Floods
6–8

Flood Science

LESSON PLAN 2

What Are Floods?

Floods are a high water flow or an overflow of rivers or streams. Floods occur in floodplains when prolonged rainfall over several days, intense rainfall over a short period of time, an ice jam or a debris jam causes the rivers and streams of a watershed to overflow their banks.

Key Terms and Concepts

channeling	floodplain	precipitation
flash flood	flood stage	surface runoff
flood	infiltration	

Purpose

To help the students understand floods and their relationships to the hydrologic cycle, terrain and types of soil

Objectives

The students will—

- Use a stream table and *You're the Hydrologist* to illustrate runoff and channeling and the relationship between rain and floods.
- Use a topographic map and information from *You're the Hydrologist* to illustrate floodplains and flood dangers in their area and to assess the community's building practices for safety in floods.
- Understand the deposition of fertile river silts and sediments into floodplains with the help of *Floodplain*. (Linking Across the Curriculum)
- Apply knowledge from the stream table activity to assess the safety of different areas of a simulated city and learn how this rating can affect insurance rates. (Linking Across the Curriculum)
- Compare soil types from different sections of the community to determine their capacity for infiltration; test ideas by using the soils in a composite landscape in the stream table. (Linking Across the Curriculum)
- Outline their local watershed with the aid of Internet resources and analyze how human activities affect the watershed.
- Access the Internet with their families to locate their addresses and gauge the danger from flood. (Home Connection)
- Create an economic web to show how areas of the community might be affected in the event of flood. (Linking Across the Curriculum)

American Red Cross

Visit the American Red Cross Web site at *www.redcross.org/disaster/masters*

Floods
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LESSON PLAN 2

What Are Floods?

- Work in groups to investigate cultures around the globe to learn the effects of seasonal floods. (Linking Across the Curriculum)

Activities

"Stream Table"

"Mapping Your Watershed"

American Red Cross

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LESSON PLAN 2

What Are Floods?

Materials

- *You're the Hydrologist*, 1 copy per student

For each group:

- Very large pan or plastic-covered box
- Water source with hose
- Large basin or area for drainage
- Bricks or blocks
- Soil of different types and porosity, including sand, garden soil and clay
- Toy houses, buildings and cars (game-piece size)
- 2 or 3 spray bottles
- Local elevation map

- *Floodplain*, 1 copy per student (Linking Across the Curriculum)

American Red Cross

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"Stream Table"

SET UP 30 minutes **CONDUCT** two 45-minute classes

Social Studies: Mapping; Science: Earth Science

1. To introduce the students to the water cycle in our environment, begin by dividing the class into several small groups and distributing *You're the Hydrologist*.

2. Have the students follow the steps to illustrate how rivers form and change with time and to see how flooding and channeling occur.

Answers to *You're the Hydrologist*

1. As the water continues to flow, you can see the channel begin to form and enlarge. Sand is deposited in a fan-shaped delta at the end of the stream, and the erosion of the river banks over a period of time will change the river channel.

2. Land would be more easily moved by the water, causing a broader delta, a faster-moving and growing channel and much greater erosion along the floodplain.

3. The channel would widen because the greater volume of water would broaden the streambed and would also move more soil downstream.

4. The water infiltrates the soil as the rainstorm intensifies.

5. Water rises in streams and streambeds when the soil becomes saturated and the groundwater supply increases. New channels are created from the runoff of overflowing banks.

6. The runoff flows into low-lying areas, through streambeds and into lakes.

7. The low-lying areas that surround the channel and its delta are the areas most affected by rising rivers and groundwater runoff.

8. Low-lying areas and depressions, such as lakes.

9. The high ground will remain unflooded, but its soil can become saturated and unstable. Buildings on the slope of a hill can slide. Higher areas farther from the floodplain are the safest places to build.

Floods
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LESSON PLAN 2

What Are Floods?

Wrap-Up

Why do floods occur? What events could precipitate a flood with little warning?

