Lightning Activity Key

*** For ease of use during class the Teacher Key pages are numbered the same as the Student Activity Book pages.

I. Introduction

Lightning kills hundreds of people around the world each year. It is estimated that lightning strikes the earth about 100 times every second. Lightning starts wildfires, destroys computers, fries the wiring in phones, and upsets AM radio reception.

A. Get Info Objectives

1. Explain the causes of lightning and thunder.
2. Describe lightning damage.
3. Describe the most safe and least safe places to be during a thunderstorm.

B. Gather Data Objectives

1. Draw the types of lighting.
2. Determine the place and time lightning strikes most often in the United States.
3. Explain first aid for someone struck by lightning.

C. Applying Principles Objectives

1. Calculate the distance from a strike using the flash to bang rule.
2. Calculate the speed of sound in feet per second.
3. Calculate the speed of sound in meters per second.

II. Get Info

A. Lightning Occurrence and Formation

- Click on the "Frequently Asked Questions about Lightning" site.
- Read the information and answer the following questions.

1. What causes lightning?

Flashes originate 15,000 to 25,000 feet above sea level when rain is converted to ice. The charge then moves down in ~50 yard sections called step leaders. When something will conduct electricity to the ground, the circuit is completed and the charge is lowered to the ground.

2. What conditions are most favorable for lightning formation?

Lightning needs a parent cumulonimbus cloud, upward motion, instability in the vertical, and moisture to produce a deep cloud that reaches up to levels somewhat colder than freezing.

3. What kinds of damage can lightning cause?

Lightning causes serious physical injuries or death, explosions of objects, fires, and damage to electronic equipment by passing through wires or plumbing.

4. Where are the most dangerous places to be during a thunderstorm?

The most dangerous places to be during a thunderstorm are: out in the open, on or in the water, near plumbing, and on the telephone.

- Click "Back" to return to the Lightning "Get Info" web page.
- Click on the "Characteristics of a Storm" site.
- Read the thunder section. Answer the questions below.

5. Explain, in your own words, how thunder forms.

The lightning is 20,000 degrees Celsius. The clear air around the lightning bolt gets heated and produces a shock wave that decays into a sound wave that moves away from the lightning channel.

- Click "Back" to return to the NOAA Research "Lightning" main page.

III. Gather Data

A. Types of Lightning

- Click on the "Types of Lighting" site.
- Scroll down the web page until you see "Types of Lightning".
- Read the types of lightning section.

1. Draw and label the three major types of lightning.

Intracloud lightning is lightning within a single cloud.

Intercloud lightning is lightning between two clouds.

Cloud-to-ground lightning is between a cloud and the ground.

- Click "Back" to return to the Lightning "Gather Data.1" web page.

B. Frequency of Strikes

- Click on the "Frequency of Strikes" site.

1. What areas of the continental United States have the most lightning strikes per year?

Florida

Oklahoma and Texas

Answers will vary to include States along the Gulf

- Click "Back" to return to the Lightning "Gather Data.1" web page.

C. Time of Strikes

- Click on the "Time of Day Variation" site.

1. During what six-hour period does most severe weather occur?

Noon to 6 pm

- Click "Back" until you get to the Lightning "Gather Data.1" web page.
- Scroll down to the bottom of the web page and click "Forward".

D. Safety

- Click on the "Frequently Asked Questions about Lightning" site.
- Scroll down to and read the section "How can I stay safe from lightning?"

1. What does "flash to bang" mean?

When you see lightning, count the seconds until you hear the thunder. If you count five seconds, this means the lightning is a mile away. If it is 2 – 3 miles away, find shelter quickly.

2. During what phases of a thunderstorm does lightning kill the most people?

Most fatalities occur before the storm starts raining hard, and after the worst part of the storm is over.

3. Where is the safest place to be during a thunderstorm?

The best place to be is in a substantial building with grounded wires and plumbing. Cars with metal roofs are fairly safe, but not as good as a building with grounded wires and plumbing.

- Click "Back" to return to the Lightning "Gather Data.2" web page.

E. Lightning Injuries and Damage

- Click on the "Lightning Social and Economic Costs" site.
- Scroll down to table 2.

1. What organic (physical) problems do lightning strike survivors have?

Lightning strike survivors have problems with stiffness in joints, photophobia (light sensitivity), muscle spasms, hearing loss, inability to sit for long periods, and external burns.

- Click "Back" to return to the Lightning "Gather Data.2" web page.
- Click on the "First Aid" site. (Remember, first aid is the same for lightning victims in all parts of the country.)

