Over 20 Reproducible Flood Science Worksheets

FRIGHTFUL FLOODS!
Storm Science Activity Book

The Science of History’s Most Catastrophic Floods

Thrill Students with the Subjects They Love!
Rain is falling, and it must find somewhere to go. Most rain soaks into the soil. Some runs over the ground. This runoff flows into rivers and streams. It flows into storm drains built around cities and towns. It puddles and pools in streets, parking lots, and other paved surfaces. Long-lasting or slow-moving storms dump extra heavy rains. What happens when the soil is so wet, it can’t soak up any more rain? What happens when rivers and streams swell with rainwater and rise beyond their banks? What happens when storm drains fill and start to spill back out onto streets and sidewalks? A flood happens.
Flooding takes many forms. It can happen quickly—just hours after a storm begins. Or, it can happen slowly, over several days or even a week. This photo shows what happens when a river floods. Rising water spreads across the landscape. When people settle next to rivers, they place themselves in the path of floods. All rivers and streams flood from time to time. For people, flooding can not only be expensive, but dangerous.
A flash flood is the fastest, most dangerous type of flood. It happens when heavy rains quickly fill a stream or ditch, creating a wall of rushing water. Flash floods also happen when dams or levees break along rivers. A giant wave 10 (3 m) feet high or more rushes over the land at speeds more than 30 miles (48km) per hour. Flash floods have enough power to lift boulders, knock over buildings, and break down bridges. Most deaths are caused by flash floods.
In the hours and days after a flood, people focus on rescuing others who have been trapped or finding those who have been killed. Most people are killed when they try to drive or walk through floodwaters. The force of the flowing water sweeps cars and people away. When floodwaters fall back, they leave behind a dirty mess, with many buildings unsafe to live in. Floods are the most common, most deadly, and most expensive weather disasters.
Weather makes a great subject for study. It’s always happening just outside the window, and it’s always changing. Weather affects us all, daily and seasonally. It ties into many areas of our lives—and, as a result, many areas of the school curriculum.

Weather Wise activity books focus on weather’s dramatic, disastrous side. They teach students the science behind various weather phenomena, as well as their social impact. Activities are designed to support National Education Standards; they cover such concepts as weather patterns, measuring and quantifying data, science and technology, personal health and safety, and natural hazards and associated risks.

Each Weather Wise book kicks off with four pages of full-color photographs. Each image captures an important aspect of a severe weather event. The photographs may spark discussion about students’ personal experiences, or about a recent event that made the news. And, they can spark curiosity about why severe weather happens.

Students discover the answers to their questions as they read a story about how a severe weather event gets its start, what happens as it unfolds, and what happens when the weather clears. Each activity contains a paragraph of information that tells part of the story. This is followed by a hands-on activity to further explore concepts covered in the storyline.

In Weather Wise: Frightful Floods!, students follow the rise and rushing arrival of a flood. The book is organized into three units:

Unit 1: Floodwaters Rising
Unit 2: The Flood Flows In
Unit 3: After the Storm

Each unit contains teaching notes that provide tips for presenting activities, as well as ideas for science fair projects. The six activities in each unit integrate science, math, social studies, geography, and language arts. Students practice using science tools and technology, on an individual and group basis. A quiz at the end of each unit allows for assessment of student learning.

Even if you’re community is not at risk for flooding, your students will learn to appreciate this awesome weather event. They will place themselves in the shoes of others who have faced floods in real life. They will be more aware of weather and its risks. And, they will have a foundation to explore more general topics, such as clouds, rain, climate, and weather prediction.

So enjoy this handy resource book! We hope it allows you to learn all about floods from the safety of your classroom!
Getting Started

A good way to present the material in this book is to set up an experience station. Start by stocking the station with materials about floods, thunderstorms, cloud types, major U.S. river systems, and weather forecasting. You might wish to create a display from the photos at the beginning of this book. Include a copy of the Flood Safety Smarts handout (pages 30-31), and make copies for students to use throughout the activities.

Begin with a discussion about floods. Generate a list of what students know and what they would like to know. Share the photos at the start of this book, along with the information on each page. Explain that students will have a chance to follow the story of a fictional flood, from beginning to end. They will perform experiments and other activities to better understand this awesome weather event. Introduce students to the experience station; allow them free time to explore it. Tell students they will be involved in adding to the station over time.

Teaching the Unit

Begin each lesson by reviewing the storyline and defining vocabulary terms (which appear in boldface).

Lesson 1: Be sure students understand the concept of density. Discuss density in terms of objects that sink or float (or rise, in the case of air). Students will observe that the colored water rises as it escapes from the film canister. It rises all the way to the top, because it is less dense than the surrounding cold water.

Lesson 2: Before students do this activity, be sure they understand evaporation and condensation. Discuss such examples as disappearing puddles, “sweat” on cold glasses, and humidity. Discuss the diagram of the water cycle. Have students work in groups. Students will see drops of water form on the underside of the tuna can. Water has evaporated off the hot water surface. Upon coming in contact with the cold tuna can, the air cools and loses its moisture, which condenses in the form of drops. These drops are comparable to rain.

Lesson 3: This activity should ideally be done with an actual rainstorm. Have students work in groups to build their rain gauges. Help them find an appropriate place to set up the gauges and to time the storm. NOTE: If rain is predicted after school hours, have students work with their parents. If no rain is predicted for the next school week, you may wish to set up an artificial rainstorm to keep the momentum of the unit going. In this case, you can have kids set up their rain gauges in the shower. They can run the water for 5 minutes. This will provide skewed results, so for the second half of the activity, you might want to substitute different data. An example would be 1/2 inch (0.6 cm) of rain falling in 72 minutes. Have students use calculators if needed.

