

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

- 4.2A **Plan and implement descriptive investigations, including asking well defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions.** (Introduced)
- 4.2D **Analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured.** (Addressed)
- 4.2E **Perform repeated investigations to increase the reliability of results.** (Introduced)
- 4.2F **Communicate valid oral and written results supported by data.** (Introduced)
- 4.3B **Represent the natural world using models such as the water cycle and stream tables and identify their limitations, including accuracy and size.** (Addressed)
- 4.7B **Observe and identify slow changes to Earth’s surface caused by weathering, erosion, and deposition from water, wind, and 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 10

Objective: Investigate rates of erosion.

Launch 5 minutes

Let students know they are still working toward developing an understanding of erosion and its causes. Display the driving question board, and remind students that in the previous lesson, they discussed some questions related to how quickly erosion occurs. These questions refer to the **rate of erosion**, which is how quickly or slowly erosion occurs. 

- In our last lesson, we added questions about how quickly or slowly erosion can occur. Today, we will start to answer our questions by investigating the rate of erosion on a river bank.



English Language Development

Understanding the phrase *rate of erosion* is required to participate fully in the activity. Introduce this term explicitly.

Ask students to work with a partner to brainstorm ways in which erosion occurs quickly and ways in which it occurs slowly. Students should share a few ideas and then record them in their Science Logbooks (Lesson 10 Activity Guide). Also direct students to record the investigation question: What affects how quickly or slowly erosion occurs?

Agenda

Launch (5 minutes)

Learn (35 minutes)

- Plan Investigations about Rates of Erosion (15 minutes)
- Investigate Rates of Erosion (20 minutes)

Land (5 minutes)



Teacher Note

Avoid defining *rate* mathematically (e.g., the amount of soil eroded over time). In this lesson, students make subjective observations of rate of erosion, but the lesson could be extended to make quantitative measurements by keeping one quantity the same (e.g., time) and collecting data about the other quantity (e.g., amount). For example, students could design an investigation that measures the amount of soil eroded over a consistent period of time.

Learn 35 minutes

Plan Investigations about Rates of Erosion 15 minutes

Tell students they will now work through the process of designing an investigation to gather evidence to evaluate a claim about rate of erosion. 

Divide students into small groups, and review class expectations for working in groups.  Direct students to discuss their ideas about how erosion can occur quickly or slowly. Students in each group should agree on one idea and write a claim in their Science Logbooks (Lesson 10 Activity Guide) about what affects the rate of erosion for one cause of erosion. Instruct students that their claim must be testable with materials like the ones they used for the wind and water investigations in the previous lesson. As students are working, circulate and check that the claims that groups are developing are reasonable to test with the class materials and time allowed. Ask a few groups to share their claims with the class.

Sample claims:

- *The rate of erosion increases when the volume of water flowing over soil and rocks increases.*
- *The rate of erosion increases when water is released more quickly.*
- *The rate of erosion increases when the strength of the wind increases.*

Then direct each student group to develop a plan to test their claim. Tell students their plan may include diagrams and written steps. Allow groups time to brainstorm an initial plan on chart paper or a whiteboard. Once students have finished, post their plans around the room, and ask them to complete a Gallery Walk to view the plans. Discuss the similarities and differences among the plans. Give students time to revise their plans based on the Gallery Walk, and then approve plans as groups indicate they are ready. After approving each plan, direct students in each group to record their plan in their Science Logbooks (Lesson 10 Activity Guide). 



Teacher Note

This may be students' first attempt planning an investigation to gather evidence to evaluate a claim. Plan on providing extra support and modeling how to develop an investigation plan.

Groups may need help narrowing down variables for investigation. Ensure that students choose one cause of erosion to investigate (e.g., rainfall using a cup with holes, stream flow using cups, wind using straws) and are specific about how they will test at least two different rates of erosion. Also discuss with groups whether their investigation is a fair test. As needed, encourage students to think about ideas to make their tests more fair (e.g., using multiple trials, replacing soil after each trial).



Differentiation

If team dynamics are not well balanced, consider assigning roles to each student so that all students have an active role. Roles can be assigned to support students' strengths. Some possible roles include time keeper, recorder, reporter, materials leader, and discussion leader.



