Science Standard 4.10B	Model and describe slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

Phenomenon	**Week 20:** A sidewalk has been broken down, and the pieces create a hazardous area.

Engineering Design Scenario	**Week 21:** A sidewalk has been broken down, and the pieces create a hazardous area.

Unit Objectives

Students will be able to model and describe slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice through the investigation of cause-and-effect relationships and development of models and prototypes.

SEP	RTC
4.1G: Develop and Use Models Develop and use models to represent phenomena, objects, and processes or design a prototype for a solution to a problem.	**4.5B: Cause and Effect** Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems.

Activity Summary

		Lesson Time	5E	Page
Optional: Prior Knowledge			Engage	12.10
1. Review Vocabulary 2. Weathering, Erosion, and Deposition: Prior Knowledge Article		[10 minutes] [15 minutes]		
Week 20: Weathering, Erosion, and Deposition		**3 Hours 45 Minutes Total**		
Day 1 **45 min.**	**1. Phenomenon Introduction**	45 minutes	Engage	12.12
Day 2 **45 min.**	**2. Weathering**	45 minutes	Explore	12.15
Day 3 **45 min.**	**3. Erosion**	45 minutes	Explore	12.18
Day 4 **45 min.**	**4. Deposition**	45 minutes	Explore	12.22
Day 5 **45 min.**	**5. Phenomenon Explanation**	45 minutes	Evaluate	12.25
Week 21: Weathering, Erosion, and Deposition		**3 Hours 45 Minutes Total**	**EDP** (Engineering Design Process)	**Page**
Day 6 **45 min.**	**6. Engineering Design Problem**	45 minutes	Define	12.28
	Optional: Wellness: The Power of Listening	[25 minutes]		12.31
Day 7 **45 min.**	**7. Research**	45 minutes	Define	12.32
Day 8 **45 min.**	**8. Ideate and Plan**	45 minutes	Develop Solutions	12.35
Day 9 **45 min.**	**9. Create**	45 minutes	Develop Solutions	12.38
Day 10 **45 min.**	**10. Test, Improve, and Communicate**	45 minutes	Optimize	12.40
Optional: Extension Activities				12.42
1. Gravity and Erosion 2. Plants and Erosion 3. Deposition 4. Preventing Erosion		[45 minutes] [30 minutes] [30 minutes] [60 minutes]	Elaborate Elaborate Elaborate Elaborate	

Standards Coverage

**Bolded elements are covered within this unit.*

Earth and Space	**4.10: The student knows that there are processes on Earth that create patterns of change. The student is expected to:** • B: **model and describe slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.**
SEP **Scientific and Engineering Practices**	4.1: Ask Questions and Define Problems • A: **Ask questions and define problems based on observations** or information **from** text, **phenomena, models, or investigations.** (Activities 1, 6) 4.1: Plan and Conduct Investigations and Design Solutions • B: Use scientific practices to plan and conduct descriptive investigations and **use engineering practices to design solutions to problems.** (Activities 7, 8, 9, 10) 4.1: Collect Evidence • E: **Collect observations and measurements as evidence.** (Activities 2, 3, 4, 5, 10) 4.1: Collect and Organize Data • F: **Construct appropriate graphic organizers used to collect data, including** tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and **input-output tables that show cause and effect.** (Activity 3) 4.1: Develop and Use Models • G: **Develop and use models to represent phenomena,** objects, **and processes or design a prototype for a solution to a problem.** (Activities 2, 3, 4, 5, 8, 9, 10) 4.2: Identify Advantages and Limitations of Models • A: **Identify advantages and limitations of models such as their size,** scale, properties, **and materials.** (Activity 10) 4.2: Analyze Data • B: **Analyze data by identifying any significant features,** patterns, or sources of error. (Activities 2, 3, 4, 5) 4.2: Evaluate Designs • D: **Evaluate a design** or object **using criteria.** (Activity 10) 4.3: Develop Explanations and Propose Solutions • A: **Develop explanations and propose solutions supported by data and models.** (Activities 2, 3, 4, 5, 10) 4.3: Communicate Explanations and Solutions • B: **Communicate explanations** individually and **collaboratively in a variety of settings and formats.** (Activity 5) 4.3: Listen Actively and Discuss • C: **Listen actively to others' explanations to engage respectfully in scientific discussion.** (Activities 1, 6, 8)
RTC **Recurring Themes and Concepts**	4.5: Cause and Effect • B: **Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems.** (All Activities)
ELAR **English Language Arts and Reading**	4.1: Developing and Sustaining Foundational Language Skills • D: **Work collaboratively with others to develop a plan of shared responsibilities.** (Activities 8, 9, 10) 4.7: Response Skills • G: **Discuss specific ideas in the text that are important to the meaning.** (Activities 2, 3, 4) 4.12: Composition

	• B: **Compose informational texts, including brief compositions that convey information about a topic, using a clear central idea and genre characteristics and craft.** (Activity 5) 4.13: Inquiry and Research • B: **Develop and follow a research plan with adult assistance.** (Activity 7)
ELPS **English Language Proficiency Standards**	1: Learning Strategies • E: **Internalize new** basic and **academic language by using and reusing it in meaningful ways in speaking** and writing **activities that build concept and language attainment.** (Activities 3, 4, 5) • F: **Use accessible language and learn new and essential language in the process.** (Activities 6, 7, 8) 2: Listening • C: **Learn new** language structures, expressions, and **basic** and academic **vocabulary heard during classroom instruction** and interactions. (Activity 6) • D: **Monitor understanding of spoken language during classroom instruction and interactions** and seek clarification as needed. (Activities 2, 3, 4, 6) 3: Speaking • E: **Share information in cooperative learning interactions.** (Activity 7) • H: Narrate, describe, and **explain with increasing specificity and detail as more English is acquired.** (Activities 5, 8, 10) 4: Reading • F: **Use visual and contextual support** and support from peers and teachers **to** read grade-appropriate content area text, **enhance and confirm understanding**, and develop vocabulary, grasp of language structures, and background knowledge needed to comprehend increasingly challenging language. (Activities 3, 4, 7) • G: **Demonstrate comprehension of increasingly complex English by** participating in shared reading, retelling or summarizing material, responding to questions, and **taking notes commensurate with content area and grade level needs.** (Activity 7) 5: Writing • B: **Write using newly acquired** basic vocabulary and **content-based grade-level vocabulary.** (Activity 5)
MATH **Connection**	4.8: Geometry and Measurement • C: **Solve problems that deal with measurements of length,** intervals of time, liquid volumes, **mass**, and money **using** addition, **subtraction**, multiplication, or division as appropriate. (Activity 3)
WELL **Connection** **Wellness**	The Power of Listening (Activity 6)
Review **Vocabulary**	• cause and effect • communicate • create • define • Earth's surface • engineering design process • evaluate • ideate • identify improvements • matter • plan • rapid changes • research • rock • test • weathering

New Vocabulary	**deposition**: when small pieces are dropped off or left in one place **erosion**: the process of moving pieces of Earth's surface from one place to another
 **Common Misconceptions**	• Rocks do not change. • Weathering and erosion are essentially the same thing; the two words can be used interchangeably. • Erosion happens quickly.

Materials List	Activities	Quantity Needed
aluminum foil pans, 13x9x2 in	5, 9	6
anchor chart paper	6	1–2 sheets
dirt	9	5 lb
glue sticks	8	24
marbles, small	9	100
marine sand	4	6 tsp
measuring spoons, 1 Tbsp	9	4
pipe cleaners	9	3 bags
poster paper	10	6 sheets

prepared erosion stations
• aluminum bread loaf pans (4)
• chalk (3 pieces)
• digital scale (1)
• measuring cup, ½ cup (1)
• plastic cup (1)
• prepared bag of ice (1)
  ○ resealable plastic bag (1)
  ○ water (as needed)
• rulers (2)
• salt (1½ c)
• sand (8 lb)
• small clear container with lid (1)
• sticky notes (3)
• string, 1-ft piece (1)
• water (as needed)
	3	2

prepared rock and soil pans • aluminum foil pan, 13x9x2 in (1) • small rocks or gravel (as needed) • soil (4 lb)	4	6
prepared sidewalk model • aluminum foil pan, 13x9x2 in (1) • ruler (1) • saltine crackers (18) • sand (5 lb) • water bottle, 20 oz or larger (1)	1, 6, 8	1

prepared weathering stations
• newspaper (1 piece)
• prepared Weathering by Ice stations
  ○ balloon (1)
  ○ hardening chocolate syrup (16 oz)
  ○ scissors (1 pair)
  ○ styrofoam cups (2)
  ○ water (as needed)
• sand (1 c)
• small clear container with lid (1)
• sticky notes (3)
• straws (3)
• sugar cubes (3)
• water (1 c)
	2	2

research materials (desktops, laptops, and/or tablets; books; printed articles; etc.)	7	as needed
rulers	5, 9	6
saltine crackers	5, 9	72
sand	5, 9	30 lb
scissors	8	24 pairs
straws, thick	9	50
student models	10	6
timer	2, 3	1
toothpick flags	4, 5	96
toothpicks	9	2 boxes
water	10	as needed
water bottles, 20 oz or larger	4, 5, 10	6

Teacher Support Resources

Title	Media	Description
Weathering, Erosion, and Deposition: **ELD Lesson**	PDF	Differentiated language scaffolds that can be projected to students and taught before or after the core science activities
Weathering, Erosion, and Deposition: **Overview Video**	Video	This video overview discusses what the students will learn in the unit as well as information that can help teachers execute the activities successfully.
Weathering, Erosion, and Deposition: **Topic Background Information**	Podcast	A podcast that discusses information to aid teachers in instructional strategies, content, and misconceptions students might have in the unit
Weathering, Erosion, and Deposition: **Lesson Slides**	Slides	A slide presentation for teachers to help guide instruction
Weathering, Erosion, and Deposition: **Answer Keys**	Printable	In this document, you will find answer keys, rubrics, and feedback suggestions for all activities in the unit.
Weathering, Erosion, and Deposition: **Unit Assessment**	Printable	Summative assessment that evaluates students' learning of the unit. This assessment uses a variety of question types to analyze multiple dimensions of learning.
Weathering, Erosion, and Deposition: **Performance Task**	Printable	Summative assessment that gives students the opportunity to apply what they've learned to a novel situation. This assessment allows students to demonstrate understanding through application.
Weathering, Erosion, and Deposition: **Reading Test Prep**	Printable	STAAR® This resource provides complex scientific reading and STAAR® reading style questions to prepare students for STAAR® reading testing.

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Student Support Resources

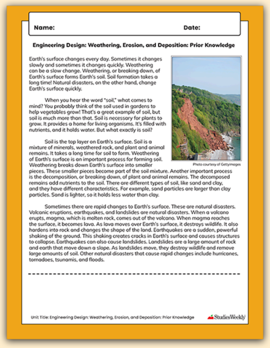
Title	Media	Description
Weathering, Erosion, and Deposition: **Phenomenon Video**	Video	This video will introduce students to the phenomenon.
Coastal Damage	Video	A road is weathered; small pieces of the road and rocks are eroded and deposited by waves. This video is used in Activities 2, 3, and 4.
Weathering, Erosion, and Deposition: **Summary Video**	Video	This video summary discusses what the students learned in the unit, including an explanation of the phenomenon and evidence that supports it as well as a description of the engineering design process they followed and possible solutions.
Weathering, Erosion, and Deposition: **Home Letter**	Printable	This letter to caregivers is a helpful resource to guide teacher communication. It provides information about the design of the program and how caregivers can reinforce student learning and development.