Lesson 4: Students should recognize that Texas had the most flooding. Hawai‘i, South Dakota, Rhode Island, Maryland, Alaska, and Massachusetts had no flooding. The eastern half of the United States experienced more flooding than the western half. Have students compare your state’s data to that of other states to decide the state’s flood risk.

Lesson 5: Have students work in groups. They should observe that the sponge not only soaks up most of the water, it also traps most of the “sediment.” As marshy floodplains are cleared, this natural form of flood control is lost. Floods spread farther and last longer. River ecology is also changed when people build dams or change the river’s course to control floods.

Lesson 6: Have students work in groups. Use soft modeling clay for this activity. The clay will get sticky when wet, so have students dry it thoroughly between tests. In the first test, water rises and floods at the bottom of the model. In the second test, water backs up upstream, and flooding begins there instead.

Once students complete all the lessons and the Weather Wise Wrap-Up, discuss this stage of flood activity as a class. Predict what will happen next.

Science Fair Starters

1. Make a diorama showing a river that has flood control measures in place, such as dams, diversion channels, and levees.

2. Set up a display that demonstrates how water is absorbed by plants rooted in soil, but runs off paved surfaces. Use a baking pan filled with soil and planted with grass for the first example, and a concrete paver or brick for the second example. Provide an opportunity to “rain” on these areas with a watering can and observe the runoff.

3. Make a three-dimensional model of the water cycle. Set up simple evaporation and condensation experiments as part of the display. There might be an opportunity to boil water and breathe on a mirror’s surface, for example.
A summer thunderstorm is brewing. It all begins with moving air. Sometimes, as on this day, a mass of cold, dry air mixes with a mass of warm, wet air. The warm air, which has been trapped near the Earth’s surface, is able to rise due to a drop in air pressure. The warm air rises into the cold air, because warm air is less dense, or lighter, than cold air. As the warm air rises, it expands, or spreads out. It cools off. It also releases its moisture. The moisture forms clouds. The clouds grow larger and taller. Soon, they form cumulonimbus clouds, or thunderheads.

Make a model to compare the density of hot and cold air.

You’ll need: clear drinking glass, cold and hot water, film canister, marble, food coloring, tin foil, rubber band

1. Fill a drinking glass three-fourths full with cold water. This is your cold air mass.

2. Place a marble in a film canister. Fill the canister with hot water. Add a few drops of food coloring. This is your hot air mass.

3. Cover the film canister with tin foil. Use a rubber band to hold the foil in place.

4. Carefully place the film canister in the glass of cold water. It should be heavy enough to rest on the bottom.

5. Predict what will happen if you let the warm water mix with the cold water. Think in terms of hot and cold air.

6. Carefully poke a hole in the tin foil with the point of a pencil. Watch what happens.
   a. What happened to the warm water once you poked a hole in the foil?

   b. Why do you think this happened?

   c. How does this experiment model what happens when cold and warm fronts meet?
This thunderstorm is an important part of the **water cycle**. All of Earth’s water is recycled as it goes through each stage of the water cycle again and again. When water at the Earth’s surface heats up, some of it **evaporates** into a gas. The gas, called **water vapor**, adds moisture to the air. This moisture “drops” out of the air, or **condenses** into a liquid, as the air cools. This is how clouds form. Inside the clouds, more moisture gathers in the form of rain. Eventually, raindrops form that are heavy enough to fall to Earth. The rain will collect on the Earth’s surface. The cycle will begin again. This thunderstorm promises to send plenty of rain.

### Make a model that shows how rain forms.

#### You’ll need:
glass jar, hot water, ice cubes, a clean, empty tuna fish can

1. Pour hot water into an empty jar. Place an empty tuna fish can over the mouth of the jar.

2. Place a few ice cubes inside the tuna fish can.

3. Watch what happens to different surfaces on the jar and the can for the next few minutes.

   a. What happened inside the jar?

   b. What happened on the bottom of the tuna can?

   c. Where do you think evaporation took place?

   d. Where do you think condensation took place?

   e. Where does “rain” form in this model?

   f. How do hot and cold temperatures play an important role in this model?
RAINDROPS KEEP FALLING

The thunderstorm is bringing very heavy rains. In fact, after two hours, four inches (10 cm) of rain have already fallen. All this water must find someplace to go. It soaks into the ground. It puddles up on sidewalks and parking lots. It flows into storm drains. It adds to rivers, streams, and other bodies of water.

Measure rainfall and calculate the hourly rainfall of a rainstorm.

You’ll need: 2-liter plastic bottle, scissors, index card, ruler, tape, calculator, permanent marker

1. Measure 8 inches (20 cm) up from the bottom of a 2-liter plastic bottle. Make a mark. Do this at two other points on the bottle. Cut off the top of the bottle at the marks, as shown. Make sure you cut an even line all the way around.

2. Remove the bottle’s cap. Turn the top half upside down and place it inside the bottom half, as shown. Tape the edges of the bottle halves together so water will not leak.

3. On an index card, use a permanent marker to draw a vertical line and mark the bottom “0.” Measure up the line, and make marks every inch (or every centimeter) for 4 inches (10 cm). Label the marks.

4. Make 1-inch marks between each inch mark. Do not worry about labeling them. (It is not necessary to follow this step if you are working in centimeters.)

5. Tape the index card to the side of your rain gauge. The zero mark should be at least 2 inches (5 cm) from the bottom of the bottle. The scale should read from bottom (the “0” mark) to top.

6. Fill the rain gauge with water until it reaches the “0” mark.

7. With your teacher’s help, set up the rain gauge before the next rainstorm. Place the gauge outside where rain can easily fall into it. You will need to record how long the storm lasts. You will also need to measure how much rain is collected in the rain gauge.

