
Teacher	Present-Day Grand Canyon Figure 4 (Lesson 1 Resource D)	●			
	Drill, drill bit (size depends on rubber stopper diameter)	●			
	Driving question board		●	●	●
	Colorado River Map and Photographs (Lesson 11 Resource A)				●
	Anchor chart, anchor model				●
	Conceptual Checkpoint Photographs (Lesson 11 Resource B)				●
Preparation	Create stream table bins by drilling one hole in one corner of each plastic bin. The diameter of the hole depends on the rubber stopper diameter. The rubber stopper should fit snugly in the hole, preventing water flow.	●			
	Prepare materials for investigations and determine how students will retrieve materials. Either line up all materials by item on a counter for students to access when needed or gather each group's set of materials beforehand.	●	●	●	
	Create cups with 1, 2, and 3 holes for Rate of Erosion Investigation.			●	

Lesson 9

Objective: Investigate how sediment is moved.

Launch 3 minutes

Have students return to the groups they were in for Lesson 8 and position their stream tables for their investigations. Remind students they will use the landscapes they created in their stream tables to model what happens to the weathered rock in the Grand Canyon.

► **What do you think could move weathered rock?**

- *People could pick up the rocks.*
- *Sand blows around at the beach, so maybe wind could move rock.*
- *Big machines could move really big rocks.*
- *I think water could move the smaller pieces of rock, because when my sister waters the garden, dirt sometimes goes all over the place.*

Remind students that the materials they used to create the stream tables in Lesson 8 and the materials they will add in this lesson represent weathered (broken) rock and other natural materials found in the Grand Canyon. Ask students to keep these connections in mind as they conduct their investigations and make observations. 🐛

Agenda

Launch (3 minutes)

Learn (37 minutes)

- Investigate Causes of Erosion (27 minutes)
- Define Erosion (10 minutes)

Land (5 minutes)



Extension

The investigations in this lesson cover natural causes of erosion. As an extension, have students research different ways humans impact the land and how those impacts contribute to erosion.

Learn 37 minutes

Investigate Causes of Erosion 27 minutes

Explain that students can find procedures for three investigations in their Science Logbooks (Lesson 9 Activity Guide A). These investigations aim to answer the Phenomenon Question **Where does all the weathered rock go?** Students should record this investigation question at the top of the page in their Science Logbooks (Lesson 9 Activity Guide A).

Direct students to read and discuss the investigation procedures. Ensure that students understand how to set up their stream tables for the investigations. Review class expectations for working in small groups as well as necessary safety guidelines.

Safety Note

These investigations pose potential hazards. To minimize the risk, review these safety measures and look for evidence that students are following them (5.1A).

Wind Investigation (Investigation 1)

- Wear goggles throughout the entire investigation to avoid blowing debris into the eye.
- Do not touch the straw to the contents of the stream table or suck anything into the straw to avoid ingesting any material from the stream table.
- Only blow air, not saliva, through the straw to avoid contamination.

Water Investigation (Investigation 2)

- Clean up water spills and debris immediately to avoid slips and falls.

Distribute materials and direct students to work through the investigations as directed in their Science Logbooks. If needed, clarify what the pebbles, large rocks, and grass represent in the landscape before students start the investigations. All groups should start by setting up their stream tables for the investigations and should do the investigations in order. As students work, circulate, reminding students to refer to their procedure sheets and to record detailed observations in their Science Logbooks (Lesson 9 Activity Guide A).



Teacher Note

The pebbles, rocks, and grass needed for these investigations can be bought from an online vendor or garden center, or they can be sourced locally. For example, students can bring the materials from home or collect the materials outside around the school.



Teacher Note

Although the Teacher Edition has the investigations labeled as Wind, Water, and Gravity, avoid naming the investigations for students until after they complete the tasks. Through the inquiry process, students should naturally develop a deeper understanding of what each investigation models.