Activity	Success Criteria	Formative Assessment Evidence
1. Phenomenon Introduction	I can ask questions and hypothesize about what caused the sidewalk to break down.	Self-Assessment
2. Weathering	I can model and describe slow changes to Earth caused by weathering from water, wind, and ice by investigating and identifying cause-and-effect relationships.	Student Edition Response
3. Erosion	I can model and describe slow changes to Earth caused by erosion from water, wind, and ice by investigating and identifying cause-and-effect relationships.	Student Edition Response and **Erosion Stations**
4. Deposition	I can model and describe slow changes to Earth caused by deposition from water, wind, and ice by investigating and identifying cause-and-effect relationships.	Student Edition Response
5. Phenomenon Explanation	I can model and describe slow changes to Earth caused by weathering, erosion, and deposition from water, wind, and ice by investigating and identifying cause-and-effect relationships.	Student Edition Response
6. Engineering Design Problem	I can define a problem based on possible causes and effects I observe in an engineering scenario.	Student Edition Response
7. Research	I can conduct research by obtaining information from multiple sources to identify the effects of different strategies used to reduce weathering, erosion, and deposition of the Earth's surface.	**Weathering, Erosion, and Deposition Research**
8. Ideate and Plan	I can create a plan for a solution that will reduce the effects of weathering, erosion, and deposition on the sidewalk while aiming to meet the criteria and constraints of the project.	Student Edition Response
9. Create	I can create a solution that meets the criteria and constraints and solves the engineering problem by reducing the effects of weathering, erosion, and deposition on the sidewalk and surrounding area.	Student Artifact
10. Test, Improve, and Communicate	I can test my solution and evaluate how well it met the criteria and constraints and how well it solved the design problem by communicating my results with the class.	Student Edition Response

Optional: Prior Knowledge

Printable

Weathering, Erosion, and Deposition: Prior Knowledge Article



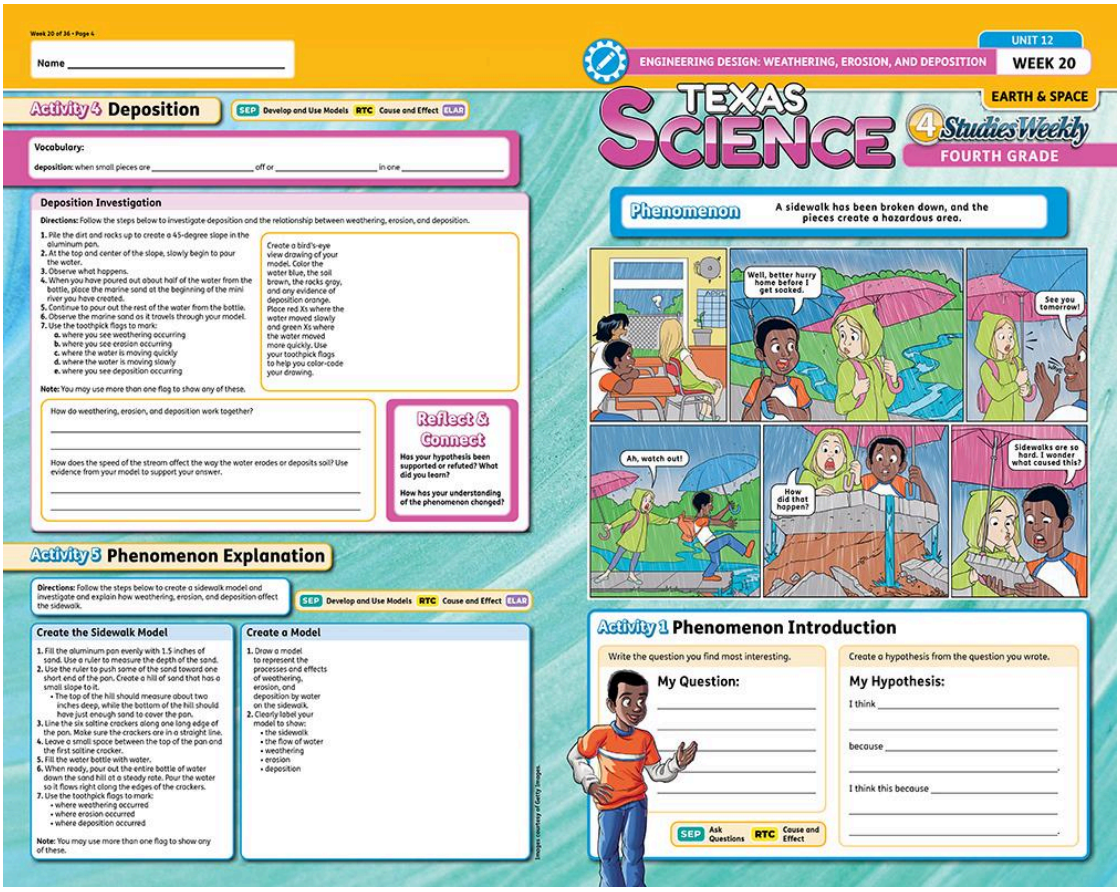
Review Vocabulary

It would be a good idea to review the prior vocabulary before beginning. You may already have these words on your word wall.

- cause and effect
- communicate
- create
- define
- Earth's surface
- engineering design process
- evaluate
- ideate
- identify improvements
- matter
- plan
- rapid changes
- research
- rock
- test
- weathering

Prior Knowledge Article

It would be a good idea to read the article prior to the unit to cover previously taught concepts and vocabulary.



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Name _____

ENGINEERING DESIGN: WEATHERING, EROSION, AND DEPOSITION | UNIT 12 | WEEK 20

TEXAS SCIENCE | 4 Studies Weekly | EARTH & SPACE | FOURTH GRADE

Activity 4 Deposition

SEP Develop and Use Models RTC Cause and Effect ELAR

Vocabulary:

deposition: when small pieces are _____ off or _____ in one _____

Deposition Investigation

Directions: Follow the steps below to investigate deposition and the relationship between weathering, erosion, and deposition.

1. Pile the dirt and rocks up to create a 45-degree slope in the aluminum pan.
2. At the top and center of the slope, slowly begin to pour the water.
3. Observe what happens.
4. When you have poured out about half of the water from the bottle, place the marine sand at the beginning of the mini river you have created.
5. Continue to pour out the rest of the water from the bottle.
6. Observe the marine sand as it travels through your model.
7. Use the toothpick flags to mark:
   a. where you see weathering occurring
   b. where you see erosion occurring
   c. where the water is moving quickly
   d. where the water is moving slowly
   e. where you see deposition occurring

Note: You may use more than one flag to show any of these.

Create a bird's-eye view drawing of your model. Color the water blue, the soil brown, the rocks gray, and any evidence of deposition orange. Place red Xs where the water moved slowly and green Xs where the water moved more quickly. Use your toothpick flags to help you color-code your drawing.

How do weathering, erosion, and deposition work together?

_____

_____

How does the speed of the stream affect the way the water erodes or deposits soil? Use evidence from your model to support your answer.

_____

_____

_____

Reflect & Connect

Has your hypothesis been supported or refuted? What did you learn?

How has your understanding of the phenomenon changed?

Activity 5 Phenomenon Explanation

Directions: Follow the steps below to create a sidewalk model and investigate and explain how weathering, erosion, and deposition affect the sidewalk.

SEP Develop and Use Models RTC Cause and Effect ELAR

Create the Sidewalk Model

1. Fill the aluminum pan evenly with 1.5 inches of sand. Use a ruler to measure the depth of the sand.
2. Use the ruler to push some of the sand toward one short end of the pan. Create a hill of sand that has a small slope to it.
   • The top of the hill should measure about two inches deep, while the bottom of the hill should have just enough sand to cover the pan.
3. Line the six saltine crackers along one long edge of the pan. Make sure the crackers are in a straight line.
4. Leave a small space between the top of the pan and the first saltine cracker.
5. Fill the water bottle with water.
6. When ready, pour out the entire bottle of water down the sand hill at a steady rate. Pour the water so it flows right along the edges of the crackers.
7. Use the toothpick flags to mark:
   • where weathering occurred
   • where erosion occurred
   • where deposition occurred

Note: You may use more than one flag to show any of these.

Create a Model

1. Draw a model to represent the processes and effects of weathering, erosion, and deposition by water on the sidewalk.
2. Clearly label your model to show:
   • the sidewalk
   • the flow of water
   • weathering
   • erosion
   • deposition

Phenomenon A sidewalk has been broken down, and the pieces create a hazardous area.

Images courtesy of Getty Images

Activity 1 Phenomenon Introduction

Write the question you find most interesting.

My Question:

_____

_____

_____

_____

_____

SEP Ask Questions RTC Cause and Effect

Create a hypothesis from the question you wrote.

My Hypothesis:

I think _____

_____

because _____

_____.

I think this because _____

_____

_____.

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Activity 2 Weathering

Directions: Read the article, then use the text as evidence to answer the questions.

SEP Develop and Use Models RTC Cause and Effect ELAR

Weathering occurs when waves break pieces off of the bottom of this rock.

Water weathers, or carves away at, the sides of the Horseshoe Bend in the Grand Canyon.

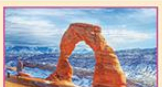
Weathering and Change

Weathering is a process that slowly breaks apart Earth's surface into small pieces. Weathering has been occurring as long as the Earth has existed. Over time, weathering can cause a landscape to change by carving rocks that make landforms.

Water, wind, and ice cause weathering. Weathering by water is the most common form of weathering. As water moves through creeks and rivers, it slowly breaks down rocks that form the riverbed. Over time, the river becomes deeper. It also becomes wider. With enough time, water that moves through riverbeds can carve canyons! Rainwater can also cause weathering. For example, if an area receives a lot of rain, the moving water can create a small temporary stream.

Ice is another cause of weathering. Water fills cracks in rocks, roads, or sidewalks. The water freezes and turns into ice when it gets cold. As the water freezes, it expands. The ice pushes on rocks, sidewalks, or roads and causes cracks. Large masses of ice, or glaciers, also cause weathering. Glaciers move slowly across the land. As glaciers move, they scrape the land, causing rocks to break.

Wind is another cause of weathering. Strong winds carry sand. Over time, the sand chips away at and breaks down rock, creating oddly shaped landforms, such as arches.



Weathering has shaped this rock formation in Arches National Park.

What is weathering?

_____

_____

_____

What is the effect of weathering by water?

_____

_____

_____

_____

What causes oddly shaped landforms, such as arches in deserts?

_____

_____

_____

_____

Draw a model to show the process and effects of weathering by ice on a sidewalk.

Activity 3 Erosion

Vocabulary:

erosion: the process of _____ _____ of Earth's surface from one place to another

Erosion Stations

Directions: Use the **Erosion Stations** printable to follow the steps for the Water Erosion and Ice Erosion stations. Use the directions in the student edition for the Wind Erosion station. When the timer goes off, follow the "Cleanup" directions for each station.

Printable Erosion Stations

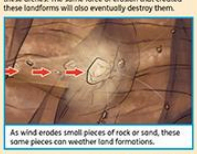
SEP Develop and Use Models RTC Cause and Effect MATH ELAR

Wind Erosion

1. Read the article and answer the comprehension question.

Have you ever been outside in windy weather? The wind can blow dust in your eyes. That dust is made up of tiny pieces of rock. Those rocks are being eroded by the wind. The wind is blowing them to another place. As the wind picks up the tiny pieces of rock, it may drive these tiny pieces into other rocks. When the tiny pieces of rock crash into other rocks, the rocks weather and erode, bit by bit. This process is slow and can take thousands of years or even longer.

Wind erosion creates rock formations all around the world. In some instances weathering and erosion due to wind and water can form curved rock formations called arches. Arches National Park in Utah has a lot of these arches. The same force of erosion that created these landforms will also eventually destroy them.



As wind erodes small pieces of rock or sand, these same pieces can weather land formations.

The Double O Arch in Arches National Park, Utah

What is wind erosion?

_____

_____

_____

2. Measure the weight of one piece of chalk on the digital scale. Record the weight in grams in the table.
3. Measure ½ cup of salt. Place the salt in the plastic container.
4. Add the piece of chalk to the container with the salt. Close the container tightly with the lid.
5. Take turns shaking the container vigorously for 150 seconds, or two and half minutes.
6. At the end of the 150 seconds, open the container and observe what happened to the chalk.

What natural processes did the shaking represent?

_____

_____

What are its effects?

_____

_____

_____

_____

_____

7. Remove the piece of chalk from the container. Weigh it on the digital scale again. Record the weight in grams in the table.
8. Complete the rest of the table, and answer the questions.

Draw a before and after model showing the effects of wind erosion. Label the observations and measurements you took and circle the evidence of erosion.	Weight
Before:	**Before:** ___ grams
After:	**After:** ___ grams **Difference:** ___ grams

Why was there a difference between the weight of the chalk before and after you shook the container?