8. Record your data in the table below. Use a calculator for help if needed.

| Total Rainfall (inches or centimeters) | Storm Start Time (hour and minute) | Storm End Time (hour and minute) | Total Storm Time (in minutes—each hour contains 60 minutes) | Hourly Rainfall Rate (total rainfall divided by total storm time, multiplied by 60) |
Heavy rains like these could cause a flood. A flood happens whenever water overflows onto land. Floods usually happen when a lot of rain falls during a short time, or when it rains in one area for several days. In addition to thunderstorms, tornadoes and hurricanes can bring floods. Floodwaters may rise slowly or with great speed, depending on where the water overflows. Rivers are a common source of floods. Cities and towns built along rivers face a regular risk of flooding.

Learn more about where floods take place in the United States.

Look at the map below. It shows information collected by the National Weather Service. The map shows the total number of floods recorded for each state from 1995 to 2000.

1. Which state experienced the most flooding during this time period? ______________

2. Why do you think this is so? ____________________________________________

3. Were there any states that experienced no floods during this time period? ______________

4. In terms of flooding, how does the eastern half of the United States compare to the western half? ____________________________________________

5. How many floods did your state experience during this time period? ______________

6. Is your state at (low/medium/high) risk for floods based on this map? (Circle one.)

7. Look at a United States map that includes bodies of water. Identify one major river, and a state where it is located. If this river floods, what cities are put at risk in the state?
   River: __________________________ State: __________________________
   Cities at risk from flooding: ____________________________________________
RUN, WATER, RUN

This thunderstorm is dumping rain on several towns built near a river and its connecting streams. Flooding is a healthy part of a river’s natural cycle. Floods carry out extra dirt and sediment from the river bottom. This material mixes with soil to make it richer. The land along a river is usually flat and marshy. It is called a floodplain. Floodplains are good at soaking up floodwaters and releasing them slowly. When people settle along rivers, they change floodplains. They replace the marshy land with paved surfaces, which don’t absorb water. People have even changed the natural pathways of rivers. These activities change the way the river floods.

Make a model of a floodplain.

You’ll need: newspaper, large bread loaf pan, sponge (clean and dry, at least 1\(\frac{1}{2}\) inch (2\(\frac{1}{2}\) cm) thick), scissors, 1\(\frac{1}{2}\) cup water, 1\(\frac{1}{2}\) teaspoon pepper

1. Cover your work area with newspaper. Place a bread loaf pan on the paper.

2. Cut a sponge so that it is just a bit wider than the bread loaf pan. Press the sponge flat into the center of the pan, as shown. Be sure the sponge is pressed down all the way. This is your floodplain.

3. Stir the pepper into the water. The pepper acts as dirt and sediment.

4. Slowly pour the water into the space on one side of the sponge. This is your river. Stop pouring when the water reaches the top of the floodplain.

5. Slowly tilt the pan so the water flows through the floodplain to the other side.

   a. What happens to the sponge? ____________________________

   b. How does water flowing out of the floodplain compare to water flowing into the floodplain in your model? ____________________________

   c. Why do you think people would want to build cities and towns near rivers? ____________________________

   d. How do you think human activities change the way a river might flood? ____________________________
The river is rising. It is still several feet below flood stage—the water level at which the river overflows its banks. This river has flooded before. In fact, several towns have built levees on the river’s banks. These levees are walls built from hard-packed soil. They are five feet high and 10 feet wide. Levees change the river’s flood stage—the river can hold more water before flooding. The levees protect the towns, but have other effects, too. They cause water to back up further upstream, causing floods there instead. If a levee breaks, a huge, deadly wave of water will rush inland all at once.

Make a model to learn more about how levees work.

You’ll need: newspaper, small glass casserole dish, modeling clay (enough to cover the bottom of the dish), butter knife, ruler

1. Work on a flat surface. Cover your work area with newspapers. Cover the bottom of a casserole dish with a layer of modeling clay (¼ inch or about 1 cm thick).

2. Use a butter knife to carve a river out of the modeling clay. It should run from one end of the casserole dish to the other. It should also measure 1 inch (about 3 cm) wide. At one end, add a few smaller “streams” that feed into the river, as shown. Be sure the river “banks” are at least ¼ inch (about 1 cm) high.

3. With the dish lying flat, use a measuring cup to slowly pour water into the streams and river. Stop when the water is almost even with the banks.

4. Tilt the dish a bit. Slide your hand under the end of the dish where you carved the stream banks. What happens to the water level in the streams?______________________________

What happens to the water level in the main river? ________________

5. Keeping the dish tilted, slowly add about ½ cup water to the model from the top. This extra water is much like rain during a thunderstorm. Where does the flooding start?______________________________

6. Build clay levees at the bottom of your river as shown. Make the levees about 1 inch (3 cm) high. Inside the levees, narrow the river so that it is about ¼ inch (1.5 cm) wide. Repeat steps 3 and 4. What happens to the water level at the top?______________________________

What happens to the water level along the levees? Where does the flooding start? ________________________________
WEATHER WISE WRAP-UP

Use what you have learned in this unit to complete this page.

1. Mark each statement true or false.
   a. Warm air is more dense than cold air. \( T \) \( F \)
   b. “Thunderhead” is another name for a cumulonimbus cloud. \( T \) \( F \)
   c. Floods are a healthy part of a river’s natural cycle. \( T \) \( F \)
   d. A flood can be the result of a hurricane or tornado. \( T \) \( F \)
   e. The land near rivers is not very rich, due to flooding. \( T \) \( F \)

2. Circle the correct answer.
   a. The change from liquid water into a gas in the air is called:
      A. condensation   B. cloudification   C. evaporation   D. circulation
   b. Wide, flat, marshy land found near riverbanks is called a:
      A. riverbed     B. flatland     C. runoff     D. floodplain
   c. A tool used to measure rainfall is called a:
      A. rain gauge    B. rain meter    C. rain graph    D. rain calculator

3. Fill in the blanks to complete these flood facts.
   A thunderstorm is a natural part of the _________________. First, clouds form, as water vapor in the air ________________ into liquid droplets. These droplets eventually grow into ________________ that falls to Earth. Really heavy rains can cause ________________. Rivers overflow their banks when they rise above ________________. This action is actually good for rivers, because it carries away extra ________________. When people settle on rivers, they may build ________________ to allow the river to hold extra water.

