Levee Construction:
What types of soils are best?

Based on a lesson from American Field Guide Teacher Resources: Floods, www.pbs.org/americanfieldguide/teachers

Complete this lesson at home. Then, visit the exhibition *Living with Hurricanes: Katrina and Beyond* at the Presbytère to learn more about levees, their purpose, and how they failed during Hurricane Katrina.

OVERVIEW

Earthen levees are good at channeling and holding back water under relatively constant hydrostatic pressure where the height of the water is not rapidly changing. An example would be a river at flood stage. The soil and water reach equilibrium. One of the dangers is a rapid fall of water against a levee system. A rapid fall destabilizes the soil. The factor of safety is reduced. A subsequent rise could cause levee failure, such as back-to-back storms (Hurricanes Katrina and Rita; Hurricanes Gustave and Ike).

If a clay levee is properly built tall enough, wide enough, and given enough time to compact, there likely won't be a failure. However, the cost of properly building clay levees tall enough and wide enough is tremendous due to the sheer size of the structure. Earth levees that are expected to withstand powerful tidal surge must be very wide. In many cases a levee with an elevation in excess of 20 feet must be 500ft-750ft wide. The levee itself might only be 120ft-150ft wide, however, expansive reinforcing berms (150ft-250ft) must be put on both sides of the levee. This helps to keep it stable and prevent global failure.

OBJECTIVES

Students will understand the following:

1. Different types of soil have different capacities for retaining rainwater.
2. If the soil in an area will not hold enough rainwater, flooding problems will ensue.
3. Soil can be tested for its water-retaining capacity.

MATERIALS

- Three soil samples: sand, agricultural soil (potting soil), and clay
- Water
- Three measuring cups
- Funnel
- Filter paper
- small sponges

INTRODUCTORY DEMONSTRATION

Some types of soils are more conducive to flooding than others. Test various types of soils by putting them into a cone-shaped piece of filter paper held over a cup and pouring a set amount of water over each one. Measure the amount that drains through the soil into the cup. (You may want to do two runs of this step - one while the soil is dry, and one while it is saturated.) Based on your results, consider which soil would be most likely to flood. Explain that students will experiment with different types of soil to determine which is best for levee construction.

PROCEDURES

1. Tell students that their challenge is to test different samples of soil to see how much water the soil will absorb. This test will determine the best soil for building levees.
2. Divide your class into small groups, distributing materials to each group.
3. Students should first test each type of soil in its dry state by measuring the same amount of each soil, in turn, into a funnel lined with filter paper, and then pouring a measured amount of water through it. They should use the same amount of water for each type of soil. The water that drains through each type of soil should be collected in another measuring cup and the amount recorded.
4. Have students repeat the test using the same types of soil in their saturated states.
5. Discuss with the class which soil held the most water when dry and which saturated soil held the most water. Which type of soil would be most likely to cause flooding problems?
6. Have each student write a lab report describing the soil tests, including an explanation of how communities and developers would use such tests.

DISCUSSION

1. Explain why a river can flood even if there was no recent rain in that section of the river valley.
2. Why are sediments found in rivers? Discuss how rivers carry sediments and explain how this impacts the land during a flood.
3. What characteristics determine how much water soil can hold?
4. Debate the merits of building dams upstream to prevent flooding—thereby making former floodplains available for development.
5. Discuss why hydrologists—scientists who study the water cycle—track snow accumulation as a part of long-term flood forecasting. What other data would help them make more accurate flood predictions?