7 Cutting Canyons and Building Deltas

MODELING

GRAVITY CAUSES WATER to flow downhill from higher elevations to lower elevations. As you have learned, water can pick up contaminants as it moves on the surface of and through earth materials. Moving water can also pick up and carry away **sediments.** Sediments are small pieces of earth materials, such as rocks, shells, and other debris. Faster moving water transfers more energy and can carry larger sediments than slower moving water. As flowing water slows down, any sediments it can no longer carry are dropped to the ground. If enough sediments get dropped in the same area, these deposits can form new landforms, such as deltas. In this activity, you will investigate the effects of moving water with a model.

After using the model to observe the effects of flowing water on a land surface, you will design a structure to reduce river erosion. All engineering projects have minimum requirements, called **criteria** (singular **criterion**), for how the design must function. Projects also have **constraints,** things that limit or restrict the design. For example, a criterion for an electronic device could be that it must operate continuously while a constraint could be that it must run on batteries.

GUIDING QUESTION

How does moving water affect the areas through which it flows?

Mud is a mixture of sediment and water.

MATERIALS

For each group of four students

Parts A and B

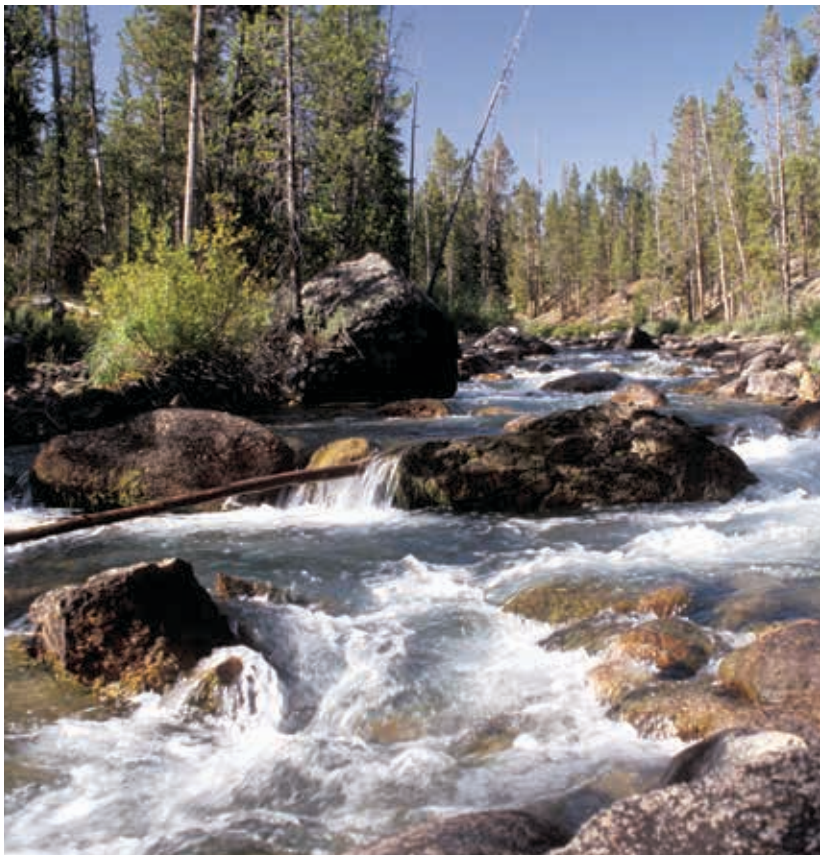
- 1 river model
- 1 river model stand
- 1 river model catch basin
- 1 rainmaker
- 1 graduated cylinder (50-mL)
- 1 spoon
- 1 graduated cup (30-mL)
- 1 plastic cup (9-ounce, to hold sand)
- supply of sand
- supply of water
- paper towels and/or newspapers

Additional Materials for Part B

- 1 channel maker
- 9 building bricks
- 2 mesh sleeves
- supply of small rocks

For each student

- 1 Student Sheet 7.1, "River Model Drawings"

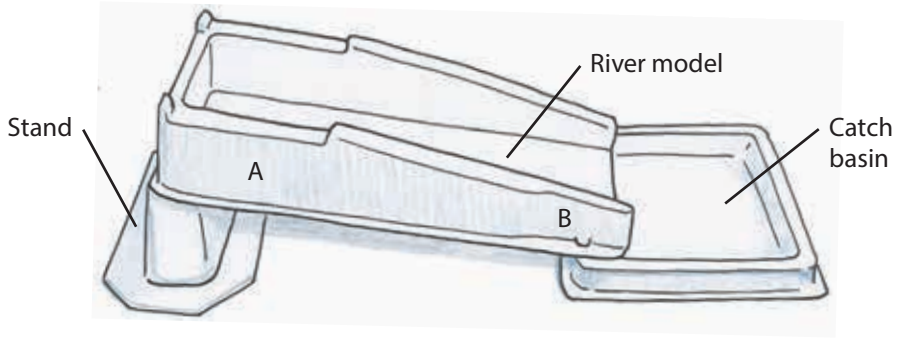


The water in rivers and streams carries sediment downriver.

