

Stop River Bend Erosion

Grade level

Fifth Grade

Time Allotted

five 45-minute lessons

Learning Objectives

Students will explore the process of water erosion and recognize how it changes Earth's surface. Students will use a physical model of a river bed to determine the causes of erosion and will brainstorm ways to prevent it within their model.

Next Generation Science Standards Addressed:

5-ESS2-1 Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5-ESS3-3 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment (NGSS Lead States, 2013).

Science Texas Essential Knowledge and Skills (TEKS)

5.3 Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to: (A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student; (D) connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

5.4 Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to: (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, pan balances, triple beam balances, graduated cylinders, beakers, hot plates, meter sticks, compasses, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observation of habitats of organisms such as terrariums and aquariums.

5.7 Earth and space. The student knows Earth's surface is constantly changing and consists of useful resources. The student is expected to: (B) recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth's surface by wind, water, and ice.

5.8. Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon systems. The student is expected to:

(D) identify and compare the physical characteristics of the Sun, Earth, and Moon. (Texas Education Agency, 2017b).

Math TEKS:

5.1 Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to: (A) apply mathematics to problems arising in everyday life, society, and the workplace; (B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution; (C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems (Texas Education Agency, 2012).

ELAR TEKS:

5.7 Reading/Comprehension of Literary Text/Literary Nonfiction. Students understand, make inferences and draw conclusions about the varied structural patterns and features of literary nonfiction and provide evidence from text to support their understanding. Students are expected to identify similarities and differences between the events and characters' experiences in a fictional work and the actual events and experiences described in an author's biography or autobiography.

5.26 Research/Organizing and Presenting Ideas. Students organize and present their ideas and information according to the purpose of the research and their audience. Students are expected to synthesize the research into a written or an oral presentation that: (A) compiles important information from multiple sources; (B) develops a topic sentence, summarizes findings, and uses evidence to support conclusions; and (C) presents the findings in a consistent format.

5.27 Listening and Speaking/Listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity. Students are expected to: (A) listen to and interpret a speaker's messages (both verbal and nonverbal) and ask questions to clarify the speaker's purpose or perspective; and (C) determine both main and supporting ideas in the speaker's message.

5.29 Listening and Speaking/Teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to participate in student-led discussions by eliciting and considering suggestions from other group members and by identifying points of agreement and disagreement (Texas Education Agency, 2017a).

Lesson Assessment

Formative Assessment

Students will participate in formative assessment discussion questions throughout the lesson. Using a science journal/notebook, students will write what they have learned—see the Explain section of the lesson plan. Students will complete an engineering design activity sheet.

Summative Assessment

A rubric will be used to assess the students-see the Evaluate section of the lesson plan.

Instructional Design using a 6E Lesson Plan

*Engage (5 minutes)

1. Students will view the following NASA time lapse video showing erosion along the coastline in Massachusetts--https://earthobservatory.nasa.gov/Features/WorldOfChange/cape_cod.php .

2. Formative Assessment Discussion Questions:

- What are you observing in the video?
- What may have caused the land along the coastline to change in the video?
- What is erosion and what causes it?
- What can we infer from this video?
- What do you think can scientists learn about Earth by using this image taken from space?

*Explore (40 minutes)

1. As a whole class, the teacher will guide the students in using a KLEWS chart to record what students know (K) about erosion. The teacher and students will refer to the KLEWS chart throughout the lesson.

2. Students will view the following video on water erosion--<https://www.youtube.com/watch?v=5bqJo5ze3Bk> . After viewing the video, students will discuss observations and questions they may have about the video and/or erosion.

3. Students will access the “Erosion by Water” Google Slides which has been shared in their Google Classroom. Students will work with partners to search online for an image showing erosion by water. Students will copy the image, place it on their assigned slide in Google Slides, and be prepared to explain how water is affecting erosion and land in their picture. The class will view the Google Slide presentation. Partners will explain and discuss the images. Students may add what they are learning on the KLEWS chart (L) and the evidence that supports their learning (E).

Formative Assessment Discussion Questions:

- What are you observing in the images?
- What may have caused the land to change in the images?

- What can we infer from these images?
- What part does the water cycle play in erosion?
- What do you think can scientists learn about Earth by viewing these types of images?