4. Write about how humans change the way rivers flood and the effects this has.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
Getting Started

Add materials that were generated in Unit 1 to the flood experience station. Gather information about the following topics to use for discussion and at the experience station: flood preparedness, urban floods, river floods, flash floods, flood fatalities, and evacuation measures.

As a class, discuss what students expect will happen next in the flood’s story. Share thoughts about what students would do if facing a flood and how they would feel. You might show a movie, such as the NOVA documentary “Flood!” about the Great Flood of 1993.

Teaching The Unit

Begin each lesson by reviewing the storyline and defining vocabulary terms (which appear in boldface).

Lesson 1: Before presenting this activity, prepare a letter to send home with students. Make copies of all the students’ certificates and display them in the classroom. You might wish to make simple certificates as a culminating activity for this book and invite parents in for a Disaster Day certificate ceremony.

Lesson 2: Students can start this scavenger hunt by using the National Weather Service Web site search engine. Students will likely generate more questions as they come across information they may wish to know more about. Encourage them to do further research on topics such as satellites. Students can write an essay about the National Weather Service and flood management, and include it in a homemade book with printouts collected for the scavenger hunt.

Lesson 3: This activity presents important information: almost all flood fatalities are the result of people getting trapped in their cars or trying to walk through swift-moving floodwaters. Be sure students understand the concept of buoyancy.

Lesson 4: Have students work in groups. If sand is not available for this activity, you can use flour (although sandwich bags are hard to seal once coated with flour, so students will need to work with care). Encourage students to be inventive with their sandbag building. They only need to pour a cup or two of water to test each wall. Be sure students expect some leaking; the trick is to find a way to minimize it. Successful designs can be demonstrated for the whole class.

Lesson 5: Students should find one of the two routes marked on the diagram shown here. Route B is shorter than Route A. You might wish to follow up this activity by looking at a local street map to decide which roads might be off-limits during a flood, due to bridges, low elevation, or proximity to waterways.

Lesson 6: Help students take their measurements. You might tape together two yardsticks or use a tape measure. Leave the tape up while you are presenting activities in this book, to remind students of a flood’s effects.

Once students complete all the lessons and the Weather Wise Wrap-Up, discuss this stage of flood activity as a class. Predict what will happen next.

Science Fair Starters

1. Challenge students to design a dam that holds back water. Display results.
2. Display winning sandbag designs as part of a display on flood preparedness.
3. Demonstrate the water pressure involved in a flash flood. Design an experiment in which two equal amounts of water are allowed to flow over a model landscape at two rates: slowly vs. all at once. (For example: Fit the mouth of a drinking glass with a cover in which one hole is punched to let water out slowly; compare this to dumping water all at once).
Lesson 1

HERE COMES THE FLOOD

Heavy rains keep falling. The National Weather Service decides to put the area under a flood watch. This means people should watch for signs of flooding in the next few hours. Local weather forecasters talk about flood safety. They ask people to gather supplies they might need. They tell people to avoid traveling. Forecasters also warn that some areas might have to evacuate.

Work with your family to prepare for a weather disaster like a flood.

Take this checklist home with you. Go over each step with your family. Place a check in each box when you finish each step. When all steps are finished, have an adult sign the certificate.

☐ STEP 1. Talk about floods and other weather disasters.
  • What questions do you have about weather disasters?
  • What weather disasters have you experienced?

☐ STEP 2. Make a family disaster plan.
  • How will you make your house safe?
  • Where will you go in the house to be safe?
  • What would you do if you had to evacuate?
  • Does someone know CPR and first aid skills?

☐ STEP 3. Choose check-ins.
  • Which two places could you meet if a disaster strikes when you are not all together?
  • Who could you contact locally during a disaster? Post this number by the phone.
  • Who could you contact out-of-state if you must evacuate? Post this number by the phone.

☐ STEP 4. Put together enough disaster supplies to last 3 days.
  • Include the following items for each person: water (1 gallon per day), non-perishable food, a change of clothing, extra footwear, a blanket or sleeping bag. Also include: a first aid kit, battery-powered radio, flashlight, extra batteries, an extra set of car keys, hygiene supplies, and waterproof containers to hold important family papers.

I'VE MASTERED DISASTER!

CERTIFICATE OF HONOR

The ______________________family has taken all the steps needed to prepare for disaster. We pledge to follow our steps during a disaster to stay safe.

Adult Signature: ________________________ Date: ______________
Student Signature: ______________________ Date: ______________
Wherever they are, people stay tuned to reports about the weather. They listen to the radio. They watch the television. Many people go on-line. They log on to the National Weather Service Web site. There, they can get up-to-the-minute information. They find out where the river’s water level is, find pictures of the area, and read about the flood watch.

Log on to the National Weather Service Web site at www.nws.noaa.gov/ to complete this activity. You are going on an electronic scavenger hunt! Can you find the following pieces of information? For each one you find, give yourself one point. Print out each Web page that shows the information you need.