_____

_____

_____

_____

_____

_____

In this experiment, where did the wind erosion move the pieces of chalk to?

_____

_____

_____

_____

_____

_____

Cleanup: Empty the container into the garbage can. Leave the container at the station for the next group to use.

Independent Work

Directions: Observe the image, then answer the questions.

The Lighthouse, a rock formation in the Palo Duro Canyon, Texas

Support the claim by using your own reasoning along with observable evidence from the image.

Claim: The Lighthouse was slowly formed over time from the effects of weathering and erosion.

Evidence: What types of weathering and erosion caused this landform?

_____

_____

_____

_____

_____

Reasoning: How do you know? How did this happen?

_____

_____

_____

_____

_____

_____

Week 20 Lesson Plans

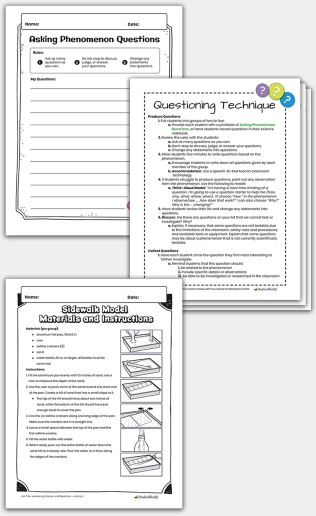
Activity 1	Phenomenon Introduction — Engage	45 minutes

Materials:

- prepared sidewalk model (1; see Materials and Instructions page)

Printable

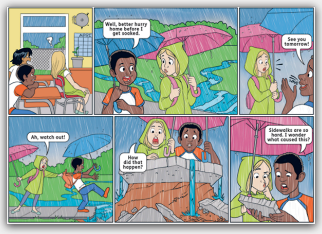
Asking Phenomenon Questions
Phenomenon Questioning Technique
Sidewalk Model Materials and Instructions



SEP **Ask Questions**
Listen Actively and Discuss

RTC **Cause and Effect**

Phenomenon Comic:



Guiding Question

How do weathering, erosion, and deposition by water, wind, and ice cause slow changes to the sidewalk?

Success Criteria

I can ask questions and hypothesize about what caused the sidewalk to break down.

Teacher Note

Prior to this activity, you will need to set up the sidewalk model, using the **Sidewalk Model Materials and Instructions** printable.

The students' initial ideas and understanding may include some misconceptions. However, at this point, do not correct any false assumptions. Rather, let students discuss, and encourage them to revise their initial ideas throughout the unit as new evidence builds on their prior knowledge.

Prior to Activity 2, you will need to prepare the Weathering by Ice station one day ahead of time. Refer to the Teacher Note in Activity 2 for materials and instructions.

Lesson Guide

Unit Transition

Explain to students that in the previous unit, they learned about the water cycle, which is a process on Earth that causes change. In this unit, they will continue to investigate processes on Earth that cause slow changes over time.

Phenomenon Comic

1. Have students read the phenomenon comic strip in the student edition in pairs or small groups.
    - Have students use visual clues from the comic to support their reading of the comic text.
2. Prompt students to share their prior knowledge and/or experiences that relate to their observations about the comic.
    - This is an opportunity to create an inclusive classroom culture by sharing students' experiences.
    - The purpose of the comic is to activate students' prior knowledge about weathering, erosion, and deposition due to water, wind, or ice.
3. **Discuss:** What do you notice or wonder as you observe the illustrations?
    a. Encourage students to point out parts of the comic that relate to their prior knowledge, and help them to make sense of what the comic may mean.

Introduce Phenomenon

1. Before presenting the phenomenon, prepare students by asking them to pay attention to their thoughts and questions, as well as what they already know, as they observe the phenomenon.

2. Present the phenomenon by using the **Sidewalk Model Materials and Instructions**.
    - During the demonstration, point out that the crackers represent the sidewalk.
    - Provide students with the **Asking Phenomenon Questions** printable.
    - Tip: You may wish to present the phenomenon to students several times while they are producing questions.
3. Use the **Phenomenon Questioning Technique** to guide students in producing questions, creating a Student-Driven Question Board, and forming a hypothesis.
    a. The guiding question for this unit is: *How do weathering, erosion, and deposition by water, wind, and ice cause slow changes to the sidewalk?*
    b. Below are key terms that can be used to guide students when grouping together similar questions during the Create a Student-Driven Question Board section.
        - develop, model, phenomenon
        - identify, investigate, cause, effect
        - weathering, erosion, deposition, water, wind, ice, slow change, Earth's surface
        - break, erode, weather, deposit, move, crack, sidewalk
    c. While completing the Create a Student-Driven Question Board section, you may consider aligning the following example questions with student questions:
        - What causes the sidewalk to break down into pieces?
        - What causes the sidewalk pieces to move farther away from where they were broken?
        - How do sidewalk pieces get dropped off somewhere far away from the broken sidewalk?
        - How long does it take for the sidewalk to break down?
4. After you have completed the Student-Driven Question Board, have students write the question they find most interesting to investigate in their student editions.

Form a Hypothesis

1. Tell students that they will create a hypothesis about this question, using their observations and/or prior knowledge.
2. Have students write their hypotheses in their student editions.
    a. If students struggle, provide them with the following differentiated examples:
        i. Example: I think [part of question] because [reason]. I think this because [observation/prior knowledge].
        ii. Example: I think the flower wilts because it doesn't get enough water. I think this because when we went on vacation, we didn't water our plants and they were all wilted when we got back.
3. Call on students to share their hypotheses.
    a. Make sure to respond to all hypotheses in the same way by using phrasing such as, "Thank you for sharing."

Optional

Differentiation

Developing

- Allow students to work in small groups to ask and collect questions, with each student asking 1–3 questions.
- Fill in the first part of the hypothesis sentence stem with part of the guiding question for students.

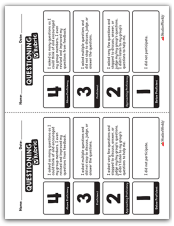
Advanced

Encourage students to use reasoning from previous science lessons in their hypotheses.

Fine-Motor Accommodations

Provide students with a speech-to-text alternative.

Formative Assessment



Printable

Evidence	Self-Assessment

Have students grade themselves using the **Questioning Rubric** to check for proficiency of the success criteria.

Activity 2	Weathering — Explore	45 minutes

Materials:

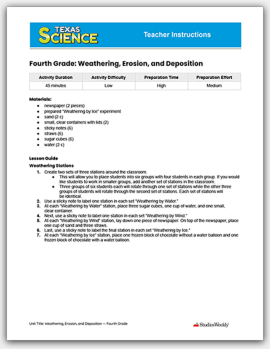
- prepared weathering stations (6; see **Teacher Instruction Page**)
  - prepared Weathering by Ice stations (2; see **Teacher Instruction Page**)
- timer (1)

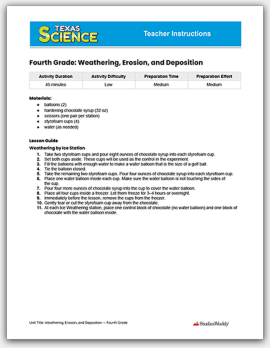
Video **Coastal Damage**

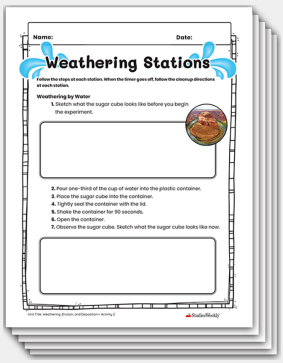
Printable **Weathering Station: Teacher Instruction Page**

Printable **Weathering by Ice Station: Teacher Instruction Page**

Printable **Weathering Stations**







Success Criteria

I can model and describe slow changes to Earth caused by weathering from water, wind, and ice by investigating and identifying cause-and-effect relationships.

Teacher Note

Prior to this activity, you will need to prepare two sets of stations around the classroom. Refer to the **Weathering Station: Teacher Instruction Page** for materials and instructions.

You will also need to prepare the Weathering by Ice station three or four hours prior to class; it can also be prepared the day before. Refer to the **Weathering by Ice Station: Teacher Instruction Page** for materials and instructions.

Review Rules 1, 2, and 7 from the General Laboratory Safety Rules section of the Texas Safety Standards document.

Lesson Guide

Student-Driven Inquiry

1. Present the **Coastal Damage** video.
2. Have students observe the video.
3. Post the discussion questions for students to see:
   - What do you notice?
   - What cause-and-effect relationships do you see?
   - What do you think is happening in this video?
4. Have students discuss the questions in pairs.
5. Call on students to share their ideas and responses to each question.
6. If necessary, review the term “weathering” from third grade. Remind students that weathering is a process that slowly breaks apart the Earth’s surface into smaller pieces.
7. Have the class look at the Student-Driven Question Board to relate ideas from the inquiry to questions they can investigate in today's activity.
8. Guide students toward the question: What causes the sidewalk to break down into pieces?

Collaborative Learning

1. Provide each student with the printable **Weathering Stations**.
2. Have students work in groups of four, or create six equal groups of students.
3. Point out the two sets of three stations in each half of the classroom.
   - Tell three groups of students that they will rotate through the weathering stations on one side of the classroom while the other three groups of students will rotate through the weathering stations on the other side of the classroom.
4. Assign each group to a station.

SEP **Develop and Use Models**
Collect Evidence
Analyze Data
Develop Explanations

RTC **Cause and Effect**

ELPS **2D**

5. Set a timer for eight minutes. At the end of eight minutes, have students clean up the station they are at by following the directions in their student editions, then move to the next station.
6. Have students follow the directions on the printable for the station they have been assigned.
7. As you circulate, check for understanding of:
   - Weathering is the process that slowly breaks apart Earth's surface into smaller pieces.
   - Water, ice, and wind cause weathering.
8. If students struggle with either of these concepts, use the following prompts:
   - What happened when ...
   - What did you observe when ...
   - Why do you think ...
   - How did wind/water/ice affect ...

   a. Remind students that in third grade, they learned how weathering breaks down rocks to create soils, such as sand and clay.
   b. This is an opportunity to monitor understanding of spoken language during classroom interactions. [ELPS 2D]

ELAR **4.7G:** Discuss specific ideas in the text that are important to the meaning.

Reading to Learn

1. Have students follow the directions in their student editions.
2. **Discuss:** What cause-and-effect relationships did you read about in the article? **(Answers may vary but should include: Water, wind and ice can cause weathering. The effect of all three types of weathering is a breakdown of rocks and possible changes to earth's surface.**
3. **Ask:** How does water cause weathering? **(The constant flow and pressure of water can break down rock or cause pieces of rock to break off.)**
4. **Ask:** How does ice cause weathering? **(Ice can push against the sides of rocks, roads, or sidewalks, causing them to crack or break.)**
5. **Ask:** How does wind cause weathering? **(Strong winds can cause parts of rocks to break off formations, creating oddly shaped landforms.)**
6. **Discuss:** How do these cause-and-effect relationships of weathering build on what you learned about in third grade when you explored weathering? **(Answers may vary but could include the idea that weathering can cause slow changes to Earth's surface over time, which builds on the idea that weathering can break down rocks to create soils.)**

Reflect and Connect

1. **Discuss:** Has your hypothesis been supported or refuted? If so, what did you learn?
   - Encourage students to share their original hypotheses, evidence that either supports or refutes their hypotheses, and if or how they would revise their hypotheses.
   - Remind students that scientists change their hypotheses all the time when new information is learned or evidence is gathered.
2. **Discuss:** How has your understanding of the phenomenon changed so far? **(Answers may vary. Example: Weathering has caused the sidewalk to break down.)**

- Allow students to share their interpretations of learning. Some students may share information that is partially correct. This is okay at this time, but make note to check in with students in later activities to monitor progression of learning.

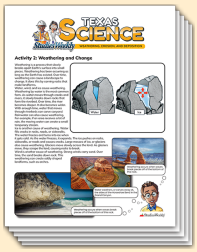
3. **Discuss:** What are you still wondering?
   - Collect all questions or statements of wonder at this time. Encourage inquiry as a natural step in the learning process.