Using a topographical or physical map that illustrates elevation, have the students point out the floodplains in your town. Based on their stream table experience, where do they think potential flash floods could occur? Are there areas in your town that are threatened by river floods? Has the community built in ways that will mitigate flood damage to homes? A flood occurs because of the inability of the hydrologic system to accommodate a large amount of water at one time. Do the students think floods are a natural part of the hydrologic system? Why or why not?

Linking Across the Curriculum

Social Studies: Mapping; Geography: Physical Systems; Science: Earth Science

Floods have always affected human and natural history. One of the most important effects of flood is the deposition of fertile river silts and sediments onto floodplains. These seasonal deposits replenish soil nutrients for a more productive agricultural industry. Have the students work through the activity sheet *Floodplain* to illustrate the effects of flooding in the building of floodplains.

Answers to *Floodplain*

1. The deposition occurred along the banks of the river and low-lying areas of the floodplain. Much of the soil also fanned out into the delta at the mouth of the stream. This rich mixture of soil is excellent for agriculture, but the flooding is a trade-off.

2. Answers will vary depending on the composition of the soil mixture. Less porous soil, such as clay, will be deposited farther from the bank.

3. Answers will vary depending on the composition of the soil mixture. Less porous, heavier soil will sink to the bottom of the channel.

Social Studies: Economics

Have the students act as independent insurance agents. Based on the stream table experience, how would they rate different areas of their simulated city as more or less safe from floods? Does this affect insurance rates? Explain. Would all the people of the area need flood insurance? Why or why not?

American Red Cross

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Floods
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LESSON PLAN 2

What Are Floods?

Science: Ecology

For this activity, you will need magnifying glasses and a variety of soil types.

Have the students bring in soil from different areas in the community. Have them compare the types of soil for texture, color and moisture content. Use magnifying glasses to compare the components of the different types. Which soil is the most easily infiltrated? Which soil would cause the greatest surface runoff?

Have the students test their suppositions by using the different types of soil in a composite landscape in the stream table. Based on their observations, which type(s) would contribute most to flash flooding? Why?

American Red Cross

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Floods
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LESSON PLAN 2

What Are Floods?

Materials

- Computer and color printer
- Large political, geographic and topographic maps of the community in which the school is located

American Red Cross

Visit the American Red Cross Web site at *www.redcross.org/disaster/masters*

"Mapping Your Watershed"

SET UP 30 minutes **CONDUCT** one 50-minute class

Science: Physical Science and Problem Solving

Use the following Internet sites to find local topographic maps.
Internet Sites

- Microsoft Terraserver Web site at *http://www.terraserver.microsoft.com* includes both topographic maps and matching aerial photos. Input the address of your school to access the local map, choose the large map (three boxes at the top left of the map) and adjust the map by zooming in or out and moving north, south, east or west.
- Google maps at *http://maps.google.com/* features both aerial photos and street maps. Input the address, including the city, state and zip code, and choose the "hybrid" map to show both the landscape and the street names.
- Topozone at *http://www.topozone.com/* is a resource for topographic maps, aerial photographs and street maps. Go to View Maps (top left corner), click the state and click the school name. You may register to find all the maps you need. The registration is free and requires only your e-mail address.

Procedure

1. Watersheds: Connecting Weather to the Environment at *http://www.meted.ucar.edu/broadcastmet/watershed/* comprises a set of learning units that are written for broadcast meteorologists to help them as they interpret the weather news for their areas. The units are very readable and employ a variety of media to get their points across.

2. Begin the activity by challenging the class to help you create a short watershed glossary, including the following terms. This will help them as they learn about watersheds from Watersheds: Connecting Weather to the Environment.

catalogued watershed	river basin	water resource regions
drainage of a river system	runoff	watershed
divide	snowmelt	urban watershed
headwaters	subwatershed	
hydrologic unit code (HUC)		

3. Divide the students into three groups and assign "Unit 1: Watersheds" to one group, "Unit 2: Watershed Systems" to the next group and "Unit 5: Storms and Flooding" to the last group. Have the groups work through the units and identify the Hydrologic Unit Code (HUC) address for the watershed in which the school is located, before the next class period.