Points

1. Find out if there currently are any flood watches or warnings in the United States. _______
2. Find a U.S. map showing current weather conditions. _______
3. Find a radar image showing current weather. _______
4. Find a satellite picture showing weather. _______
5. Find flood information from the last 24 hours. _______
6. Find flood information from sometime in the last month. _______
7. Find one fact about floods. _______
8. Find a picture of a flood. _______
9. Find the 24-hour weather forecast for your state. _______
10. Find information about river water levels. _______

Total number of points: _______

How would you use information like this? ____________________________
People are reporting signs of urban flooding. Parking lots and some streets are starting to flood. The National Weather Service changes the flood watch to a flood advisory. People are warned not to try to drive through floodwaters or even walk in floodwaters deeper than six inches (15 cm). The fast-flowing waters can be dangerous. It is impossible to see if the ground below them is safe. And, they move with enough force to sweep cars and people away. In the meantime, the levees are keeping the river from flooding, but it keeps rising.

**Learn more about how rising waters can be dangerous to travelers.**

**Problem #1**
Imagine standing in water that is six inches (15 cm) deep. Use a ruler to measure how high this water level would reach on your body. Draw a line to show your answer in the picture at the right. Flood waters flow at an average speed of 10 miles (16 km) per hour. At this speed, even six inches of water will flow past your body with hundreds of pounds of force. How does this compare to your own weight?

**Problem #2**
How deep do flood waters need to be to carry away a typical car? Before you answer this question, make a prediction. Look at the drawing below. Draw a line across the car to show how deep you think water must be to carry away this car. Then, keep reading to find the actual answer.

This car weighs about 2,000 pounds (3,200 kg). When an object, even a car, is placed in water, it weighs less than it does on land. This is because water has buoyancy. Buoyancy is an upward force that pushes upon objects placed in a liquid. For each foot (.3 m) of water rising up the side of a car, it weighs 1,500 pounds (2,400 kg) less due to buoyancy. As a result, how many feet of water would supply enough buoyancy to overcome the weight of the car and make it float? _______ ft./m

Draw a line to show your answer on the car. How did your actual answer compare to your prediction? Once the car is floating, the force of the moving water will sweep it away.
Unit 2: The Flood Flows In

Lesson 4 STACK THOSE BAGS

Parts of the river are almost at flood stage. The flood advisory becomes a **flood warning**. The weather service expects some **river flooding**. People who live near the river start to prepare. They move valuable property to the highest points in their homes. They fuel up their cars and make sure they have the supplies they need. Some people begin stacking sandbags around their homes. The tightly packed, heavy bags form a wall. This wall will keep most water out.

**Make a model to show how sandbags hold back floodwaters.**

**You’ll need:** sand, large spoon or scoop, 10 reclosable plastic snack bags, medium-size clear plastic tub, water

1. Spoon or scoop sand into 10 snack bags. Be sure the bags are almost full. Seal each bag. Pat the sand inside the bag to spread it out.

2. Build a wall of sandbags across the middle of a clear plastic tub. Place them any way you choose. Think about trying to hold back a wall of water.

3. When your wall is done, add water. Pour the water into one side of the tub. Watch what happens.

4. Experiment with other sandbag wall designs. Try stacking them, standing them up, or a combination of both. Which design worked best? Draw your design here.

5. Did the sandbag wall keep all the water out, or did you have some leaking?
EVERYBODY OUT

The levees downtown are still holding back the rising river. In other areas upstream, things are different. The flooding has begun. Officials decide to evacuate people who live right on the river. The evacuation is an order. People must now think about saving themselves, not their property. Officials set up an evacuation route. They block off roads that have begun to flood or might flood. The evacuation route leads to an American Red Cross shelter.

Imagine driving to safety during a flood evacuation.

Look at the map below. Find the correct evacuation route to the shelter. Draw a line to show which way the car should go. Stay away from bridges, flooded roads, and road blocks. There may be more than one possible route. BONUS: Can you find the shortest route? Use the mileage scale for help.
Suddenly, one of the levees on the river breaks! All the water that has built up behind the levee bursts through. This is a **flash flood**. It is the most dangerous kind of flood. People have only minutes or even seconds to get to higher ground. The river water rushes out in a 10-foot (3 m) wave. It flows across the land at 35 miles (56 km) per hour. The force of all this water tears up boulders, tosses cars, tears up trees, and wrecks bridges. Most deaths from flooding happen during flash floods.

**Imagine a flash flood that rushes through your classroom.**

Imagine a flash flood sweeps a 10-foot (3 m) wave of water through your classroom. Think about what might happen.

1. With your group, choose a spot on your classroom wall to take a measurement.
2. Measure up from the floor. Place a piece of masking tape at the 10-foot (3 m) mark.
3. Once all the marks in your room have been made, connect them. Use a line of masking tape.
4. Look around the room.
   a. What objects would be covered in water? ____________________________________________
   b. What objects would be above the flash flood level? ____________________________________
   c. Do you think you could find a place of safety in this room during a flash flood? Explain your answer. ____________________________________________________________
   d. Based on your answer, where would you go if your school were in the path of a flood?
   e. Make a 10-foot (3 m) strip of paper and bring it home. Measure how high this water level would reach in your home. Write about your results. ____________________________________________
WEATHER WISE WRAP-UP

Use what you have learned in this unit to complete this page.

1. Answer these questions.
   a. What are three kinds of floods? ____________________________
   b. What are four things that should be in a disaster supply kit?
   c. What organization is in charge of issuing flood watches and warnings?
   d. How many feet of water can lift and carry away a car during a flood? ____________
   e. What is one thing people should do during an evacuation? __________________________

2. Mark each statement true or false.
   a. Flash floods are the most dangerous kind of flood.  T  F
   b. Flood danger increases from a watch to an advisory to a warning.  T  F
   c. It is safe to move around in floodwaters as long as they are less than 2 feet (61 cm) deep.  T  F
   d. Urban floods involve water flowing over floodplains.  T  F
   e. Rivers flood when they fall below flood stage.  T  F

3. Write a definition for each of these terms.
   evacuation: __________________________________________________
   shelter: ______________________________________________________
   buoyancy: ____________________________________________________
   flood watch: _________________________________________________

4. Label each picture to identify each kind of flood.
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

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Getting Started

Add materials that were generated in Unit 2 to the flood experience station. Gather information about the following topics to use for discussion and at the experience station: U.S. flood history, stories and articles about recent floods, your school’s policy regarding floods, flood relief organizations.

