Hurricanes
6–8

Hurricane Science

LESSON PLAN 1

Under Pressure

Understanding the power of hurricanes, helps young people understand the need to be prepared.

Key Terms and Concepts

air pressure
atmosphere
atmospheric pressure
Coriolis effect
density
eye of the hurricane
eye wall
high pressure
hurricane
low pressure
mass
molecule
Northern Hemisphere
properties
Southern Hemisphere
tropical depression
tropical storm
weight
wind speed

Purposes

To give students and their families an understanding of the air properties of weight and mass and changes in air pressure

To help students use the relationship between air pressure and weather patterns to understand hurricanes

Objectives

The students will—

- Work in groups to suggest properties concerning the weight and mass of air and design ways to test their hypotheses.
- Use *A Weighty Problem* to guide an examination and demonstration of the properties of air.
- Find pictures or draw illustrations of the uses of air pressure to create a Pressure Power bulletin board; write a step-by-step explanatory paragraph on the use of air pressure in one of the illustrations.
- Determine ways air pressure and changes in pressure are used in our daily lives. (Home Connection)
- Explain ways in which the use of air pressure affects industry. (Linking Across the Curriculum)
- Participate in a simple demonstration of the relationship between air pressure and wind speed. (Linking Across the Curriculum)
- Read Hurricane Science in the Background to this module and search the Internet to answer questions about the science of hurricanes from *Hurricane Basics*.
- Use research to define the words in Key Terms and Concepts; design posters to explain hurricane science.
- Gather family stories about experiences or knowledge of hurricanes. (Home Connection)

American Red Cross

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- Use *Real-life Hurricanes* to research and record statistics for comparing the impact of recent hurricanes. (Linking Across the Curriculum)

Activities

"Under Pressure"

"Hurricane Basics"

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Hurricanes 6–8

LESSON PLAN 1

Under Pressure

Materials

- *A Weighty Problem*, 1 copy per team
- 2 large balloons of equal size
- 12-inch (30-centimeter) ruler
- 12-inch (30-centimeter) string
- Tape
- Table or desk

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"Under Pressure"

SET UP 15 minutes **CONDUCT** 40 minutes

Science: Physical Science; Language Arts: Writing

TEACHING NOTE To understand weather and the velocity of winds, students must first understand the concept of air pressure and be able to quantify differences in air pressure. The following activity allows students to demonstrate their understanding of air pressure. The activity will show that air has both weight and mass.

1. To help the students consider the properties of air, ask—
   - Does air have weight or mass?
   - How can we demonstrate this?

   Have the students state their ideas and reasons.

TEACHING NOTE If the students are completely unfamiliar with the concept of the weight and pressure of air, you may wish to use *A Weighty Problem* as a teacher demonstration or have student teams perform the demonstration. Afterward, have them complete the activity, beginning with Step 3.

Answers to *A Weighty Problem*

1. The ruler will balance, assuming the balloons are tied equidistant from the center of the ruler.
2. The inflated balloon weighs more because air has been added. It will tip the end of the ruler down.
3. The air inside and outside the inflated balloon is the same.
4. As the air inside the balloon is released, the air outside the balloon pushes against the balloon, causing it to shrink and collapse.

2. Divide the class into teams of two or three students and have them design ways to prove their hypotheses concerning air weight and mass. For example, the teams could—
   - Examine the difference in weight between an inflated balloon and a deflated balloon.
   - See what happens when they place a book on a deflated balloon and then inflate the balloon.
   - Discover why inflating a tire can lift a 2,000-pound (908-kilogram) car or inflating an air mattress can lift a 200-pound (91-kilogram) person.
   - Figure out why the lift is greater when the pressure within the tire or mattress is greater.

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Under Pressure

3. Ask the students to share their discussions and provide scientific explanations. (Air molecules are in constant motion. Air molecules push and press on the surfaces they contact. When a balloon is inflated, air is forced into the balloon and pushes against the inside of the balloon. This pressure stretches the balloon. Since the air inside a balloon is pushed into a smaller area, it is denser, or has greater air pressure, than the air around the balloon.)

4. Have student teams set up their demonstrations, if possible, or model or videotape those that cannot be brought into the classroom.

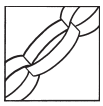
Wrap-Up

Encourage the students to find pictures or draw illustrations of the uses of air pressure—changing air pressure, using air pressure as a tool, or taking advantage of the differences in air pressure. Use these in a Pressure Power bulletin board.

Assign the students to write an explanatory paragraph on the science of air pressure demonstrated in one of the illustrations.

Home Connection

Place the following question on the board: How do we use air pressure in our lives? The students' immediate responses will probably be "tires," "air mattresses," and "flotation devices." Encourage the students to take the question home to their families to discover other ways air pressure or pressure change is used in daily life and in different fields: construction (pneumatic drills), medicine (angioplasty), technical industries (cleaning tools), manufacturing (carbonation testers in soda plants or pneumatic conveyor belts), meteorology (weather forecasting), transportation (airbrakes on trains).