Floods 6–8

LESSON PLAN 2

What Are Floods?

4. In a class meeting, discuss the term "watershed." What is it? How is it defined? What are the connections between watersheds and floods? How does the U.S. Geological Survey assign an HUC address to a watershed?


Wrap-Up

The map of HUC addresses is a U.S. Geological Survey publication (*http://water.usgs.gov/wsc/map_index.html*). Ask students to use this map to draw an outline of their local watershed. Challenge students to use other maps of the state to name the main water sources for this area. Have them also locate human features, such as towns, parks, roads and farms, on the map.

- What human activities would be in danger if a flood occurred? Are there businesses that might be flooded? Residential areas? What would be the economic effect of a flood? Explain.
- What habitats would be flooded and how would that affect the animals that live there?
- How would the area's different contours affect that outcome?
- If you could build a house or locate a town, what area within the watershed would you choose? Why?

Home Connection

Encourage students to share the following Internet sites at home with their families. They can use the information to find and label the watershed where they live. Are their family homes in danger if a flood occurs? Under what conditions? What can they do as families to make their homes safer from floodwater?

- Environmental Protection Agency: Surf Your Watershed at *http://cfpub.epa.gov/surf/locate/index.cfm*
- Meteorology Education and Training: Watersheds, Connecting Weather to the Environment at *http://www.meted.ucar.edu/broadcastmet/watershed/*

Linking Across the Curriculum

Social Studies: Economics

If a major industry or businesses built on a floodplain, how would the city be affected in time of flood? Create an economic web to show how each change has an impact on other areas. For example, if farms are flooded, produce is destroyed; the local farmers' market closes because it has nothing to sell; and the large supermarket that buys produce from other areas is open for business, but delivery trucks cannot reach it.

Social Studies: Geography

Have student groups investigate cultures around the globe whose history is intimately interwoven with dependence on seasonal floods, peoples along the Nile and Yangtze Rivers, for example. Have floods been both a boon and a curse for these peoples? Explain.

American Red Cross

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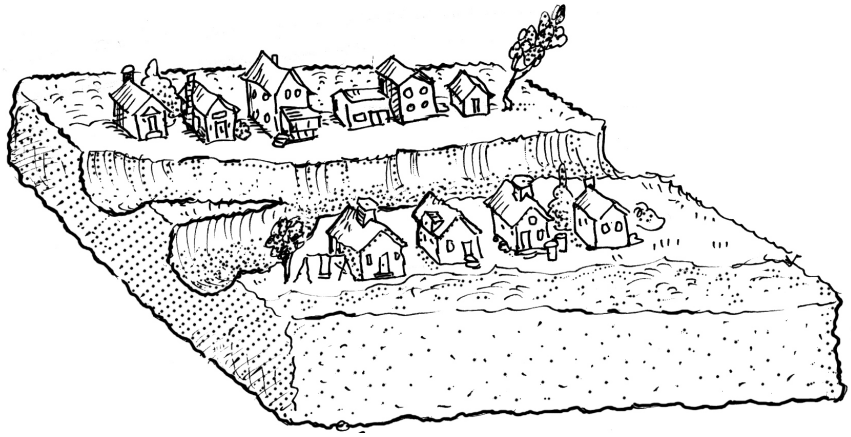
You're the Hydrologist

Name _____

Directions: Follow the directions on pages 1 and 3 to show how rivers form and floods occur and to investigate the effect of floods on human lives. Then, try to analyze your results and answer the questions on pages 2 and 4.