Teacher Note

Students may choose to test wind or water. The sample detailed investigation plan provided is for water. However, students may develop a plan such as the following to test wind:

- *Use different strengths of wind to see the effects on the rate of erosion.*
- *Use soft and hard breaths sustained for 30 seconds each.*

Sample investigation plan:  

Investigation Plan: Release water faster and slower from the stream table to see the effects on the rate of erosion.

1. Set up the stream table.
2. Fill a one-hole cup with 100 mL of water.
3. Release the water from the cup.
4. Record your observations.
5. Reset the table and repeat steps 2–4 two more times.
6. Repeat steps 2–5 with a two-hole cup.
7. Repeat steps 2–5 with a three-hole cup.

	Trial 1	Trial 2	Trial 3	
<i>One-Hole Cup (100 mL)</i>				
<i>Two-Hole Cup (100 mL)</i>				
<i>Three-Hole Cup (100 mL)</i>				

Investigate Rates of Erosion 20 minutes

As students work, circulate around the classroom, and remind them to refer to their investigation plan and to record detailed observations in their Science Logbooks (Lesson 10 Activity Guide).

Sample observations:

- *When we released the water faster (three-hole cup), it washed away the smaller sediment rapidly and moved the larger pieces of rock. The water at the bottom (base) of our stream table also contained a lot of sediment at the end.*
- *When we released the water slower (one-hole cup), it didn't wash away a lot of sediment. The water at the bottom (base) of our stream table didn't contain as much sediment as when we released the water quickly.*



Content Area Connection: Mathematics

When students are creating and executing an investigation plan, encourage them to use precise measurements. Supply rulers, scales, and beakers so students can examine and test if the precise measurements support the plan or if the measurements need to be adjusted. If applicable, ask students to use measurement units when they report their data.



Teacher Note

Students may need to use additional soil when they reset their stream tables between trials. Students may also conduct additional trials if they find inconsistencies in their data. An additional column is provided to record data for a fourth trial, but students may record more data as needed.



Spotlight on Knowledge and Skills

The goal of this lesson is for students to explore causes of varying rates of erosion in a given area. If necessary, facilitate a discussion to explore cause and effect. Note that students directly observe that erosion is caused by water, ice, wind, and gravity and that it can occur quickly or slowly in the investigations they plan and conduct.

Land

5 minutes

Once the investigations have been completed, ask students to revisit their claims and write a brief conclusion in their Science Logbooks (Lesson 10 Activity Guide). 🌱 Have students share their conclusions along with evidence that supports or refutes their claims. While students listen to their peers, they can use nonverbal signals to indicate whether they had similar observations and conclusions. 🗣️

Sample conclusion:

- *Our investigation supported our claim that releasing water faster can increase the rate of erosion. During the investigation, more sediment moved to the bottom of the stream table when we released water using the three-hole cup than when we released water using the one-hole cup.*



Check for Understanding

As students analyze their data, they should use this information as evidence to develop an explanation and evaluate their claim with the Claim, Evidence, Reasoning format.

Evidence

Look for evidence that all students

- include the claim that was written before the investigation, and
- connect evidence from the investigation to their claim by using reasoning.

Next Steps

Because this is the first time that students develop a Claim, Evidence, Reasoning explanation, guide them to make connections between the evidence (data) from their investigations and its relationship to their claim. See the Implementation Guide for more information on developing Claim, Evidence, Reasoning explanations.

Optional Homework

Students research how natural disasters such as floods, cyclones (hurricanes or typhoons), or tornadoes affect rates of erosion.



Content Area Connection: English

Students' knowledge of writing informative and opinion texts may help them understand the Claim, Evidence, Reasoning Format. Help students recognize that they must use evidence to write about both literary and scientific topics and that scientific evidence may come from measurements, observations, and other sources. From writing instruction, students may be familiar with evidence organizers in which they elaborate on evidence to develop a topic. The skill of elaborating on evidence will help students develop their reasoning about how evidence supports their claim.



Spotlight on Knowledge and Skills

Help students reflect on the relationships between observations, data, evidence, and explanations. Collecting observations for reference or analysis creates a qualitative set of data. Quantitative data can be measured or written down with numbers. Data must meet certain criteria, such as resulting from a fair test, demonstrating patterns, and being replicable, to be considered reliable and valid evidence that can support a claim. Scientists identify and interpret the relevant evidence to explain phenomena.