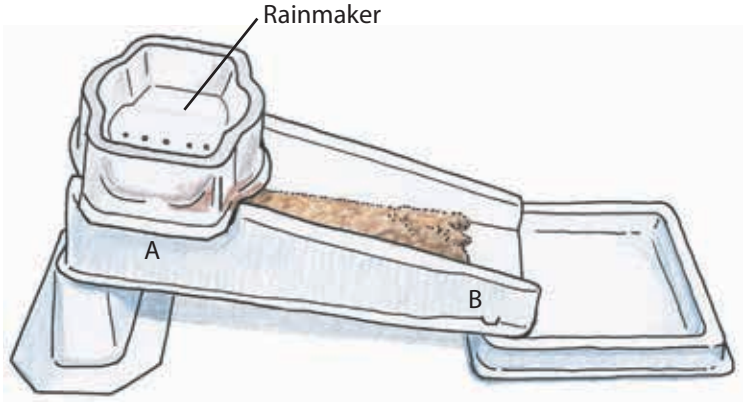
PROCEDURE

Part A: Modeling Erosion and Deposition

1. Set up the river model as shown below.



2. Using the 30-mL graduated cup, put 3 full cups of sand into the river model between Point A and Point B.
3. Use your fingers or the spoon to pack the sand into a uniform layer that covers the bottom of the river model between Point A and Point B. If the sand is too wet, mix in a little dry sand until it is the consistency of cookie dough.
4. Place the rainmaker over Point A of the river model, as shown below.



5. Use the left-side diagram labeled "Predictions" on Student Sheet 7.1, "River Model Drawings," to sketch a picture showing where you think the sand and water will end up after water is poured into the rainmaker and allowed to "rain" on the model.

6. Add 50 mL of water to the rainmaker.
7. Carefully observe what happens. Don't forget to watch what happens in the catch basin. Sketch or write down what you see.
8. Repeat Steps 6 and 7 two more times.
9. Use the right-side diagram labeled "Observations" on Student Sheet 7.1 to draw the position of the water and sand in the model. Label the diagram as completely as you can.
10. Read the following description of some geological processes and landforms. Then write a complete description of what happened in your river model using the bolded terms.

    The removal of sediments from an area is called **erosion** (e-ROW-zhun). Common causes of erosion are gravity and moving water, wind, and ice. Erosion leads to **deposition** (de-puh-ZI-shun), which happens when the current slows down and the sediments settle out of the flowing water, ice, or wind and drop to the ground. A **delta** is a fan-shaped landform that develops where sediments are deposited in one area as a result of flowing water (such as a stream or river) entering still water (such as a lake or ocean).

Part B: Engineering an Erosion-Control Structure

11. Read the following criteria and constraints for designing a system that will reduce erosion in the model. As a class, clarify or add any relevant criteria or constraints to the design challenge.

    Design Criteria

    The design must

    - provide less erosion over the length of the river model than if there was no erosion-control system in place.
    - result in less deposition in the catch basin.

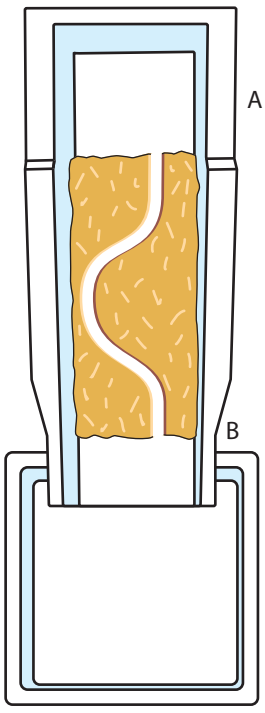
    Design Constraints

    The design is limited by

    - using the channel maker to begin the design.
    - using the materials provided.

The retaining wall along the side of this stream is designed to reduce erosion due to water in the river channel.