Teacher Note

The large rocks and pebbles represent the larger pieces of weathered rock at the Grand Canyon, and the grass represents plants and other debris.

Investigation 1 (Wind)

During the Wind Investigation, students explore how wind can move weathered material. 

Sample observations:

- *When we blow lightly down into the stream table, the smaller pieces of dirt and grass move easily, while the larger pieces (e.g., pebbles, rocks) do not move.*
- *When we blow harder down into the stream table, more material moves than when we blow lightly.*
- *One hard puff of air moves a lot of smaller materials from a small area of the stream table.*

Investigation 2 (Water)

During the Water Investigation, students explore how water, in liquid and solid states, can move weathered material. 

Sample observations:

- *The ice, acting as a glacier, moves some dirt as we push it down the stream table. It leaves a small track behind it and a ridge of sediment in front of it.*
- *Water falling like rainfall from the cup with small holes moves some dirt down the stream table.*
- *Pouring a large amount of water (like a river) moves a lot of material down the stream table.*
- *The clear water becomes muddy as it travels down the stream table.*

Investigation 3 (Gravity)

During the Gravity Investigation, students look at photographs and infer how gravity can cause landslides or falling rocks, which can move weathered material.



Teacher Note

Keep the straws for the Wind Investigation in a clean container until ready to use. Be sure each student uses a new, clean straw, and dispose of used straws appropriately.



Differentiation

If students are unable to have continuous breath due to breathing issues such as asthma, have them record the results of other team members.



Teacher Note

Students are introduced to the term *glacier* in their Science Logbooks (Lesson 9 Activity Guide A) as a part of the water investigation.

1



2



3



Sample observations:

- In the first and second pictures, it looks like large rocks fell down the side of the canyon.
- In all the pictures, I can see smaller pieces of rock that are scattered at the bottom of the wall of rock.
- Some of the rocks may have knocked into others as they fell and made them fall too.
- Gravity pulled the rocks down to the bottom of the canyon.

Define Erosion 10 minutes

Debrief the investigation with students as a class.

► **What do our breath and liquid water represent about the Grand Canyon?**

- *Blowing through a straw is like the wind.*
- *The cup with small holes makes water fall like rain.*
- *The cup with one hole is like the river or the waterfall.*

► **What similarities do you notice about all three investigations?**

- *Certain materials in the stream table always move with any amount of water or air.*
- *A force causes the dirt and rocks in the stream table to move. The force comes from moving air, moving ice, moving water, or gravity.*

Explain that all three investigations represent **erosion**, which is a process that moves weathered rock, and that the weathered rock that is carried away by wind, water, ice, or gravity is called **sediment**.

► **What happens to the sediment when we take away the cause of erosion?**

- *The sediment settles into an area away from where it was before.*



English Language Development

This module uses the words *erosion* and *sediment* repeatedly. Introduce these terms explicitly. Sharing the Spanish cognates for *erosion* (*erosión*) and *sediment* (*sedimento*) may be useful (5C).

Tell students they will now use observations from their investigations to develop a working definition of erosion.