Optional

Differentiation

Printable

Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles



Developing

- Students can read the lower Lexile® measure version of the article "Weathering and Change" (Lexile® measure: 750; word count: 212) in the **Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles** printable.
- Allow some groups of students to record a group set of data for each station to minimize the amount of writing each student needs to complete.

Advanced

- Have students create a prediction before each station about what they think the effects of each type of weathering will be.
- Have students research local examples, or Texas-specific examples, of weathering.

Formative Assessment	**Evidence**	Student Edition Response
	Use article questions and models to check for proficiency of the success criteria.	

Activity 3	Erosion — Explore	45 minutes

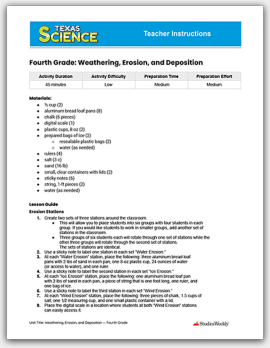
Materials:

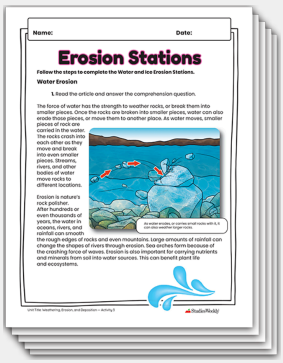
- prepared erosion stations (6; see Teacher Instruction Page)
  - prepared bags of ice (2; see Teacher Note)
- timer (1)

Video **Coastal Damage**

Printable **Erosion Station: Teacher Instruction Page**

Printable **Erosion Stations**





Printable **Weathering, Erosion, and Deposition: Flash Cards**

Printable **Weathering, Erosion, and Deposition: Word Wall Cards**

Vocabulary

erosion: the process of moving pieces of Earth's surface from one place to another

SEP **Develop and Use Models**
Collect Evidence
Analyze Data
Develop Explanations
Collect and Organize Data

Success Criteria

I can model and describe slow changes to Earth caused by erosion from water, wind, and ice by investigating and identifying cause-and-effect relationships.

Teacher Note

Prior to this activity, fill two resealable plastic bags with water and freeze them. Do not remove the bags of ice from the freezer until you are ready to begin the activity.

You will also need to set up two sets of erosion stations around the classroom. Refer to the **Erosion Station: Teacher Instruction Page** for materials and instructions.

Review Rules 1, 2, and 7 from the General Laboratory Safety Rules section of the Texas Safety Standards document.

Lesson Guide

Student-Driven Inquiry

1. Present the **Coastal Damage** video.
2. Have students observe the video.
3. Post the discussion questions for students to see:
   - What cause-and-effect relationships do you see?
   - How does this connect to what you learned in the previous activity?
4. Have students discuss the questions in pairs.
5. Call on students to share their ideas and responses to each question.
6. Before replaying the video, prompt students to carefully observe what happens as the wave moves into the shoreline, then retreats back to the ocean.
7. Replay the **Coastal Damage** video.
8. Have students discuss with a partner what they observed.
9. Call on students to share their observations.

Vocabulary

10. ***Say:*** *I hear that a lot of you observed that a piece (or pieces) of the road have started to move after they have been broken.*
11. ***Say:*** *erosion*
12. Have students repeat the word "erosion" three times out loud.
13. ***Say:*** *After a part of the Earth's surface is weathered, or broken down into smaller pieces, those smaller pieces are moved through erosion.*
14. ***Say:*** ***Erosion*** *is the process of moving pieces of Earth's surface from one place to another.*
    - Allow students to use cognates in their native language to describe or draw connections to erosion.
15. Have students write the definition of "erosion" in their student editions.

RTC **Cause and Effect**

ELPS **1E, 2D, 4F**

16. Have students turn to their partners and use the word “erosion” to describe what they observed in the video. Provide the following sentence stems, if necessary:
    - I see erosion when ____.
    - ____ is eroded. I can tell this because ____.

---

17. Have the class look at the Student-Driven Question Board to relate ideas from the inquiry to questions they can investigate in today's activity.
18. Guide students toward the question: What causes the sidewalk pieces to move farther away from where they were broken?

Collaborative Learning

ELAR **4.7G:** Discuss specific ideas in the text that are important to the meaning.

MATH **4.8C:** Solve problems that deal with measurements of length, intervals of time, liquid volumes, mass, and money using addition, subtraction, multiplication, or division as appropriate.

1. Provide each student with the **Erosion Stations** printable.
2. Have students work in groups of four, or create six equal groups of students.
3. Point out the two sets of three stations in each half of the classroom.
    - Tell three groups of students that they will rotate through the erosion stations on one side of the classroom while the other three groups of students will rotate through the erosion stations on the other side of the classroom.
4. Assign each group to a station.
5. Point out to students where the digital scale is located. The scale will be used during the Wind Erosion station.
    - If necessary, demonstrate how to use a digital scale.
6. Set a timer for 10 minutes. At the end of 10 minutes, have students clean up the station they are at by following the directions in their student editions, then move to the next station.
7. Have students follow the directions on the **Erosion Stations** printable for the Water Erosion and Ice Erosion stations. Have students follow the directions in their student editions for the Wind Erosion station.
8. As you circulate, check for verbal understanding of:
    - Erosion is the process of moving pieces of Earth’s surface from one place to another.
    - Erosion occurs after weathering.
    - Water, ice, and wind can erode pieces of Earth’s surface.
9. If students struggle with any of these concepts, use the following questions to support or deepen thinking:
    - What happened when ...
    - What did you observe when ...
    - Why do you think ...
    - How did wind/water/ice affect ...

    a. This is an opportunity for students to internalize new academic language by using and reusing it in meaningful ways in speaking activities. [ELPS 1E] It is also an opportunity to monitor understanding of spoken language. [ELPS 2D]
10. **Discuss:** How did the images in the texts help support or confirm your understanding of each process?
    - This is an opportunity for students to reflect on how visual supports can be used to enhance or confirm their understanding of text. [ELPS 4F]

11. **Discuss:** Why did you measure the depth of the sand in the Water Erosion and Ice Erosion stations? **(to show evidence that some sand was moved from one area to another, which is erosion)**
12. **Discuss:** Why did you measure the weight of the piece of chalk in the Wind Erosion station? **(to show evidence that some parts of the piece of chalk were eroded)**

⚠ **Misconception:** Rocks do not change. Explain to students that over time, rocks can be worn down and carried away, changing their shape and size.

⚠ **Misconception:** Weathering and erosion are essentially the same thing; the two words can be used interchangeably. Explain to students that weathering is the process of breaking down, while erosion is the process of being moved. Weathering and erosion are two separate processes but often occur one after another.

⚠ **Misconception:** Erosion happens quickly. Explain to students that some forms of erosion can take years. For example, glaciers move at an extremely slow rate, so erosion due to glaciers (or ice) occurs over a long period of time.

Independent Work

1. Have students follow the directions in their student editions in the "Independent Work" section.
2. Use a map to locate the Gulf Coast of Texas. Have students use cardinal directions to tell where they live in relation to the coastline. Explain to students that the Gulf Coast of Texas weathers and erodes, on average, by four feet each year. Government agencies and organizations work to slow the rates of weathering and erosion along the coastline. [Connection to Social Studies]

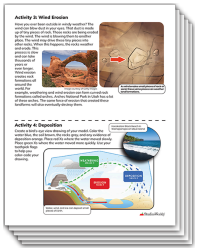
Optional

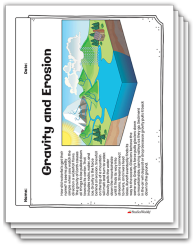
Differentiation

Printable

Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles

Gravity and Erosion



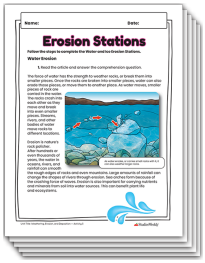


Developing

- Students can read the lower Lexile® measure version of the article "Wind Erosion" (Lexile® measure: 750L; word count: 124) in the **Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles** printable.
- Have students work together in small groups to construct a response that supports the claim with evidence and reasoning.

Advanced

- Have students research local examples, or Texas-specific examples, of erosion.
- Have students complete the **Gravity and Erosion** extension activity.

Formative Assessment	Evidence	Student Edition Response and **Erosion Stations**
Printable		Use erosion station responses to check for proficiency of the success criteria.

Activity 4	Deposition — Explore	45 minutes

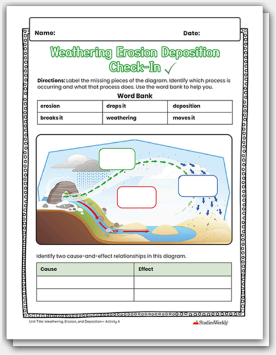
Materials:

- marine sand (1 tsp per group)
- prepared rock and soil pans (one per group; see Teacher Note)
- toothpick flags (10 per group)
- water bottles, 20 oz or larger (one per group)

Video **Coastal Damage**

Printable **Weathering, Erosion, Deposition Check-In**

Printable **Deposition Article**


Name: Date:

Weathering Erosion Deposition Check-In

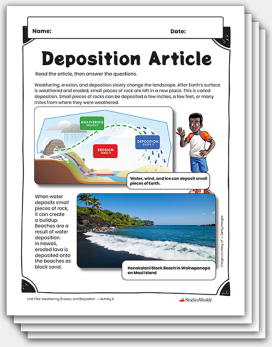
Directions: Label the missing pieces of the diagram. Identify which process is occurring and what that process does. Use the word bank to help you.

Word Bank

erosion	drops it	deposition
breaks it	weathering	moves it

Identify two cause-and-effect relationships in this diagram.

Cause	Effect


Name: Date:

Deposition Article

Read the article, then answer the questions.

Water, wind, and ice can deposit small pieces of earth.

When water deposits small pieces of rock, it can create beaches. Beaches are a result of water deposition. In Hawaii, molten lava is deposited onto the beaches as black sand.

Printable **Weathering, Erosion, and Deposition: Flash Cards**

Printable **Weathering, Erosion, and Deposition: Word Wall Cards**

Vocabulary

deposition: when small pieces are dropped off or left in one place

Success Criteria

I can model and describe slow changes to Earth caused by deposition from water, wind, and ice by investigating and identifying cause-and-effect relationships.

Teacher Note

Prior to this activity, collect small rocks or gravel and mix them with the soil that students will use in the activity. Then place about four pounds of mixed soil and rocks in each of the aluminum pans.

Review Rules 1, 2, and 7 from the General Laboratory Safety Rules section of the Texas Safety Standards document.

Lesson Guide

Student-Driven Inquiry

1. Present the **Coastal Damage** video.
2. Have students observe the video.
3. Have students turn to a partner and discuss how their understanding of what happens in the video has changed over the past activities. If necessary, provide the following prompts for students to discuss in their pairs:
   - What do you see now that you didn't see before?
   - What do you understand now that you didn't know before?
4. Before replaying the video, prompt students to carefully observe what happens to the piece(s) of the road that have been eroded.
5. Replay the **Coastal Damage** video.
6. Have students discuss with a partner what they observed.
7. Call on students to share their observations.

Vocabulary

8. ***Say:*** *I hear a lot of you saying that you observed that the bigger piece of road was eventually pushed up onto the shore and left there by a wave.*
9. ***Say:*** *deposition*
10. Have students repeat the word “deposition” three times out loud.
11. ***Say:*** *After a part of the Earth’s surface is weathered, or broken down into smaller pieces, those smaller pieces are moved through erosion. Eventually, those small pieces are dropped off, or deposited, in one area.*
12. ***Say:*** ***Deposition*** *is when small pieces are dropped off or left in one place.*
    - Allow students to use cognates in their native language to describe or draw connections to deposition.
13. Have students write the definition of “deposition” in their student editions.
14. ***Say:*** *Deposition has the root word “deposit.” To deposit means to put down.*

SEP **Develop and Use Models**
Collect Evidence
Analyze Data
Develop Explanations

RTC **Cause and Effect**

ELPS **1E, 2D, 4F**

- Have students discuss when they have heard the word “deposit” before (for example, at the bank) and how this relates to the meaning of the word.