Linking Across the Curriculum

Social Studies: Economics

Have the students select one of the concepts from the Wrap-Up and research to discover how the use of air pressure increases productivity, solves a problem or saves money in a given field or industry.

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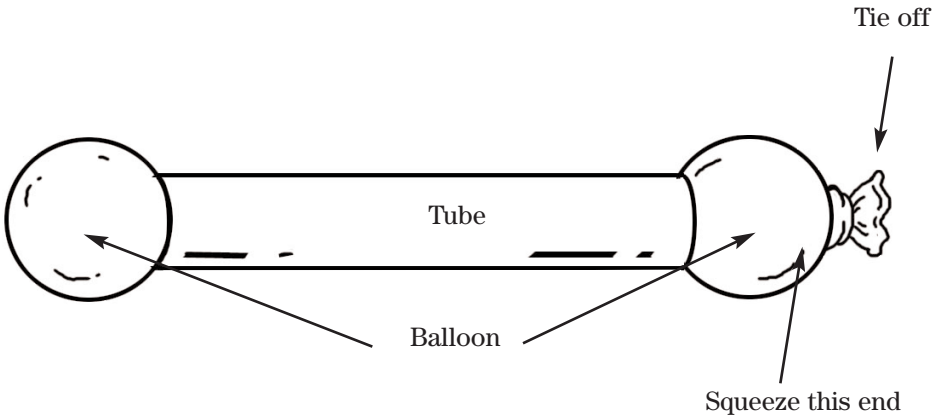
Science: Meteorology

For this activity you will need a long balloon, a plastic or cardboard tube and water to fill the balloon.

Typically, the lower the air pressure, the more intense the hurricane and its winds. Work through the following demonstration with students to make sure they understand this concept.

1. Insert a long balloon through the tube.
2. Fill the balloon with enough water to make both ends bulge. Tie a knot at the end of the balloon to seal it.
3. Ask the students to imagine that the water inside the balloon represents wind speed; the tube represents distance; and the opposite ends of the balloon represent atmospheric pressure—the larger end is the "high" and the smaller end is the "low."
4. Student analysis:
    - What happens to the "wind speed" (water) when the "high" section of the balloon is squeezed into the "low" section within two seconds? 10 seconds? 30 seconds?
    - What changes in atmospheric pressure occur when you squeeze either end of the balloon?
    - How does this illustrate the relationship between atmospheric pressure and wind speeds in a hurricane?



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LESSON PLAN 1

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Materials

- Hurricane Science *(*in the Background), 1 copy per student
- *Hurricane Basics*, 1 copy per student
- Science texts and dictionaries; access to the Internet
- *Real-life Hurricanes* (Linking Across the Curriculum)

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"Hurricane Basics"

SET UP 15 minutes **CONDUCT** 40 minutes

Language Arts: Research; Science: Meteorology

1. Distribute Hurricane Science from the Background to this module, *Hurricane Basics*, science texts and dictionaries to teams of students. Teams must also have some time to conduct research on the Internet.

Give student teams time to read and discuss the information they find. They will work together to define each of the Key Terms and Concepts at the top of *Hurricane Basics* and then answer the questions that follow. Remind the students to use as many of the Key Terms and Concepts as they can in their answers.

Share team findings in a class discussion.

- What are the main ingredients it takes to create a hurricane? (Warm, moist tropical air; a low-pressure system that begins a wind pattern near the ocean's surface and spirals air inward; and a build-up of moisture.)
- What is the structure of a hurricane? (The hurricane's structure includes the eye, the eye wall and the rain bands.)
- What are the major causes of hurricane damage? (High winds, storm surges, torrential rains and flooding, and tornadoes spawned by the hurricane.)
- What kinds of damage can a hurricane inflict on a home? (Wind and water damage and fire damage caused by impaired electrical and gas systems.)
- What are the major hazards of hurricanes to humans? To animals? To the environment? (Hurricanes most often cause death to humans or animals by a storm surge or flooding; wind-blown objects and falling trees can harm humans and animals; vegetation can be destroyed by winds and flooding; and sands and land shift in the winds and the storm surge.)
- Do hurricane winds blow toward the center of the storm or away from the center of the storm? (At the bottom of the hurricane, warm, moist air from a warm ocean flows in and whirls upward in a counterclockwise direction. Cooler air at the top of the hurricane descends into the eye, creating a small center of calm weather. The eye wall surrounds the eye and is composed of dense clouds that contain the highest winds in the storm. The storm's outer rain bands—often with winds of hurricane or tropical-storm force—are made up of dense bands of thunderstorms that extend as little as 50 miles from the storm in small hurricanes to as much as 400 miles in large ones.)
- How might a hurricane change someone's life? (Answers will vary.)

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Wrap-Up

Divide the questions among the student teams. Each team will create a simple, informative poster to explain the answer to their question. Challenge students to use illustrations to clarify their written information.

Home Connection

If you live in a hurricane-prone area, have the students use their research as the starting point for a family discussion on local hurricanes. What statistics can family members remember? Have the students gather hurricane stories to share with the class.