***Explain** (45 minutes) Directions are adapted from

<http://daytonregionalstemcenter.org/wp-content/uploads/2013/08/What-s-All-the-Commotion-About-Erosion-Webversion.pdf>

1. Prior to lesson, using a stream table, the teacher will set up a River Tray Model for demonstration. The teacher will demonstrate water erosion using a physical model. The model will consist of aquarium sand, fine sand, gravel, plastic aquarium plants, and small houses and Lego people (optional). A river bed with a bend should be pressed into the sand.
2. Review the concept of erosion with students. Explain that you will be pouring water into the river to simulate water flow. They will observe erosion as the water flows through the riverbed. Before the demonstration, ask the students what they think will happen when the water is poured into the model. Students should write three observations from the demonstration in their science notebook while they observe.
3. Demonstrate erosion using the model. Using a full 2-liter bottle of water, steadily pour all contents at the rate of approximately 2 liters per 22 seconds (the amount of water and the time may need to be adjusted for the size of the stream table pan).
4. Formative Assessment Discussion Questions:
 - What effect does the flow of the water have on the land?
 - Did you see erosion? Where?
 - How does erosion affect the plants?
 - Where is the greatest amount of erosion taking place?
5. Help students conclude that the greatest amount of erosion is taking place at the bend.
6. Ask the question, "How can we reduce or eliminate erosion?" Use the KLEWS chart to record what has been learned and the evidence to support that learning. Record science vocabulary and/or scientific concepts into the section labeled "S."
7. Direct student to read the following online article, "Interesting Facts About Erosion," <http://www.scienceforkidsclub.com/erosion.html> . Students will view the following erosion video-- <https://www.youtube.com/watch?v=R-Iak3Wvh9c> . Students will record three things they have learned about erosion in their science notebook. Students will share their ideas in small groups.

***Elaborate** (45 minutes)

1. Create design teams of three to four students.
2. Explain to students that they will be testing different materials to see if they are able to reduce or eliminate erosion at the river bend on their own models. Show materials students may choose to use: clay, craft sticks, foam pieces, large rocks, bottle caps, corks, index cards, tape, Styrofoam peanuts, or other materials teams suggest and the teacher approves.
3. Explain that teams will begin with a model similar to the teacher's model. Show a picture of the teacher's model and point out the way the model was set up and designed. Explain that conducting tests in the real world requires changing one variable at a time, thus the models must be created to be identical so as to conduct a valid test. Students will use a camera to take a picture of their initial model so that it can be replicated.
4. Review the Engineering Design Process with students. Explain to students that they will be working in teams, utilizing the Engineering Design Process, to see if they can engineer a design to eliminate or reduce erosion at the river bend. Distribute the activity sheet—see final page in lesson plans.
5. Teams will complete the Ask, Imagine, and Plan sections on their Engineering Design Process activity sheet. Teams will present their design to the class for review. Audience members may ask for further clarification from presenting teams. Audience members may offer ideas to improve each team's design. Teams may choose to add these ideas to their plan.

***Engineer** (45 minutes)

1. Teams will set up their stream tables for the first trial. Each team must create a river bed with a river bend. Teams will take any necessary measurements and photograph their original model.
2. Teams will complete their activity sheet by testing their design. Students will analyze the success of their design and determine if it needs to be improved. Students will need to use their original photograph to assist in setting up their stream table for further testing. Students will complete the Create, Improve, Communicate, and Reflect sections on their activity sheet.
3. Once teams have completed their work, each team will explain and share their final design. Teams will discuss why their final design is successful/is not successful.
4. As a class, discuss the results and encourage students to offer suggestions on how each model could be improved. Remember to consider both materials and structural design.
5. After the assessment of the models, ask teams to list three positive and three negative aspects of their model. Teams should collaboratively decide (and list) how they would improve their models if they were given any materials of their choice and how they would construct another (better) model with the new materials.

***Evaluate**

Science notebook: Assess student comprehension as they share what they have learned about erosion. Students will also complete the KLEWS chart.

Activity sheet: Assess student comprehension as they progress through the activity sheet to research, brainstorm, design, build and improve their designs.