12. Get the additional engineering materials from your teacher.
13. Set up the river model as you did in Steps 1–4.
14. Press the channel maker into the sand layer and then remove it. This forms a shallow channel like the one shown to the right. Make a sketch of the channel in your science notebook.
15. Add 50 mL of water to the rainmaker, and carefully observe what happens. Add information to your sketch showing and describing the erosion patterns.
16. Talk among your group about how to use the materials provided to prevent erosion along the river channel. Choose a design to test in the river model.
17. Repeat Steps 13 and 14, and then add your erosion-control structure. Make sure to include your structure in your sketch.
18. Test your design, making sure to record any information that indicates how effective your structure was at reducing erosion.
19. Based on your results, redesign your erosion-control structure to optimize erosion control. Sketch and describe your design, and then write a brief explanation using scientific concepts about how your revisions will improve the design.
20. Retest your design and record the results.



EXTENSION 1

Investigate how the steepness of the land affects the movement of sediments. Model a steeper river by placing a book under the base of the river model, and then repeat Part A. Compare the results from the steeper slope with those from Part A.

EXTENSION 2

Investigate how the type of earth material that the river flows through affects the movement of sediments.

ANALYSIS

1. Thinking about the river model in this activity, answer the following:
   a. How is the model like a real river?
   b. How is it different from a real river?
2. What were the biggest changes that occurred
   a. at the higher elevations? Explain why you think this happened.
   b. at the lower elevations? Explain why you think this happened.
3. How well did your redesigned erosion-control structure work compared with your original? Use evidence from your tests to explain why your design changes did or did not make a difference.
4. What do you think are the biggest challenges when building effective erosion-control structures on real rivers? Use evidence from this activity in your response.
5. How could the movement of sediments cause a problem if someone builds on
   a. Delta Wetlands?
   b. Green Hill?
   c. Seaside Cliff?

6. Observe the photograph at right. It shows a river at the bottom of a canyon with hard rock walls.
   a. Explain how the water flowing down the river created the canyon.
   b. Explain what happened to the rock that once filled up the canyon.

A canyon cut by the Daning River in China

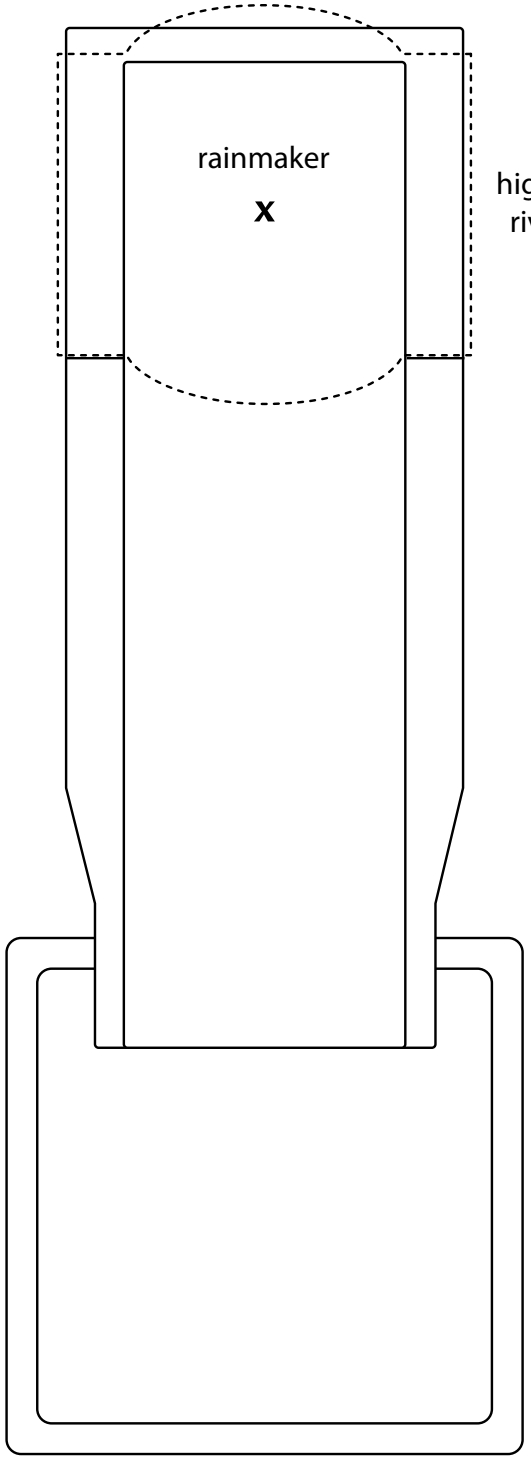
Name_____ Date_____

STUDENT SHEET 7.1

RIVER MODEL DRAWINGS

PREDICTION

Draw what you think will happen to the sand and water after it "rains" at Point X.



OBSERVATIONS

Draw what actually happened to the sand and water after it "rained" at Point X.