15. Have students turn to a partner and use the word “deposition” to describe what they observed in the video. Provide the following sentence stems, if necessary:
    - I see deposition when ____.
    - ____ is deposited. I can tell this because ____.
16. **Discuss:** Small pieces of rock or earth’s surface can be deposited by the force of water, wind, and ice. How do you think these forces are able to deposit these small pieces? **(Students may suggest that each of these forces are able to use energy to drop off the pieces. As the energy of each force decreases, the pieces are deposited.)**

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17. Have the class look at the Student-Driven Question Board to relate ideas from the inquiry to questions they can investigate in today's activity.
18. Guide students toward the questions:
    - How do sidewalk pieces get dropped off somewhere far away from the broken sidewalk?
    - How long does it take for the sidewalk to break down?

Collaborative Learning

1. Have students work in groups of four, or create six equal groups of students.
2. Provide each group with one 13x9x2-inch aluminum foil pan with about 4 lb of mixed soil and rocks, one large water bottle filled with water, a teaspoon of marine sand, and 10 toothpick flags.
3. Have students follow the directions in their student editions.
4. As you circulate, observe and take anecdotal data, monitoring students’ verbal understanding of the following concepts:
    - Deposition is when small pieces are dropped off or left in one place.
    - Weathering, erosion, and deposition work together to create changes to a landscape.
5. If students struggle with either of these concepts, use the following prompts:
    - What happened when …
    - What did you observe when …
    - Why do you think …
    - How did wind/water/ice affect …

    a. This is an opportunity for students to internalize new academic language by using it and reusing it in meaningful ways in speaking activities. [ELPS 1E] It is also an opportunity to monitor understanding of spoken language. [ELPS 2D]
6. Take anecdotal notes of which students are participating and which students are demonstrating an understanding of the processes of weathering, erosion, and deposition and their relationship.

ELAR **4.7G:** Discuss specific ideas in the text that are important to the meaning.

Reading to Learn

1. Provide each student with the printable **Deposition Article**.
2. Have students follow the directions on the printable to complete the reading and questions.

3. **Discuss:** How did the images in the texts help support or confirm your understanding of each process?
    - This is an opportunity for students to reflect on how visual supports can be used to enhance or confirm their understanding of text. [ELPS 4F]
4. **Discuss:** What is the effect of deposition? **(Small pieces of rock or sand are dropped off in one area, often leading to a buildup.)**
5. **Discuss:** What causes deposition? **(when moving water, wind, or ice slows down and leaves behind pieces of rock or sand that it was carrying)**
6. **Discuss:** How does investigating cause-and-effect relationships help you to better understand processes on Earth? **(Answers may vary. Example: Knowing what causes a process and the effects of the process help you to better understand the process as a whole.)**
7. **Discuss:** What other processes have you learned about that involve cause-and-effect relationships? **(the water cycle in the previous unit)**
8. Have students complete the "Reflect and Connect" section in their science notebooks.

Optional

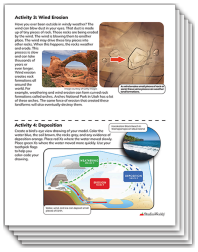
Applied Science Writing

This activity is designed for students to apply what they are investigating to their homes, cultures, or communities. Ask students to respond to the following prompt in their science notebooks: Look around your school, home, or neighborhood for signs of weathering, erosion, and/or deposition. What do you notice? What causes these processes to occur? Can you predict the long-term changes that these processes will cause or have already caused?

Optional

Differentiation

Printable **Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles**



Developing

Students can read the lower Lexile® measure version of the article "Deposition" (Lexile® measure: 670L; word count: 51) in the **Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles** printable.

Advanced

- Have students create a prediction before the "Deposition Investigation" about what they think they will observe when the marine sand is placed in the model.
- Have students research local examples, or Texas-specific examples, of deposition.

Formative Assessment	**Evidence**	Student Edition Response
	Use the "Deposition Investigation" section to check for proficiency of the success criteria.	

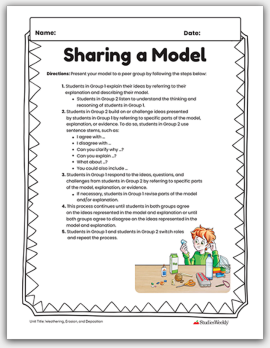
Activity 5	Phenomenon Explanation — Evaluate	45 minutes

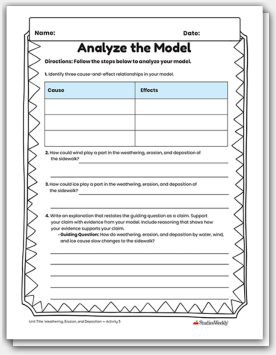
Materials:

- aluminum foil pans, 13x9x2 in (one per group)
- rulers (one per group)
- saltine crackers (six per group)
- sand (5 lb per group)
- toothpick flags (six per group)
- water bottles, 20 oz or larger (one per group)

Printable

Sharing a Model
Analyze the Model


Sharing a Model


Analyze the Model

ELAR **4.12B:** Compose informational texts, including brief compositions that convey information about a topic, using a clear central idea and genre characteristics and craft.

SEP **Develop and Use Models**
Collect Evidence
Analyze Data
Develop Explanations
Communicate Explanations

RTC **Cause and Effect**

ELPS **1E, 3H, 5B**

Success Criteria

I can model and describe slow changes to Earth caused by weathering, erosion, and deposition from water, wind, and ice by investigating and identifying cause-and-effect relationships.

Lesson Guide

Student-Driven Inquiry

1. Have students revisit and observe the phenomenon comic in Activity 1.
2. Have students turn to a partner and discuss the following prompts:
   - What do you observe now that you didn't notice before?
   - How has your thinking changed?
3. Call on students to share their responses.
4. ***Say:*** *Today, you will create a sidewalk model like the one you observed in Activity 1 to help you answer the guiding question: How do weathering, erosion, and deposition by water, wind, and/or ice cause slow changes to the sidewalk?*

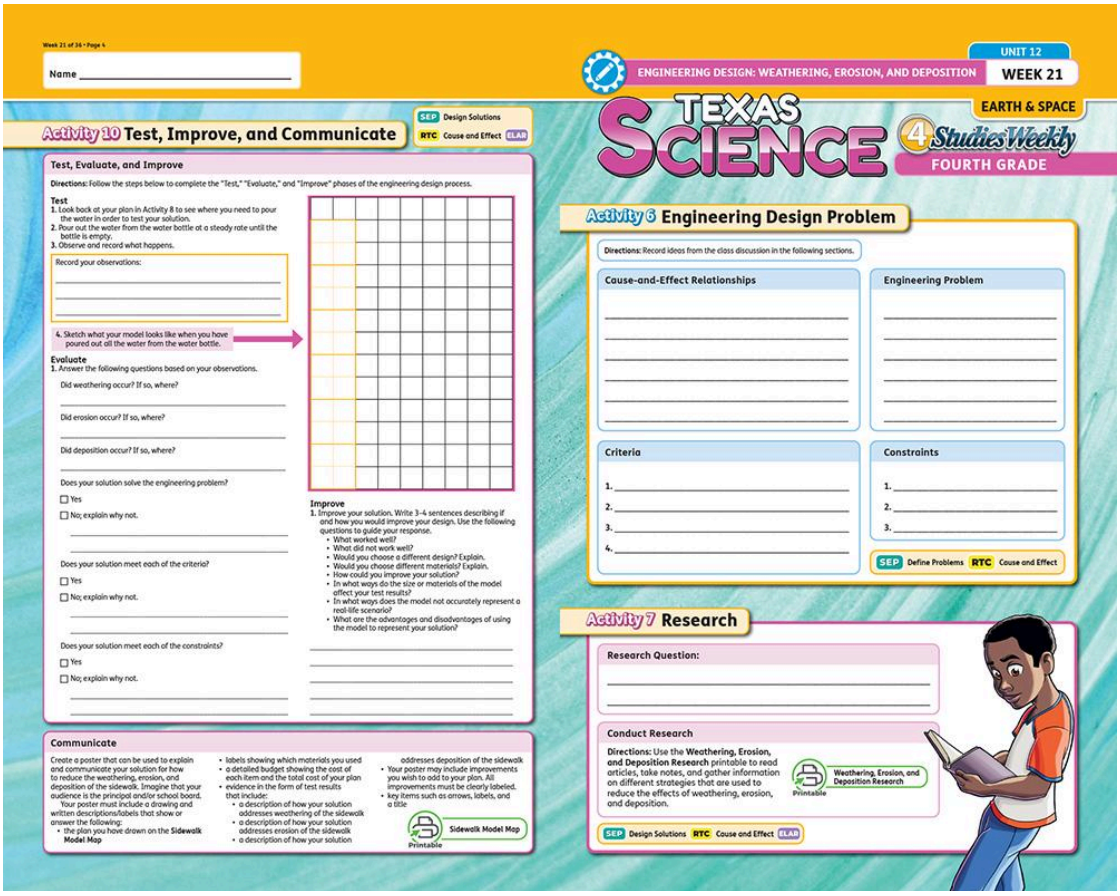
Collaborative Learning

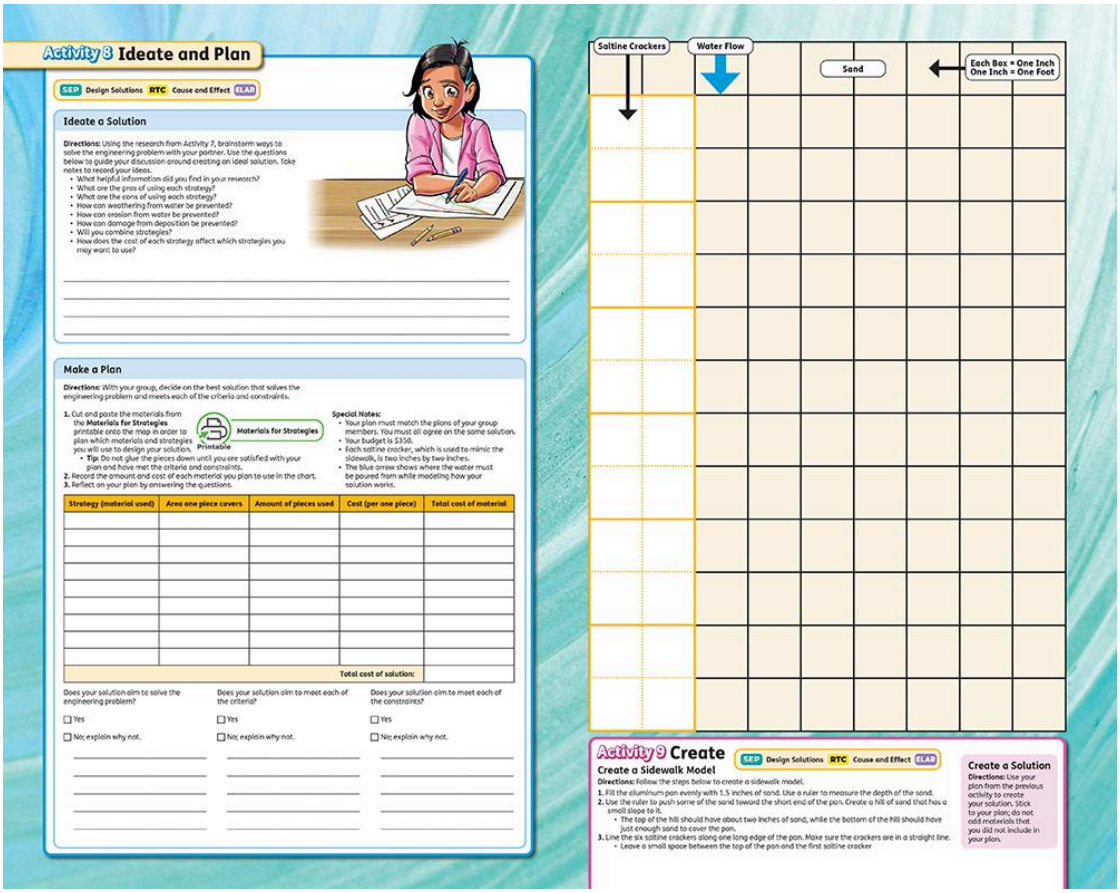
1. Have students work in groups of four, or create six equal groups of students.
   - Optional: Have students work in pairs to more accurately assess sense-making. Increase the amount of materials to accommodate this option.
2. Provide each group of students with the following materials: one 13x9x2-inch aluminum foil pan, six saltine crackers, five pounds of sand, one large water bottle (20 oz or larger), six toothpick flags, and one ruler.
3. Have students follow the directions in their student editions to create both models.
   - This is an opportunity for students to write using content vocabulary. [ELPS 5B]
4. Provide students with the printable **Analyze the Model** when they have completed both models.
   - Have students follow the directions on the printable.
5. Have each group share their drawn models and explanations with another group in order to receive peer feedback.
   - Provide students with the **Sharing a Model** printable.
   - This is an opportunity for students to internalize new academic language by using and reusing that language in meaningful ways in speaking activities. [ELPS 1E] This is also an opportunity for students to explain with increasing specificity and detail as more English is acquired. [ELPS 3H]

Optional **Differentiation**	**Developing** Have each group of students assign a writer or recorder within their group to record answers in one student edition. This will minimize the amount of writing required from each student. **Advanced** Have students choose one example each of weathering, erosion, and deposition in Texas and create a model to show how these processes work together over time to create slow changes to the state's landscape.