Linking Across the Curriculum

Mathematics: Statistics; Language Arts: Research

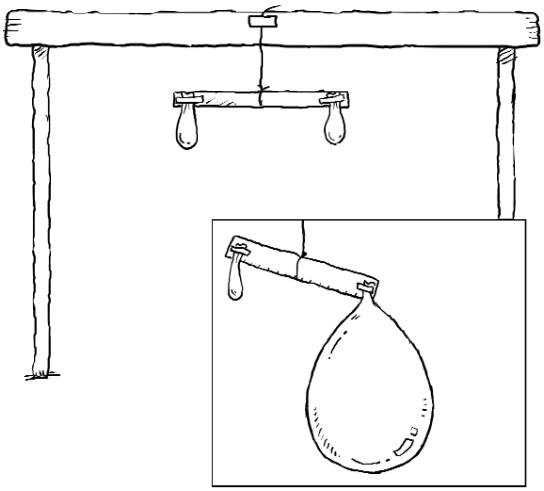
Have the students use *Real-life Hurricanes* to research and record the statistics and impact of recent hurricanes—the storm name, year, state(s) or territory or country affected, category number, lowest air pressure, highest winds and types of damage.

A Weighty Problem

Name _____

Directions: Air pressure is the force behind the power of a hurricane. Try the following experiment to learn more about air pressure.

Materials:
- 2 large balloons of equal size
- 12-inch (30 cm) ruler
- 12-inch (30 cm) string
- Tape
- Table or desk



Procedures:
1. Tie one end of the string around the midpoint of the ruler.
2. Tape the other end of the string to a table or desk.
3. Tape a balloon to each end.
4. Make sure the ruler is balanced.
5. Remove one of the balloons and blow it up. Tie a knot to keep it closed.
6. Replace it in the same spot on the ruler and observe what happens.

Observations:
1. Describe what happened to the ruler when both deflated balloons were attached to the ends.

2. What happened when you attached one inflated balloon to the end of the ruler?

3. Describe the air inside the balloon, the air outside the balloon and their relationship to each other.

4. Describe what happens to the air outside the balloon as the air inside the balloon is released.

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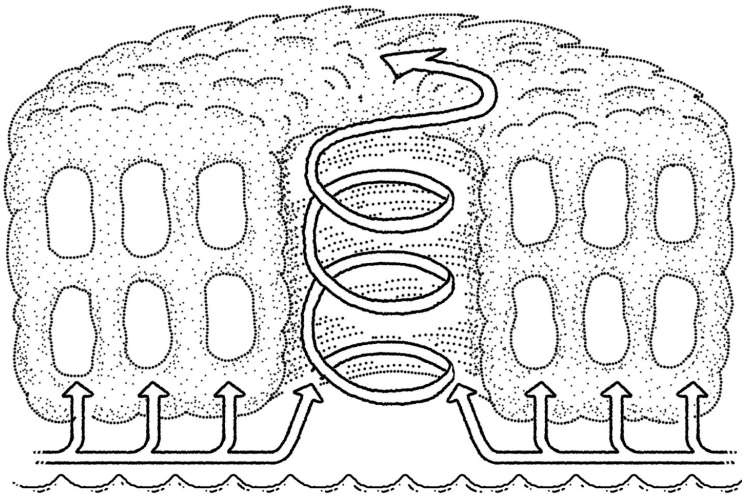
Hurricane Basics

Name _____

Directions: Find the answers to the questions below and you'll learn the basics of hurricanes. Use a variety of resources, including science texts, news media and the Internet.

Key Terms and Concepts

air pressure
atmosphere
atmospheric pressure
Coriolis effect
density
eye of the hurricane
eye wall
high pressure
hurricane
low pressure
mass
molecule
Northern Hemisphere
properties
Southern Hemisphere
tropical depression
tropical storm
weight
wind speed



1. What are the main ingredients it takes to create a hurricane?

2. What are the major causes of hurricane damage?

3. What are the major hazards of hurricanes to humans? To animals? To the environment?

4. What kinds of damage can a hurricane cause to a home?

5. Since air in a high-pressure system is drawn toward the low-pressure system of a hurricane, do hurricane winds blow toward the center of the storm or away from the center of the storm?

6. How might a hurricane change someone's life?

Internet Resources

Earth Observatory: Hurricanes: The Greatest Storms on Earth
http://earthobservatory.nasa.gov/Library/Hurricanes/hurricanes_2.html

National Weather Service: Tropical Weather
http://www.srh.noaa.gov/jetstream/tropics/tropics_intro.htm

University of Illinois: WW2010 Hurricanes
http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/hurr/home.rxml

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Real-life Hurricanes

Name _____

Directions: Research at least one storm per category on the Saffir-Simpson scale to complete the chart below.

Hurricane Category	Storm Name	Year	State/Territory/ Country Affected	Sustained Winds (mph)	Highest Winds (mph)	Lowest Pressure (inches)	Description of Damage
1							
2							
3							
4							
5							

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