As a class, discuss what students expect will happen next in the flood’s story. Share thoughts about how a flood would change life at the individual and community level.

Teaching Tips

Begin each lesson by reviewing the storyline and defining vocabulary terms (which appear in boldface).

Lesson 1: The American Red Cross has statistical information on its Web site regarding disaster relief that you can use for further discussion about the cost of floods.

Lesson 2: Have students work in groups to collect items for this activity, or conduct it as a class. Because the majority of these items will be destroyed, be sure students bring in items that can be thrown away. Items that can be salvaged will vary depending on which kind you bring in. For example, an electric tool or toy might not work after being waterlogged. Remind students that even canned food which comes in contact with floodwaters should be thrown away. This activity brings home the reality of dealing with the results of a flood, both physically and emotionally. Be sure to allow time to talk about this as a class.

Lesson 3: Help students research floods that have struck the United States. One famous recent flood is the Mississippi River flood of 1993. Students’ research may not make this clear, but flash floods cause the most deaths of any type of flood. Students should recognize that floods kill more people each year than any other weather disaster. They cause twice as many fatalities as tornadoes. This is because people have little time to prepare for flash floods, and many people make the mistake of trying to drive or walk through floodwaters. They get swept away and drown. Debris carried by floods is also dangerous to people. In addition, floods last longer than any of the other weather events listed.

Lesson 4: Help students locate printed materials and Web sites that carry photos related to flood damage. Students may need to make photocopies for the activity. Encourage them to collect at least three, and to use the back of their handout if more space is needed. Direct students to use the classic formula for writing captions in newspaper style: details should include Who, What, Where, When, Why, and How.

Lesson 5: For this activity, you may wish to read a fictional story about a flood as a class. Select a book from the reading list on page 30. Or, you can find survivor stories on the Internet. If you live in an area where floods occur, you might locate newspaper articles or even residents who have lived through a flood to share stories with you. Be sure to allow time for students to share their stories and photos from Lesson 4. You may wish to make a classroom display.

Lesson 6: Work as a class. Help students find an organization to contact. Look in the county government listings in your telephone directory for your area’s emergency management agency. You can locate local Red Cross or National Weather Service representatives through these organizations’ Web sites. You will also need to learn about your school’s policies regarding weather disasters.

Once students complete all the lessons and the Weather Wise Wrap-Up, discuss this stage of floods activity as a class. Predict what will happen next.

Science Fair Starters

1. Make a display of the waterlogged items from Lesson 2. Include a list of Do’s and Don’ts for dealing with flood damage to homes.

2. Learn the flood stage of a local river or stream. Create a diagram showing the watercourse’s flood stage and at what point it would flood. You might also include a local area map with the river or stream identified, as well as the area that would be affected during flooding.

3. Create a map showing your town’s evacuation routes, official shelters, and major waterways.
The rain has stopped falling. The flood is far from over. Many roads are completely underwater. So are the cars that got trapped on them. Houses have water up to the ceiling of the first floor. Tree branches, boulders, furniture, and other objects dot the water. Even a few people are in the water, hanging on to floating junk. Others sit on top of their roofs waiting for rescue. Boats and even helicopters may be the only way to reach them. More people will become trapped or hurt as they try to move around in the flood. People must be very careful, and stay away until they know it is safe.

Solve these word problems about the flood and its effects.

1. The three most recent floods in the area took place in 1962, 1978, 1989, and 2001. Some people in town saw all four floods. They would have to have lived here at least how many years? ______

2. The flood stage for this river is 25 feet (7.6 m). Before the thunderstorm, the river was 6 feet (1.8 m) below flood stage. How high was the river at this point? ____ The highest the river rose was 8 feet (2.4 m) above flood stage. How high was the river at this point? ____ How much higher was the river than its pre-flood point? ____ As the flood waters drew back, the river fell to 2 feet (61 cm) below flood stage. How high was the river at this point? ____ Was it higher or lower than its pre-flood point? ______

3. The hourly rate of rainfall during this thunderstorm was 2 inches (5 cm) per hour. How long did the storm last if the total rainfall was 7 inches (18 cm)? ______

4. One out of every three homeowners in the flood area has flood insurance. If there are 15,000 homeowners, how many have insurance? ______

5. One family stayed in a hotel for one week while cleaning up their home. They stayed in two hotel rooms. The cost of each room was $59.00 per night. What did it cost the family to stay in the hotel each night? ______ How much did it cost the family to stay in the hotel one week? ______

6. The same family had to pay to do their laundry. They washed and dried 8 loads of clothes. The cost to use the washing machine for one load was $1.00. The cost to use the dryer for one load was $0.60. ______ How much did it cost to do laundry for the week? ______
People start returning home. They must be careful around damaged buildings. House walls may have cracked. Electricity and gas lines may not work. The flood has left behind a smelly, wet mess. People find that strange objects have been dumped on their property by the flood. Some things can be repaired or cleaned. Many more things have been ruined. Tap water is not safe to drink. Any food touched by flood waters must be thrown out. The cleanup, which will take weeks, has begun.

Learn more about how flood waters damage household property.