Formative Assessment	**Evidence**	Student Edition Response
	Use student edition responses to check for proficiency of the success criteria.	

Week 21


Week 21 of 36 • Page 4
Name _____
UNIT 12
ENGINEERING DESIGN: WEATHERING, EROSION, AND DEPOSITION
WEEK 21
EARTH & SPACE
TEXAS SCIENCE
Studies Weekly
FOURTH GRADE
Activity 10 Test, Improve, and Communicate
SEP Design Solutions
RTC Cause and Effect
ELAR
Test, Evaluate, and Improve
Directions: Follow the steps below to complete the "Test," "Evaluate," and "Improve" phases of the engineering design process.
Test
1. Look back at your plan in Activity 8 to see where you need to pour the water in order to test your solution.
2. Pour out the water from the water bottle at a steady rate until the bottle is empty.
3. Observe and record what happens.
Record your observations:
4. Sketch what your model looks like when you have poured out all the water from the water bottle.
Evaluate
1. Answer the following questions based on your observations.
Did weathering occur? If so, where?
Did erosion occur? If so, where?
Did deposition occur? If so, where?
Does your solution solve the engineering problem?
☐ Yes
☐ No; explain why not.
Does your solution meet each of the criteria?
☐ Yes
☐ No; explain why not.
Does your solution meet each of the constraints?
☐ Yes
☐ No; explain why not.
Improve
1. Improve your solution. Write 3–4 sentences describing if and how you would improve your design. Use the following questions to guide your response.
• What worked well?
• What did not work well?
• Would you choose a different design? Explain.
• Would you choose different materials? Explain.
• How could you improve your solution?
• In what ways do the size or materials of the model affect your test results?
• In what ways does the model not accurately represent a real-life scenario?
• What are the advantages and disadvantages of using the model to represent your solution?
Communicate
Create a poster that can be used to explain and communicate your solution for how to reduce the weathering, erosion, and deposition of the sidewalk. Imagine that your audience is the principal and/or school board.
Your poster must include a drawing and written descriptions/labels that show or answer the following:
• the plan you have drawn on the Sidewalk Model Map
• labels showing which materials you used
• a detailed budget showing the cost of each item and the total cost of your plan
• evidence in the form of test results that include:
• a description of how your solution addresses weathering of the sidewalk
• a description of how your solution addresses erosion of the sidewalk
• a description of how your solution addresses deposition of the sidewalk
• Your poster may include improvements you wish to add to your plan. All improvements must be clearly labeled.
• key items such as arrows, labels, and a title
Printable
Sidewalk Model Map
Activity 6 Engineering Design Problem
Directions: Record ideas from the class discussion in the following sections.
Cause-and-Effect Relationships
Engineering Problem
Criteria
1.
2.
3.
4.
Constraints
1.
2.
3.
SEP Define Problems
RTC Cause and Effect
Activity 7 Research
Research Question:
Conduct Research
Directions: Use the Weathering, Erosion, and Deposition Research printable to read articles, take notes, and gather information on different strategies that are used to reduce the effects of weathering, erosion, and deposition.
Printable
Weathering, Erosion, and Deposition Research
SEP Design Solutions
RTC Cause and Effect
ELAR


Activity 8 Ideate and Plan
SEP Design Solutions
RTC Cause and Effect
ELAR
Ideate a Solution
Directions: Using the research from Activity 7, brainstorm ways to solve the engineering problem with your partner. Use the questions below to guide your discussion around creating an ideal solution. Take notes to record your ideas.
• What helpful information did you find in your research?
• What are the pros of using each strategy?
• What are the cons of using each strategy?
• How can weathering from water be prevented?
• How can erosion from water be prevented?
• How can damage from deposition be prevented?
• Will you combine strategies?
• How does the cost of each strategy affect which strategies you may want to use?
Make a Plan
Directions: With your group, decide on the best solution that solves the engineering problem and meets each of the criteria and constraints.
1. Cut and paste the materials from the Materials for Strategies printable onto the map in order to plan which materials and strategies you will use to design your solution.
• Tip: Do not glue the pieces down until you are satisfied with your plan and have met the criteria and constraints.
2. Record the amount and cost of each material you plan to use in the chart.
3. Reflect on your plan by answering the questions.
Printable
Materials for Strategies
Special Notes:
• Your plan must match the plans of your group members. You must all agree on the same solution.
• Your budget is $350.
• Each saltine cracker, which is used to mimic the sidewalk, is two inches by two inches.
• The blue arrow shows where the water must be poured from while modeling how your solution works.
Strategy (material used)
Area one piece covers
Amount of pieces used
Cost (per one piece)
Total cost of material
Total cost of solution:
Does your solution aim to solve the engineering problem?
☐ Yes
☐ No; explain why not.
Does your solution aim to meet each of the criteria?
☐ Yes
☐ No; explain why not.
Does your solution aim to meet each of the constraints?
☐ Yes
☐ No; explain why not.
Saltine Crackers
Water Flow
Sand
Each Box = One Inch
One Inch = One Foot
Activity 9 Create
SEP Design Solutions
RTC Cause and Effect
ELAR
Create a Sidewalk Model
Directions: Follow the steps below to create a sidewalk model.
1. Fill the aluminum pan evenly with 1.5 inches of sand. Use a ruler to measure the depth of the sand.
2. Use the ruler to push some of the sand toward the short end of the pan. Create a hill of sand that has a small slope to it.
• The top of the hill should have about two inches of sand, while the bottom of the hill should have just enough sand to cover the pan.
3. Line the six saltine crackers along one long edge of the pan. Make sure the crackers are in a straight line.
• Leave a small space between the top of the pan and the first saltine cracker
Create a Solution
Directions: Use your plan from the previous activity to create your solution. Stick to your plan; do not add materials that you did not include in your plan.

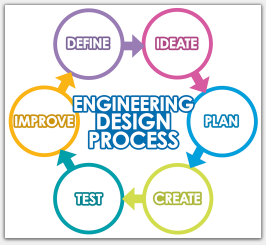
Week 21 Lesson Plans

Activity 6	Engineering Design Problem — Define	45 minutes

Materials:

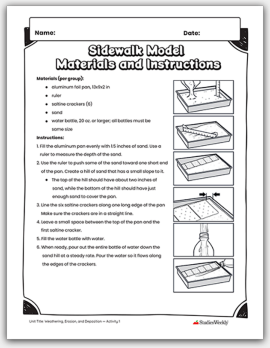
- anchor chart paper (1–2 sheets)
- prepared sidewalk model (1; see Materials and Instructions page)

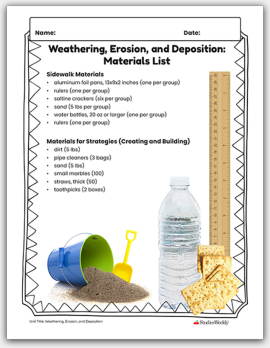
Image **Engineering Design Process**



Printable **Sidewalk Model Materials and Instructions**

Printable **Weathering, Erosion, and Deposition: Materials List**





SEP **Define Problems**

Listen Actively and Discuss

Success Criteria

I can define a problem based on possible causes and effects I observe in an engineering scenario.

Teacher Note

Prior to this activity, you will need to set up the sidewalk model, using the **Sidewalk Model Materials and Instructions** printable.

Tip: Start collecting materials for Week 21 early. Ask students to donate empty, clean materials from home. You will need materials starting in Activity 8.

Lesson Guide

Introduce Engineering Scenario

1. Have students reread the phenomenon comic from Activity 1 in pairs or small groups.
2. Have students discuss and write any cause-and-effect relationships they see in the comic in their student editions.
3. Present the engineering scenario to students by using the **Sidewalk Model Materials and Instructions** printable.
4. Have students discuss and write any additional cause-and-effect relationships they see in the engineering scenario in their student editions.
5. Call on students to share the cause-and-effect relationships they identified in the comic and during the demonstration.
    - Collect all ideas, even repeated ideas. Respond in a neutral way by saying, “Thank you for sharing.”
6. ***Say:*** *Based on what you have shared, I hear two common cause-and-effect relationships that you have identified. One cause-and-effect relationship I hear is that the river flows close to the sidewalk. The effect is that the sidewalk is weathered and eroded.*
    - Tip: Write this cause-and-effect relationship on the whiteboard for students to see.
7. ***Say:*** *Another cause-and-effect relationship I hear is that as the sidewalk is eroded, the erosion and deposition create a hazardous area.*
    - Tip: Write this cause-and-effect relationship on the whiteboard for students to see.

Define the Problem

1. Have students discuss the following prompt with a partner:
    - Based on these two cause-and-effect relationships, what problem do you think you will have to work toward solving in this unit?
    a. Remind students how cause-and-effect relationships were used in the last EDP unit to identify the problem.
2. Call on students to share their ideas.
3. ***Say:*** *The problem you will need to solve is: What can I design to reduce the effects of weathering, erosion, and deposition by water along the sidewalk?*

RTC Cause and Effect

ELPS 1F, 2C, 2D

- On an anchor chart, write the heading “Engineering Problem.”
- Record the problem on the anchor chart.
- Have students write the problem in their student editions under “Engineering Problem.”

4. **Discuss:** When have you seen a sidewalk or road affected by weathering, erosion, and/or deposition?
5. **Discuss:** Why was this sidewalk a problem for you and/or the community? **(It created a hazardous area.)**
6. Tell students that they will follow the engineering design process to design a solution that solves this problem.

Define the Criteria and Constraints

1. Display the **Engineering Design Process** image.
   - Point to the Define step.
   - The following steps are an opportunity for students to use accessible language and learn new and essential language in the process. [ELPS 1F] This is also an opportunity to monitor understanding of spoken language. [ELPS 2D]
2. ***Say:*** *We just defined the problem that you will need to solve in this unit. We must also define the criteria and constraints before we can move to the next step.*
3. Remind students that criteria are a set of standards that the solution will be judged against to determine if the solution is successful or not.
   - On the anchor chart, write a new header: “Criteria.”
4. Have students discuss the following questions with a partner:
   - How will we know we have been successful in designing a solution?
   - What criteria do we need?
5. Call on students to share their ideas for possible criteria.
   - Collect all ideas at this point, even repeated ideas, and respond to all ideas in a neutral manner.
6. ***Say:*** *I hear some common ideas for criteria. Let’s combine these ideas to create a few criteria. One criteria for your solution is that it must decrease the amount of sidewalk that is weathered.*
   - Write this criteria on the anchor chart.
   - Have students write this criteria in their student editions under “Criteria.”
7. ***Say:*** *Another criteria for your solution is that it must decrease the amount of sidewalk that is eroded.*
   - Write this criteria on the anchor chart.
   - Have students write this criteria in their student editions under “Criteria.”
8. ***Say:*** *Your solution must also decrease the amount of sidewalk that is deposited in another place.*
   - Write this criteria on the anchor chart.
   - Have students write this criteria in their student editions under “Criteria.”
9. ***Say:*** *Lastly, your solution must not create another hazardous area; your solution must deposit the water in another eco-friendly way, such as a pond or a pool.*
   - Write this criteria on the anchor chart.
   - Have students write this criteria in their student editions under “Criteria.”