The following rubric will be used to assess the students during the engineering design project (see below). The students may use this rubric for self-assessment, and the teacher may use it for grading purposes.

Engineering Design Process Rubric

*Individual Progress Report

Name _____

Date

Project _____

Grade

Criteria	4-5 Points	2-3 Points	0-1 Points	Points
Identifying the problem and brainstorming solutions	Showed a clear understanding of the problem(s) to solve. Independently brainstormed solutions.	Needed some teacher direction to define the problem(s) and brainstorm possible solutions.	Needed lots of teacher direction to define the problem(s). Little if any independent brainstorming.	
Working as a team member	Worked well with team members. Participated and stayed on task.	Was occasionally off task.	Was often off task and not cooperating or participating fully	
Using the engineering design process	Assisted team in brainstorming many design ideas. Actively participated in testing and improving the design.	Was occasionally off task instead of assisting team in brainstorming ideas, testing, and improving design.	Brainstormed few design ideas and did little testing or redesigning.	
Processing the science and engineering	Assisted team in strong presentation of its solution	Was occasionally off task during presentation.	Did not participate in presentation. Showed little	

during group presentation	to the challenge. Showed clear understanding of the science concepts and design process.	Showed less than adequate understanding of the science concepts and design process.	understanding of the science concepts and design process.	
				Total Points

Adjustments/Adaptations

Students will work in small cooperative groups during the Explain and Engineer sections of the lesson. Each group member will choose a job card so that everyone is responsible for the group projects. Students will partner read the article. Discussion questions are based on different levels of Bloom’s Taxonomy. Groups are given choices in the Engineering portion of the lesson. The lesson takes into account different learning styles—visual, auditory, and kinesthetic.

Closure/Summary

Formative Assessment Discussion Questions:

- Students will discuss how moving water causes erosion.
- Students will discuss a situation in which river erosion would need to be reduced or eliminated.
- Students will review how erosion affects coastlines, rivers, canyons, and deltas.
- Students will predict how climate change may affect water erosion in the future.

Resources and Materials Needed—large chart paper for creating KLEWS chart, Chromebooks, aquarium gravel (for each team), fine sand (for each team), bottle of water (one per team), bucket or tray for collecting water (one per team), large aluminum oven tray (29 cm X 45 cm) or stream table per team, tape measure for measuring length of river (one per team), camera (one per team), testing items: bottle caps, clay, corks, craft sticks, foam pieces, index cards, large rocks, tape, and other materials suggested by teams and teacher approved, water, science notebook

Links:

https://earthobservatory.nasa.gov/Features/WorldOfChange/cape_cod.php

<https://www.youtube.com/watch?v=5bqJo5ze3Bk>

<http://daytonregionalstemcenter.org/wp-content/uploads/2013/08/What-s-All-the-Commotion-About-Erosion-Webversion.pdf>

<http://www.scienceforkidsclub.com/erosion.html>

<https://www.youtube.com/watch?v=R-Iak3Wvh9c>

References:

NGSS Lead States. (2013). *Next Generation Science Standards: For States, by States*. Washington, DC: The National Academies Press.

Texas Education Agency. (2012). Texas Essential Knowledge and Skills for 5th Grade. §111.6. Math. <http://tea.texas.gov>

Texas Education Agency. (2017a). Texas Essential Knowledge and Skills for 5th Grade. §110.15. English Language Arts and Reading. <http://tea.texas.gov>

Texas Education Agency. (2017b). Texas Essential Knowledge and Skills for 5th Grade. §112.15. Science. <http://tea.texas.gov>

Name: _____

Stop River Bend Erosion

Engineering Design Task: Design a way to reduce or eliminate water erosion at a river's bend.

Ask

What is the problem? What does research say about this problem? What are your constraints?

Imagine

What are some possible solutions to this problem? Brainstorm ideas.

Design a Plan

Draw a model for solving the problem. Label the materials you will use to create your model.

Write the Plan

Write the steps for creating the plan.

Create

Using your plan, make your model and test it. What worked? What didn't work? What changes need to be made?

Improve

How can you improve your model?

Communicate

Was your model successful? Why or why not?

Reflect

What did you learn from completing this engineering design activity? What did you learn about erosion?