You’ll need: newspaper, tub, water, potting soil, items listed in the chart below, other items you want to use in the experiment

1. With help from your teacher and an adult at home, collect the items listed below. Include anything else you choose, as long as you have permission to use it. Some things will be ruined by this experiment!
2. Fill a tub with water. Mix in some potting soil to make the water dirty.
3. Add the items you have collected to the tub. Let the items soak for one day.
4. With your teacher’s help, take each item out of the tub. Lay the items on a sheet of newspaper.
5. With your group, fill out the chart below.
6. Write about how doing this experiment made you feel.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DAMAGE</th>
<th>DESTROYED? (Y/N)</th>
<th>IDEAS FOR SAVING ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>magazine/newspaper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>toilet paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cloth item</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>toy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>food in plastic bag</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>food in box</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>canned food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dollar bill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>photograph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>household tool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>candle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For many townspeople, this is not the first flood to come their way. They know that to live on a river is to live with floods. Most people in the area have **flood insurance**. At least their property can be replaced if needed after a flood. After this flood, some people will move from the river front, choosing to live on higher ground. Others will clean up and hope the floods are done for a long time.

### Research some floods that have taken place in the last century.

Gather information to complete the chart below.

<table>
<thead>
<tr>
<th>Date of Flood</th>
<th>Location</th>
<th>Type/Cause of Flood</th>
<th>Number of Deaths</th>
<th>Cost of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How do floods compare to other weather disasters? Look at the National Weather Service data below. It shows the average number of deaths caused by severe weather each year. The information was gathered from 1972 to 1991.

![Bar graph showing deaths due to severe weather](chart.png)

1. How do floods compare to other weather disasters?___________________________
2. Floods cause about twice as many deaths per year as what other weather disaster?___________________________
3. Why do you think floods are so much more deadly than other weather disasters?___________________________
Lesson 4

A SURVIVOR’S STORY: PART 1

As rescue work continues, more people are found. Some have been trapped, but are not hurt. Others did not survive. They may have been washed away by the flash flood. They may have fallen into the flooding river. Thanks to a good warning system, many people were prepared for the flood. They were able to stay safe. People are not the only flood victims rescued. Many pets, farm animals, and wildlife are saved, too. It will be a long time before life returns to normal.

Collect pictures that show the sweeping damage that floodwaters cause.

Find pictures taken after a flood, and place a few on this page. Look through magazines, books, and Internet sites. Cut out photos, make copies, and print out or draw pictures to use. Write a caption below each picture that gives information about what happened.
Lesson 5  A SURVIVOR’S STORY: PART 2

People come together after a disaster like a flood. Neighbors share what they can. Volunteers collect basic items, like clothing, blankets and soap, for those left homeless. Shelters offer a safe place to stay while people get back on their feet. Everyone has a story to tell about how the flood affected them. Some ordinary people will be remembered as heroes. They made smart decisions that helped save lives.

Imagine living through a flood. Write your story here.

Read stories about people whose towns were flooded. Find stories in magazines, books, or on the Internet. The reading list included in your Flood Safety Smarts pages lists several books to choose from. As you write your story, think about what you might experience before, during, and after the flood. How is your life changed?

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________
COULD YOU FACE A FLOOD?

Floods are the most common, most deadly kind of weather disaster. Even the best warning systems are useless if people ignore them. It is important for people to learn how to prepare for floods. They should know their area’s risk and have a plan for what to do. And they should always remember: If you see floodwaters, stop! Turn around! Get to higher ground!

Research your area’s risk for flooding.

Contact a weather official to learn more about your area’s risk for flooding. You might try the local American Red Cross or National Weather Service office. Your county might have an emergency management agency, too. With your class, complete the information on this page. Then, use the information to create a poster about flood safety.

1. Write the name of the organization you contacted: ____________________________

2. What is your area’s level of risk for flooding? _____________________________

3. Is your school above or below flood stage level? _________________________

4. What warning and alert signals does your area use? _____________________

5. What is the history of flooding in your area? ____________________________

6. Where are official disaster shelters for your area? _______________________

7. How would you evacuate from your school? ____________________________

8. What are examples of your area’s efforts to reduce the effects of flooding? ___________
WEATHER WISE WRAP-UP

Use what you have learned in this unit to complete this page.

1. Answer these questions.
   a. What is one example of something people should do after a flood?
   ____________________________________________________________________
   b. What kind of weather disaster is more common than flooding?
   ____________________________________________________________________
   c. What is one way to learn about your area’s risk for floods?
   ____________________________________________________________________
   d. What is the most important thing to save during a flood?
   ____________________________________________________________________
   e. What is the main rule to remember during a flood?
   ____________________________________________________________________

2. Complete the information below.
   a. Write about one flood that has happened in the United States.
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   b. Describe how a flood can be dangerous to people.
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   c. Describe how people should keep themselves safe during a flood.
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________
   d. Write about the most interesting thing you learned about floods.
   ____________________________________________________________________
   ____________________________________________________________________

3. Draw a picture that shows three examples of a family preparing for a flood.
Develop a Family Disaster Plan.
• Learn about your town’s flood risk and where your home is compared to flood stage. Learn about your community’s flood warning system. Find out where disaster shelters are located. Call your local American Red Cross chapter or the local National Weather Service office for information.
• Decide how you will react if you are home when a flood strikes.
• Place emergency numbers by all phones.
• Decide what to do if you are not all together during a flood or other disaster. Choose a place in your neighborhood to meet. Also choose a family member or friend to call.
• From time to time, review the disaster plan.

Put together a flood survival kit.
• It’s a good idea to keep a survival kit in case of any kind of disaster. Each person must pack supplies to last three days. Supplies should be stored in a backpack or gym bag and should include:
  • three-day supply of water (one gallon per person, per day)
  • food that will not spoil
  • one change of clothing and footwear per person
  • one blanket or sleeping bag per person
  • a first aid kit
  • emergency tools, including a battery powered radio, flashlight, extra batteries
  • extra set of car keys
  • special items needed for babies, older people, or people with health problems
  • hygiene supplies, such as toothbrush, washcloth, soap, toothpaste
  • a waterproof container to hold important family papers
• Keep a smaller kit in the trunk of your car.
• Replace stored food and water every six months

Stay tuned to weather reports.
• Listen to the radio or watch television for reports put out by the National Weather Service. If it has been raining hard for several hours or steady for several days, be prepared for flooding.
During a Flood...