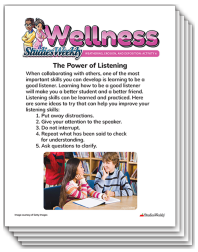
10. **Discuss:** You will use a model like the one in the engineering scenario to test your design. How can we measure if your design meets each of these criteria? **(Answers may vary but should include observing what happens to the sidewalk and the surrounding area.)**
11. Have students add these ideas to their student editions under the "How to Measure" column.
    - Optional: If there are other criteria that students have suggested, add those to the criteria list as well or write them on sticky notes as possible criteria that can be discussed as you move through the unit.
12. Encourage students to ask any clarifying questions about the criteria.
13. Tell students that engineers always work with limitations. These limitations are called "constraints."
14. On the anchor chart, write a new header: "Constraints."
15. Tell students that they will have three constraints for this project.
16. ***Say:*** *The first constraint will be time.*
    - Write this constraint on the anchor chart.
    - Have students write this constraint in their student editions under "Constraints."
17. Tell students that they will have one 45-minute class period to ideate and plan and one 45-minute class period to create their solutions.
18. ***Say:*** *The second constraint will be materials.*
    - Write this constraint on the anchor chart.
    - Have students write this constraint in their student editions under "Constraints."
19. Display the **Weathering, Erosion, and Deposition: Materials List** printable.
20. Tell students that for this project, they will be using recyclable materials or materials that can be easily donated or easily found at school or at home.
    - Optional: Edit the materials list provided for this unit by adding and/or removing items that are easier to find or that are suggested by students.
21. ***Say:*** *The third constraint will be money, or a budget.*
    - Write this constraint on the anchor chart.
    - Have students write this constraint in their student editions under "Constraints."
22. Tell students that when engineers work on projects, they have to follow a budget, meaning they can only spend so much money on materials.
23. ***Say:*** *For this project, the materials on the* ***Weathering, Erosion, and Deposition: Materials List*** *mimic real-life materials. Each of the materials will be given a price. You will also be given a budget, or a maximum amount of money that you can spend while designing your solution. You will need to add up the costs of the materials you choose to make sure you stay within your budget.*
    - This is an opportunity for students to learn basic vocabulary heard during classroom instruction. [ELPS 2C]
    - Optional: Have students reflect on when they have heard the term "budget" used. If necessary, provide examples of when budgets are used and how budgets are used to manage cost.
24. Tell students that they will learn about the costs of the materials in the research phase.
25. Give students time to ask any clarifying questions about the constraints.

Optional

WELL

Printable

The Power of Listening



Wellness: The Power of Listening

Students will read an article and complete a graphic organizer to learn about skills that improve their ability to be good listeners. Students will then practice these listening skills during an activity.

Explain to students that this week, they will practice listening skills in order to communicate and collaborate with peers while working to solve the engineering design problem.

As a class, discuss and practice listening skills that students will need when working in small engineering groups.

[Connection to Health and Wellness]

Optional

Differentiation

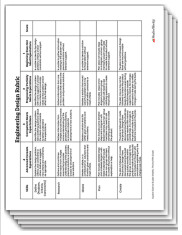
Developing

Allow students to share their responses orally or work in small groups to collectively record one set of written answers.

Advanced

Have students start brainstorming ways to reduce the effects of weathering, erosion, and deposition by water based on what they learned in the previous unit and their background knowledge.

Formative Assessment



Printable

Evidence	Student Edition Response

Use student edition responses to check for proficiency of the success criteria. Refer to the "Define" section of the Engineering Design Rubric in **Weathering, Erosion, and Deposition: Answer Keys** for guidance.

Activity 7	Research — Define	45 minutes

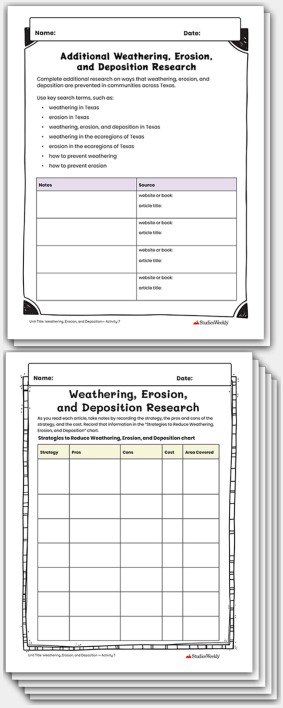
Materials:

- research materials (desktops, laptops, and/or tablets; books; printed articles; etc.)

Image **Coastline**

Printable **Additional Weathering, Erosion, and Deposition Research**

Weathering, Erosion, and Deposition Research



ELAR **4.13B:** Develop and follow a research plan with adult assistance.

SEP **Design Solutions**

RTC **Cause and Effect**

ELPS **1F, 3E, 4F, 4G**

Success Criteria

I can conduct research by obtaining information from multiple sources to identify the effects of different strategies used to reduce weathering, erosion, and deposition of the Earth's surface.

Teacher Note

Prior to this activity, select several materials or resources that can be used for additional research to guide students. Materials or resources could be digital or print. Examples could include newspaper articles, books, local conservation websites, short videos or clips, images, etc.

Lesson Guide

Student-Driven Inquiry

1. Display the **Coastline** image.
2. Have students observe the image.
3. Post the discussion questions for students to see:
   - What do you notice?
   - What do you wonder?
   - What is a cause-and-effect relationship you see?
4. Have students discuss the questions in pairs.
5. Call on students to share their ideas and responses to each question.
6. **Discuss:** What types of weathering, erosion, and deposition could take place in this image? **(weathering, erosion, and deposition caused by water and possibly wind)**
7. **Discuss:** How is the community trying to prevent weathering, erosion, and deposition?
   - Collect all answers at this point.
8. ***Say:*** *Our research question for today will be: How can weathering, erosion, and deposition be reduced in an area?*
9. Have students write the research question in their student editions.

Conduct Research

1. Remind students that before engineers design solutions to problems, they conduct research. Research can help guide them as they develop new technologies or improve existing ones.
   - The following steps are an opportunity for students to use accessible language and learn new and essential language in the process. [ELPS 1F]
2. Have students work in groups of four, or create six equal groups of students. These will be their engineering groups for the remainder of the unit.
3. Provide each student with the **Weathering, Erosion, and Deposition Research** printable.
4. Have students follow the directions in their student editions.
   - This is an opportunity for students to demonstrate comprehension of increasingly complex English by taking notes commensurate with the content area. [ELPS 4G]
5. As you circulate, observe and take anecdotal data monitoring students' understanding of the following concepts:

- Weathering, erosion, and deposition are processes that create slow changes to the Earth's surface over time.
- People have invented and/or researched natural and human-made ways to reduce these effects.

a. This is an opportunity for students to share information in cooperative learning interactions. [ELPS 3E]

b. If students struggle, check for comprehension of each article by having students retell or summarize each article to check for main ideas.

6. **Discuss:** How did the images in the texts help support or confirm your understanding of each process?
   - This is an opportunity for students to reflect on how visual supports can be used to enhance or confirm their understanding of text. [ELPS 4F]
7. When students complete the activity in the student edition, provide them with the **Additional Weathering, Erosion, and Deposition Research** printable and any additional research materials, such as laptops/tablets, books, a list of websites, and/or digital/print articles. [ELPS 3E]
   - Allow some students to research Texas government agencies to learn about local, or Texas-specific, solutions. This can be used as an advanced option.

Reflect and Connect

1. **Discuss:** How has your understanding of the engineering problem changed so far? **(Answers may vary. Students may suggest certain strategies that they think could be used as possible solutions.)**
   - Remind students that as engineers gather more information, they may change their initial ideas, thoughts, or possible solutions around the engineering process. This is a sign of growth in learning.
2. **Discuss:** What questions do you have?
   - Collect all questions or statements of wonder at this time. Encourage inquiry as a natural step in the learning process.

Optional

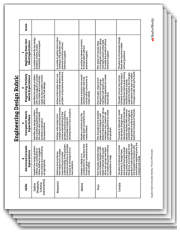
Differentiation

Printable **Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles**

Developing

- Students can read the lower Lexile® measure version of the articles "Reducing the Effects of Weathering, Erosion, and Deposition" (Lexile® measure: 790L; word count: 69), "Plants" (Lexile® measure: 600L; word count: 107), "Sand" (Lexile® measure: 700L; word count: 113), "Rocks" (Lexile® measure: 500L; word count: 101), "Pipes" (Lexile® measure: 760L; word count: 81), "Soil" (Lexile® measure: 700L; word count: 121), and "Habitat Rebuilding" (Lexile® measure: 790L; word count: 142) in the **Weathering, Erosion, and Deposition: Lower Lexile® Measure Articles** printable.
- Allow students to report their research findings through audio/video recording or by dictating to a teacher or using speech-to-text software.

	Advanced Allow students to conduct additional research on Texas landforms that are affected by weathering, erosion, and deposition, as well as strategies that are used to reduce these processes.

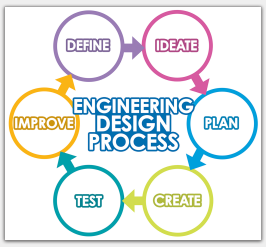
Formative Assessment	 Printable	**Evidence** — **Weathering, Erosion, and Deposition Research** Use responses from the **Weathering, Erosion, and Deposition Research** printable to check for proficiency of the success criteria. Refer to the "Research" section of the Engineering Design Rubric in **Weathering, Erosion, and Deposition: Answer Keys** for guidance.

Activity 8	Ideate and Plan — Develop Solutions	45 minutes

Materials:

- glue sticks (one per student)
- prepared sidewalk model (1; see Materials and Instructions page)
- scissors (one pair per student)

Image **Engineering Design Process**

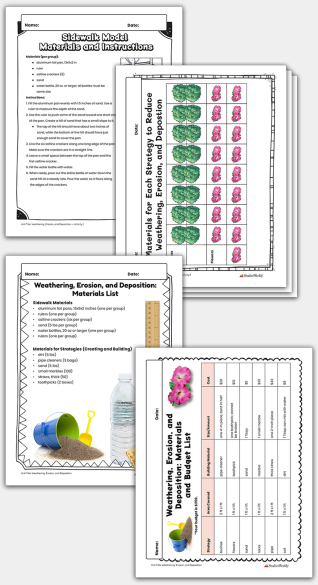


Printable **Sidewalk Model Materials and Instructions**

Materials for Each Strategy to Reduce Weathering, Erosion, and Deposition

Weathering, Erosion, and Deposition: Materials List

Weathering, Erosion, and Deposition: Materials and Budget List



Success Criteria

I can create a plan for a solution that will reduce the effects of weathering, erosion, and deposition on the sidewalk while aiming to meet the criteria and constraints of the project.

Teacher Note

Prior to this activity, you will need to create a materials collection location in the classroom where students can view materials from the **Weathering, Erosion, and Deposition: Materials List** printable. Being able to view the materials will support students who are unfamiliar with certain materials and/or students who are visual learners in making the best choices for their solutions.

Lesson Guide

Student-Driven Inquiry

1. **Discuss:** What is the engineering problem for this unit? **(What can I design to reduce the effects of weathering, erosion, and deposition by water along the sidewalk?)**
2. Present the engineering scenario to students by using the **Sidewalk Model Materials and Instructions** printable.
   - Remind students that the saltine crackers represent the sidewalk.
3. Tell students that they will create a model of the sidewalk just like the one you have created. They must then build a solution that reduces the effects of weathering, erosion, and deposition on the sidewalk in the model.
4. Have students review the criteria and constraints by reading them aloud from Activity 6 in their student editions.
   - Optional: Refer to the anchor chart made in Activity 6 and call on students to read the criteria and constraints aloud.
5. ***Say:*** *One constraint you will need to be aware of today is your budget. Your budget will be $350. You will learn more about this today.*
6. Display the **Engineering Design Process** image.
7. Tell students that in today's activity, they will ideate and plan a solution.