- Scroll down and read the section "First Aid for Lightning Strike Victims."

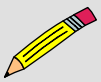
2. What first aid should you do for someone who has been struck by lightning?

Artificial respiration and cardiopulmonary resuscitation (CPR)

- Click "Back" to return to the Lightning "Gather Data.2" web page.
- Scroll down to the bottom of the page and click "Forward."

- Click on the "Lightning Damage/Costs" site.

3. What kinds of damage does lightning do?



Lightning causes forest fires; lightning leads to insurance claims; lightning causes 50% of all weather-related aircraft mishaps; 100 million dollars per year in outages to the telecommunications industry are caused by lightning; and 30% of power outages are caused by lightning. Answers may vary.

- Click "Back" to return to the Lightning "Gather Data.3" web page.

F. Common "Knowledge"

- Click on the "Lightning Injury Facts" site.
- Read the section "Prevention/Avoidance" to answer the following questions.

1. Will wearing rubber shoes help keep you safe?

No. If lightning has burned its way through a mile or more of air (which is a superb insulator), it is hardly logical to believe that a few millimeters of any insulating material will be protective.

2. Why is a car a fairly safe place to be during a thunderstorm?

Electrical current travels along the outside of a conductor (the metal body of the car) and goes to the ground through paths that include the tires and the rainwater.

3. What types of structures get struck by lightning most often?

Tall buildings, mountaintops, and antennas for radio and television stations are struck by lightning most often.

4. Should you **always** stay away from trees?

No. The tallest trees should be avoided. However, you don't want to become the tallest object in the area. If you are in a forested area, choose an area with smaller trees or a dense growth of bushes.

- Click "Back" to return to the NOAA Research "Lightning" main page.

IV. Application

A. Explain Lightning Fatalities

1. Hypothesize why most lightning fatalities occur at the beginning or end of a thunderstorm, rather than during the part of the storm with the heaviest rain.

People don't think that lightning is a problem if the storm is not strong yet or if it is weakening. Most people think that if it is not raining, it is safe to go outside.

B. Math Applications

1. If a lightning flash is seen 12 seconds before the thunder is heard, about how far away did the lightning strike?

12 ÷ 5 = 2 and 2/5 miles

2 and 2/5 miles

2. There are 5280 feet per mile. Use the "flash to bang" rule to figure out the speed of sound in feet per second.

$$\frac{1 \text{ mile}}{5 \text{ seconds}} \times \frac{5280 \text{ feet}}{\text{mile}} = \frac{1056 \text{ feet}}{\text{second}}$$

3. There are 2.54 centimeters per inch, 12 inches per foot, and 100 centimeters per meter. Convert your answer in number two to meters per second.

$$\frac{1056 \text{ feet}}{\text{second}} \times \frac{12 \text{ inches}}{\text{foot}} \times \frac{2.54 \text{ cm}}{\text{inch}} \times \frac{1 \text{ meter}}{100 \text{ cm}} = \frac{322 \text{ meters}}{\text{second}}$$

V. Enrichment Activities

A. Research

1. Research Saint Elmo's Fire. What kind of lightning is St. Elmo's Fire? Where does it occur? What problems does it cause?

2. Research "Faraday Cage".

3. Research Zeus' thunderbolts made by Vulcan.

4. Research Nicola Tesla.

5. Find out how buildings can be protected from lightning strikes.

B. Interviews

1. Interview a meteorologist about lightning. Find out what equipment and technology is used to predict and track lightning.

2. Interview an electrician. Find out what "grounded" outlets are and how they work.

3. Interview a firefighter about what lightning can do to a forest and how they put out the fires.

4. Interview a forester about controlled burning. What is it and how is it used?

C. Related Web Sites

1. Lightning Safety
   http://www.lightningsafety.com

2. Kid's Lightning Information and Safety Page
   http://www.kidslightning.info/

3. The Lightning Dictionary
   http:// library.thinkquest.org/20698/data/light4.htm

4. National Weather Service - Lightning Safety
   http://weather.gov/om/wcm/lightning/index.htm

5. Lightning Kills, Play It Safe
   http://www.lightningsafety.noaa.gov/

6. Thunderstorms and Lightning
   http://www.crh.noaa.gov/mkx/slide-show/tstm/index.html

7. A Severe Weather Primer: Lightning
   http://www.nssl.noaa.gov/primer/lightning/ltg_basics.html

8. Lightning Safety: What you need to know NOW
   http://www.nssl.noaa.gov/edu/safety/lightning.html