Stay Tuned to Weather Reports.

Make yourself safe.

If you are at home...
- Fill bathtubs, sinks, and plastic containers with water. Clean water may not be available after a flood.
- Bring outdoor items inside, so they will not be swept away.
- Move furniture and valuable property to upper floors in the building.
- If you are ordered to do so, turn off all utilities.
- Fill your car with gas, and be prepared to evacuate.

If you have to evacuate...
- You should evacuate if you live in an area that floods often, or if you are ordered to leave. Leave early, so you can get to safety before floods block roads.
- Review what to do in case you get separated.
- Follow evacuation routes. Don’t try shortcuts!
- Contact someone to tell him or her of your plans.
- Make arrangements for your pet. Public shelters and hotels/motels do not usually allow pets.
- Bring your survival kit with you. Also carry emergency road supplies and medicines you might need.

If you are in a car...
- Stay away from flooded areas. Don’t try to drive through streams. You don’t know how deep the water is, or if the road below is destroyed.
- Don’t drive past road blocks. Find another route to take.
- If your car is surrounded by rising waters or stalls, leave it. Get to higher ground.

If you are outdoors...
- Climb to higher ground. Do not try to walk in water that is more than six inches (15 cm) deep.

After a Flood...

Stay tuned to weather reports.
- Return home only when your area is officially safe.

Travel with care.
- Drive only if you must, so emergency and rescue workers can better do their jobs.
- Roads may be closed. Do not cross road blocks.
- Avoid bridges and washed out roads. Do not drive into flooded areas.
- Do not move around in water more than six inches (15 cm) deep.
- If you find someone who is hurt or trapped, give first aid or help if you can. Don’t try to move injured people. Call for help instead.

FLOOD-RELATED ORGANIZATIONS

Relief
- American National Red Cross
  www.redcross.org
- Humane Society of the United States
  http://www.hsus.org/
- Federal Emergency Management Agency
  http://www.fema.gov
- National Flood Insurance Program
  www.fema.gov/nfip/
- Salvation Army
  www.salvationarmy.org/

Research
- National Oceanic Atmospheric Administration
  http://www.noaa.gov
- National Severe Storms Laboratory
  www.nssl.noaa.gov
- National Weather Service
  http://www.nws.noaa.gov/
- Storm Prediction Center
  www.nssl.noaa.gov/~spc
- United States Army Corps of Engineers
  www.usace.army.mil/inet/functions/cw
Selected Answers

Unit 1

Lesson 1
a. It began rising to the top.
b. Warm water is less dense than cold water.
c. Warm air rises and meets cold air above. It cools off and loses moisture. The moisture forms clouds.

Lesson 2
a. A film of water appeared.
b. Water droplets formed.
c. On the surface of the hot water.
d. On the bottom of the tuna can and on the sides of the jar.
e. Where droplets fell from the bottom of the tuna can.
f. Warmth leads to evaporation, coolness leads to condensation.

Lesson 4
1. Texas
2. It is the largest state.
3. Yes, South Dakota, Hawaii, Alaska, Rhode Island, Massachusetts, Maryland.
4. There are more floods in the East.
5. Answers will vary
6. Answers will vary
7. Answers will vary

Lesson 5
a. The sponge soaked up most of the water.
b. There is much less water flowing out of the floodplain.
c. Possible answers: food, transportation, recreation
d. Answers will vary

Lesson 6
4. The water level goes down as water flows into the main river.
   The water level rises in the main river.
5. At the bottom of the dish
6. Water levels rise at the top of the dish and along the levees, but flooding starts above the levees, near top of dish

Unit 1 Weather Wise Wrap-Up (pg 13)
2. a. C. evaporation, b. D. floodplain, c. A. rain gauge
3. water cycle, condenses, rain, floods, flood stage, sediment, levees

Unit 2

Lesson 3
2 feet

Route A
Route B
Route B is shorter.

Unit 2 Weather Wise Wrap-Up (pg. 21)
1. a. river flood, urban flood, flash flood
   b. Possible answers: blankets, food, water, dry clothing and footwear, batteries, a flashlight, etc.
   c. National Weather Service
d. 2 feet
   e. Possible answers: Listen to weather reports, avoid bridges and low lying roads.
3. Evacuation: When people leave to find safety.
   Shelter: A place for people to go during or after a flood.
   Buoyancy: Upward pushing force water supplies to objects.
   Flood watch: A time when floods are possible within the next few hours.
4. a. urban flood, b. flash flood, c. river flood

Unit 3

Lesson 1
1. 39 years
2. 19 feet (5.8 m), 33 feet (10 m), 14 feet (5 m), 23 feet (7 m), higher
3. 3.5 hours
4. 5,000 insured people
5. $118.00 each night, $826.00 for the week
6. $12.80

Lesson 3
a. Floods cause the highest number of deaths.
b. Tornadoes
c. Possible answers: Little warning time, rushing waters, floods last for days or weeks.

Unit 3 Weather Wise Wrap-Up (pg. 29)
1. a. possible answers: Avoid road blocks; help people who are young, old, or sick; take pictures of damage
   b. No other disaster.
c. Possible answers: Contact the local Red Cross or National Weather Service office.
d. Yourself!
e. If you see water, stop! Turn around, and head for higher ground!
2. b. Possible answers: Flash floods can sweep people and cars away.
c. Possible answers: Get to higher ground, do not try to move about in flood waters deeper than 6 inches (15 cm).