Ideate a Solution

1. Have students work in their engineering groups.
2. Remind students that to "ideate" means to generate ideas. The purpose of the ideation phase is to collect all possible ideas, discuss ideas, combine ideas, think through ideas, and choose several ideas that seem most likely to be successful in solving the engineering problem and meeting the criteria and constraints.
   - This is an opportunity for students to use accessible language and learn new and essential language in the process. [ELPS 1F]
3. Show students the materials collection location in the classroom.
   a. Briefly review the materials that will be available for use in creating a design solution.

ELAR **4.1D:** Develop and follow a research plan with adult assistance.

SEP **Design Solutions**
Develop and Use Models
Listen Actively and Discuss

RTC **Cause and Effect**

ELPS **1F, 3H**

   b. Display the **Weathering, Erosion, and Deposition: Materials and Budget List** printable for students to reference while they discuss.
   c. Make sure to add any materials to or remove any materials from the list that you discussed as a class.
4. Have students follow the directions in the "Ideate a Solution" section of their student editions.
5. As you circulate, encourage students to show respect to their team members. They should not turn down any ideas; they should try to build on all ideas by reworking them or combining them with other ideas.
6. Provide assistance as necessary by asking questions, such as:
   - What helpful information did you find in your research?
   - How are strategies similar?
   - How are strategies different?
   - Will you combine strategies?
   - Does/Do your strategy(ies) meet the criteria of …?
   - Do any of the strategies you want to use fall outside of the constraints?
   - Can you tell me more about ...
   - Can you explain why ...
   - Why did you decide to ...
   - What do you think will happen when ..

Ideal Solutions

Ideal solutions will include one or more strategies that aim to reduce the weathering, erosion, and deposition of the sidewalk by redirecting the flow of the water and that do not create another hazardous area. Ideal solutions will also stay within the $350 budget.

Make a Plan

1. Provide each student with the **Materials for Each Strategy to Reduce Weathering, Erosion, and Deposition** printable.
2. Display the **Weathering, Erosion, and Deposition: Materials and Budget List** printable.
3. Point out to students that each material comes in a specific size (one foot by one foot, etc.) and at a specific price. As they make their plans today, students will need to figure out how many pieces of each material they will need and what the total cost will be for using that material.
   - Tell students that they will also need to calculate the total cost of all the materials they use to make sure that the total cost is $350 or less, or within their budget.
4. Have students follow the directions in the "Make a Plan" section of their student editions.
5. As you circulate, use the following questions to reinforce the application of scientific ideas and deepen thinking:
   - How will this slow or prevent weathering of the sidewalk?
   - How will this slow or prevent erosion of the sidewalk?
   - How will this slow or prevent deposition that creates a hazardous area?
   - Does this solution meet the criteria? Does this solution meet the constraints?

a. This is an opportunity for students to explain with increasing specificity and detail as more English is acquired. [ELPS 3H]

6. Take anecdotal notes of which students are participating and which students are demonstrating an understanding of the scientific ideas listed above.

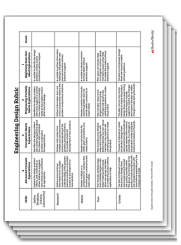
Optional

Differentiation

Developing

Have each group of students work together to create only one plan in one student edition to minimize the amount of writing required from each student.

Formative Assessment



Printable

Evidence	Student Edition Response

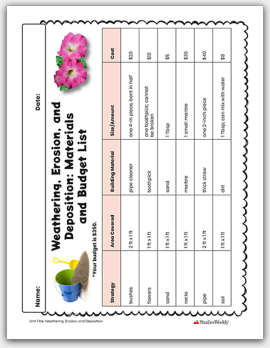
Use student edition responses to check for proficiency of the success criteria. Refer to the "Ideate" and "Plan" sections of the Engineering Design Rubric in **Weathering, Erosion, and Deposition: Answer Keys** for guidance.

Activity 9	Create — Develop Solutions	45 minutes

Materials:

- 1 tablespoon (4)
- aluminum foil pans, 13x9x2 in (one per group)
- dirt (5 lb)
- marbles, small (100)
- pipe cleaners (3 bags)
- rulers (one per group)
- saltine crackers (six per group)
- sand (5 lb per group)
- straws, thick (50)
- toothpicks (2 boxes)

Printable **Weathering, Erosion, and Deposition: Materials and Budget List**



ELAR **4.1D:** Work collaboratively with others to develop a plan of shared responsibilities.

SEP **Design Solutions**
Develop and Use Models

RTC **Cause and Effect**

Success Criteria

I can create a solution that meets the criteria and constraints and solves the engineering problem by reducing the effects of weathering, erosion, and deposition on the sidewalk and surrounding area.

Teacher Note

Create a materials collection location in the classroom by organizing and laying out the materials that students can select from the **Weathering, Erosion, and Deposition: Materials and Budget List**.

Prepare several materials ahead of time by cutting the thick straws into two-inch pieces and cutting the pipe cleaners into four-inch pieces.

Lesson Guide

Create a Sidewalk Model

1. Have students meet in their engineering groups.
2. Provide each group of students with the following materials: one 13x9x2-inch aluminum foil pan, six saltine crackers, about five pounds of sand, and one ruler.
3. Have students follow the directions in the "Create a Sidewalk Model" section of their student editions.

Create a Solution

1. Show students the materials collection place.
2. Display the **Weathering, Erosion, and Deposition: Materials and Budget List** printable.
3. Point out how students will need to count and measure certain materials.
    - For example, one "piece," or a one foot by one foot area, of sand is one tablespoon of sand. Students will need to measure out each "piece" of sand that they will need, using the tablespoon.
    - Demonstrate how to select and measure certain materials.
4. Remind students that they will not pour water into their designs today. They will test their designs in the next activity.
5. Have students work in their engineering groups to follow their plans from the previous activity to create their solutions.
    - Tip: If students express the desire to change their plans during creation, encourage them to stick to the plans they designed and save their new ideas for future improvement.
6. Collect each group's models for use in the next activity.

Optional

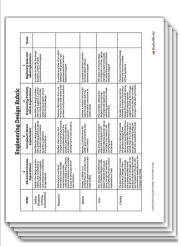
Differentiation

Developing

Provide a prepared sidewalk model for groups of students who may struggle with time management.

Advanced

Have students predict possible spots where weathering, erosion, and/or deposition may occur after building their solutions.

Formative Assessment	 Printable	**Evidence**	Student Artifact
		Use student models to check for proficiency of the success criteria. Refer to the “Create” section of the Engineering Design Rubric in **Weathering, Erosion, and Deposition: Answer Keys** for guidance.	

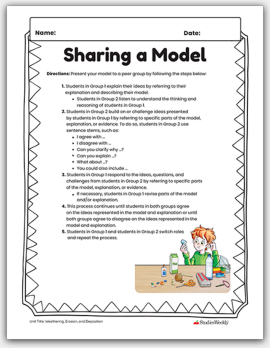
Activity 10	Test, Improve, and Communicate — Optimize	45 minutes

Materials:

- poster paper (one sheet per group)
- student models (from Activity 9; one per group)
- water (as needed)
- water bottles, 20 oz or larger (one per group)

Printable

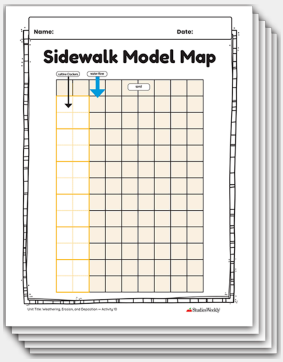
Sharing a Model
Sidewalk Model Map


Name: Date:

Sharing a Model

Directions: Present your model to a peer group by following the steps below.

1. Students in Group 1 explain their ideas by referring to their explanation and describing their model.
   - Students in Group 2 listen to understand the thinking and reasoning of students in Group 1.
2. Students in Group 2 build on or challenge ideas presented by students in Group 1 by referring to specific parts of the model, explanation, or evidence. To do so, students in Group 2 use sentence starters, such as:
   - I agree with ...
   - I disagree with ...
   - Can you clarify why ...?
   - Can you explain ...?
   - What about ...?
   - You could also include ...
3. Students in Group 1 respond to the ideas, questions, and challenges from students in Group 2 by referring to specific parts of the model, explanation, or evidence.
   - If necessary, students in Group 1 revise parts of the model or explanation.
4. This process continues until students in both groups agree on the ideas represented in the model and explanation or until both groups agree to disagree on the ideas represented in the model or explanation.
5. Students in Group 1 and students in Group 2 switch roles and repeat the process.


Name: Date:

Sidewalk Model Map

ELAR **4.1D:** Work collaboratively with others to develop a plan of shared responsibilities.

SEP
Design Solutions
Collect Evidence
Identify Advantages and Limitations of Models
Evaluate Designs
Propose Solutions
Develop and Use Models

RTC **Cause and Effect**

ELPS **3H**

Success Criteria

I can test my solution and evaluate how well it met the criteria and constraints and how well it solved the design problem by communicating my results with the class.

Lesson Guide

Test, Evaluate, and Improve the Prototype

1. Have students meet in their engineering groups.
2. Provide each group with their model from the previous activity and one large water bottle filled with water.
3. Have students follow the directions in the “Test, Evaluate, and Improve” section of their student editions.

Communicate

1. Provide each group with one **Sidewalk Model Map** printable and a piece of poster paper.
2. Have students follow the directions in the “Communicate” section of their student editions to create their poster presentations.
3. Have each group present their poster to a peer group.
4. Provide each group with the **Sharing a Model** printable.
   - This is an opportunity for students to explain with increasing specificity and detail as more English is acquired. [ELPS 3H]

Unit Transition

Explain to students that in the next unit, they will continue to investigate processes and patterns on Earth that cause changes by differentiating between weather and climate.

Optional

Video

Weathering, Erosion, and Deposition: Summary Video

This video summary discusses what the students learned in the unit, including an explanation of the phenomenon and evidence that supports it as well as a description of the engineering design process they followed and possible solutions.

Optional

Differentiation

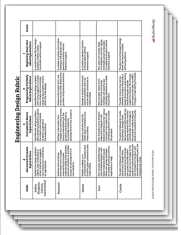
Developing

Allow each group of students to work together to create one model for the "Test" section of the activity.

Advanced

Have students write a persuasive essay based on the information presented in their poster.

Formative Assessment



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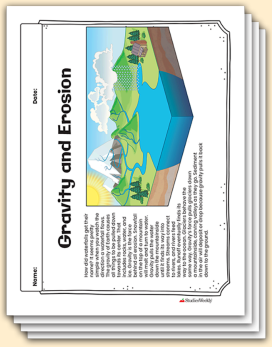
Evidence	Student Edition Response

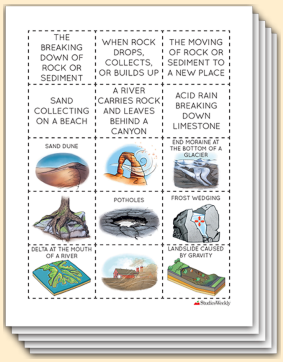
Use student edition responses to check for proficiency of the success criteria. Refer to the "Test," "Evaluate," "Improve," and "Communicate" sections of the Engineering Design Rubric in **Weathering, Erosion, and Deposition: Answer Keys** for guidance.

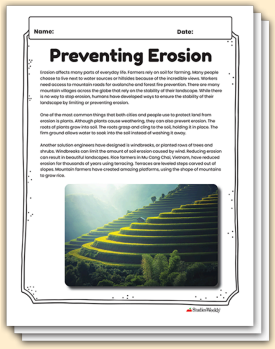
Optional: Extension Activities

Printable

Gravity and Erosion
Deposition
Preventing Erosion







These activities provide further practice/enrichment on the unit's content.

1. **Gravity and Erosion (45 minutes):** Students will play a game that simulates weathering, erosion, and deposition and read an article to further understand the role of gravity in erosion.

2. **Deposition (30 minutes):** Students will complete a sorting activity to identify weathering, erosion, and deposition and create skits to demonstrate the differences between the processes.

3. **Preventing Erosion (60 minutes):** Students will read an article and complete an investigative lab to determine the effects that plants have on the rate of erosion.