What you need:

- Very large pan or plastic-covered box
- Water source with hose
- Large basin or area for drainage
- Bricks or blocks
- Soil of different types and porosity
- Toy houses, buildings and cars
- 2 or 3 spray bottles



What you do:

"Build a River"

- Fill the large pan with damp soil to a depth of about 4 inches (10 centimeters) and smooth it flat.
- Put a hole in the center of one end of the pan to act as a drain.
- Tape the hose to the other end of the pan.
- Place the "hose end" of the pan on blocks or bricks to tilt the pan slightly.
- Place the basin at the other end of the pan to catch the drainage. Let the water trickle into the pan until the soil is saturated. As the trickle continues, a channel begins to form.

Continuously check the stream table and draw what happens in the quadrants at the right.

Time: _____	Time: _____
Time: _____	Time: _____

American Red Cross

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You're the Hydrologist

1. Explain how this illustrates the way a river forms and changes with channeling, erosion and the formation of deltas.

_____

_____

_____

_____

_____

Analysis:

2. What might happen if the angle of the slope were greater?

_____

_____

_____

_____

_____

3. What might happen if the flow of water were greater?

_____

_____

_____

_____

_____

Test your hypotheses on your stream table.

You're the Hydrologist

"Start a Flood"

Leave the riverbed and channels intact in the stream table. Use the soil around the stream to mold hills, valleys and lake areas. Add soil to create your landscape. Place the toy buildings, houses and cars into the stream table landscape to create a town.

Draw your stream table landscape.

Fill the spray bottles with water and spray the water onto the stream table to simulate steady rain across the landscape. What happens when the water hits the ground?

After a few minutes, open up the nozzles of the spray bottles and let a larger amount of water pour onto the landscape, simulating a heavy rainstorm. What happens now?

Analysis:

4. Does the water infiltrate the soil? Why or why not?

_____

_____

_____

You're the Hydrologist

5. What happens to the streams and streambeds? Are new channels created? Explain.

_____

_____

_____

6. Where does the runoff go on the stream table?

_____

_____

7. Which areas of the simulated landscape would be the "floodplain"? Why?

_____

_____

8. Which areas accumulate runoff water?

_____

_____

9. Where would be the safest place to build? Why?

_____

_____

Floodplain

Name _____

Directions: Illustrate why floodplains have historically been important to a city's growth.

What you need:

- Stream table, constructed in *You're the Hydrologist*
- Plastic trough the length of the stream table
- Waxed paper, enough to cover the soil mixture in the stream table
- Waterproof tape, such as electrical tape
- Soil mixture (30 percent topsoil, 20 percent sand, 50 percent clay works well.)
- Bucket
- Water

What you do:

"Flood the Floodplain"

- To make the trough, cut a plastic 2-liter bottle or PVC tube in half lengthwise or use a length of narrow gutter. The plastic trough will act as your "river channel." Bury it down the length of the stream table, making sure that its sides are even with the surrounding landscape. Seal the surrounding landscape with waxed paper. You may want to tape the paper to the edges of the box and the edges of the trough to prevent leakage.
- Fill the trough about half way with the soil mixture, conserving some for use later. Compact the mixture tightly.
- Fill the bucket about two-thirds full of water and add the remaining soil mix. Stir the water and soil to create a suspension.
- Slowly, pour the water-soil mix into the river channel. Continue pouring until the water overflows the river and floods the surrounding land to a depth of about 1 inch (2.5 centimeters).
- Allow the water to evaporate. (*Note:* To speed the process, place the stream table in sunlight or use an artificial heat source.)
- When the water evaporates, illustrate where the soil mix was deposited and how much accumulated.

Floodplain

Analysis:

1. Where did most of the deposition occur? Would this indicate agriculturally desirable land?

   _____

   _____

   _____

2. What materials were deposited the farthest from the river channel? How does this affect the nature of the soil away from the river?

   _____

   _____

   _____

3. Was there any apparent change in the composition of the soil mixture that was laid in the river channel prior to the "flood"? Explain.

   _____

   _____

   _____