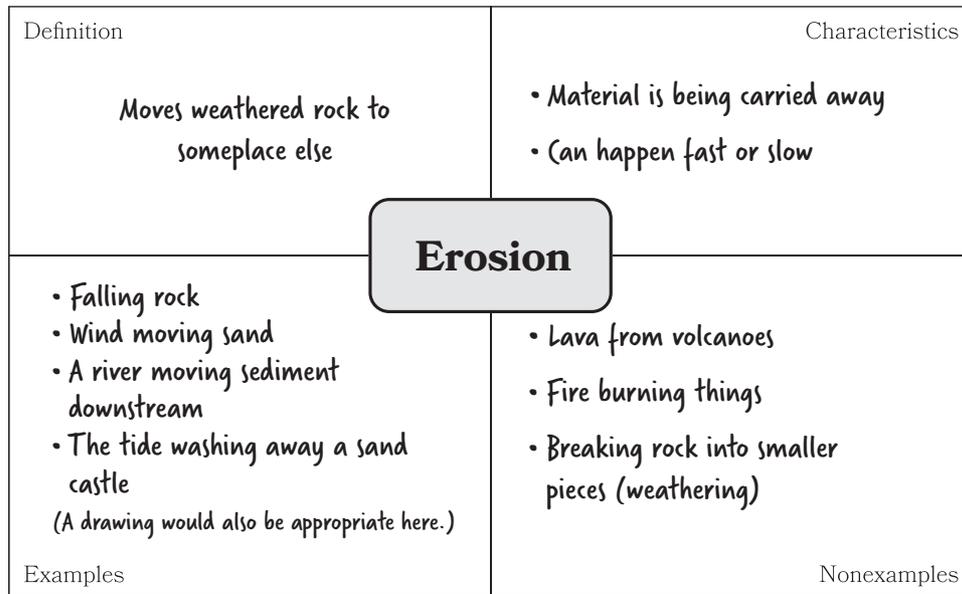
In pairs or small groups, have students complete the Frayer model graphic organizer in their Science Logbooks (Lesson 9 Activity Guide B).  Then construct a class Frayer model as students share their work from each section. Students can add to or change their working definitions during the class discussion.



Content Area Connection: English

The Frayer model is a graphic organizer that students can use to represent their understanding of a word by providing its definition, characteristics, examples, and nonexamples. This time-intensive strategy should be used sparingly with words that represent major knowledge-building concepts. The Frayer model is also a good way to summarize a concept that has already received some attention (5A).

Sample Frayer model:





Check for Understanding

As students work through the Frayer model and share their ideas, observe where students are in their understanding of weathering and erosion.

Evidence

Look for evidence that all students

- include the idea that sediment is moved and deposited somewhere (e.g., transported, carried, washed away),
- identify characteristics that relate to their definitions,
- provide accurate examples of erosion based on their investigations (e.g., water washing sand away, ice pushing material out of the way), and
- provide accurate nonexamples of erosion (e.g., fire, weathering, materials building up).

Next Steps

As these are working definitions, do not expect students to have everything correct at this stage. Through future class discussions (including the update to the anchor chart that occurs in Lesson 11), students will have opportunities to adjust their definitions of erosion. To support learning, emphasize that sediment is the natural material that is carried away by erosion when students use the stream tables again during Lesson 10.

If students define erosion with descriptions that relate to weathering (e.g., wind making a hole, ice causing a crack), consider assigning the Optional Homework to give them practice identifying examples of erosion in their community.

Land 5 minutes

Ask students to use observations from their investigations to explain their thoughts about the Phenomenon Question **Where does all the weathered rock go?**

Sample student responses:

- *Erosion moves rock to a new place. Wind, water, ice, and gravity can all move rock, like we saw in the stream table.*
- *Some types of sediment are easier to move than others. Heavier sediments like pebbles and rocks are harder to move or sometimes do not move at all.*

- *We still do not know where all the weathered rock in the Grand Canyon is now. In the stream table, some got caught on the side of the bin and some flowed into the bucket with the water.*

Display the driving question board and have students generate new questions that relate to the Phenomenon Question **Where does all the weathered rock go?** Listen for questions that relate to how fast or slow erosion occurs, and inform students they will have the opportunity to investigate more about rate of erosion in the next lesson. If students do not respond with questions related to rate of erosion, consider guiding students to do so.

Sample student questions:

- *How long does it take large objects, like glaciers, to move?*
- *Does erosion occur quickly or slowly?*
- *Is erosion why rivers often look muddy?*

Optional Homework

Have students look for evidence of erosion in their community, and ask them to draw a sketch or take a photograph of what they observe to share with the class. For example, while under adult supervision, students can safely observe a river, creek, or other natural water feature in their community.