



APPENDIX D LIGHTNING

OBJECTIVES

The students

- Invent a way to measure the distance between themselves and a lightning strike.
- Observe and describe lightning's characteristics.
- Identify places to avoid in a lightning storm.

BACKGROUND

This activity begins the study of lightning. Lightning is one of the most beautiful, terrifying, and energetic of all natural phenomena. An ordinary 12-volt car battery with an output of 10 amperes can produce a spark of an inch or so, but it takes up to 30,000,000 volts and 200,000 amperes to produce a lightning discharge. The heat produced by lightning may be hotter than the surface of the sun. The power of a single lightning discharge can split a giant tree, set fire to a home, or destroy the electrical circuitry of computers and television sets served by a power line. Despite lightning's great energy, its moment of existence is too short for us to harness its potential for commercial use with our existing technologies.

In this activity the students first learn about lightning safety through an information-giving quiz. They then observe thunderstorms. It is best to run this activity along with 4.5 EXTREME WEATHER EVENTS. Don't expect the students to know a great deal about lightning. By discussing the questions in the quiz they will gain the information they will need in the activity.

Calculating the Distance to a Lightning Strike

To calculate the distance to a lightning strike

- Count the number of seconds between sighting a bolt of lightning and hearing its thunder. The students will need to practice counting seconds.
- Divide the number of seconds by 3. The quotient is the number of kilometers away that the lightning was seen. The sound of the thunder travels about 1 kilometer per 3 seconds or about 1 mile per 5 seconds.

If it takes 9 seconds for the sound of thunder to reach your ear, then the strike was 3 kilometers or a little less than 2 miles away. An alternative technique is to use the formula for distance:

$$\text{DISTANCE} = \text{VELOCITY} \times \text{TIME}$$

Sound travels at the rate of 1 kilometer/3 seconds. Applying the formula to the problem above,

$$\text{DISTANCE} = \frac{1 \text{ kilometer}}{3 \text{ seconds}} \times 9 \text{ seconds} = 3 \text{ kilometers}$$

STUDENT ROLES

Meteorologist
Safety expert

MATERIALS

Student Page LIGHTNING QUIZ

PRODUCTS

Completed Student Pages

PROCEDURES

1. **Begin the activity by having the students take the LIGHTNING QUIZ on the Student Page. Have them discuss their answers.**

2. **Discuss lightning safety.**
Ask such questions as
 - Has lightning ever struck near anyone? Can you describe for us what it was like?
 - ✓ Be sensitive to students who may have had a personal tragedy associated with lightning.
 - Has anyone ever seen a fire set by lightning? Where was this?
 - Has anyone ever seen an object hit by lightning? What happened to the object?
 - ✓ Usually objects that are struck by lightning are burned or torn apart.
 - Where is lightning most likely to strike?
 - ✓ Point out that lightning seems to strike the highest place around. Use this information to decide where it is most likely to strike.
 - Where might lightning strike on the ocean?
 - ✓ A boat, particularly one with a mast that extends above the water level.
 - What might lightning strike in an open area?
 - ✓ Fences, trees, high ground, standing animals including humans.
 - Where might lightning strike a house?
 - ✓ The highest spot on the roof.
 - What is a lightning rod?
 - ✓ A metal rod usually placed on a roof and connected to pipes or other metal that conducts the electricity so that it harmlessly enters the ground.

3. OPTIONAL: Introduce a way to measure the distance from the students to where lightning strikes.

Have the students

- Practice counting 1001, 1002, 1003, and so forth to 1020 at a rate that is very close to 20 seconds. Each number should take a second to say.
- Note that it takes the sound of thunder 3 seconds to travel a kilometer and 5 seconds to travel a mile. Therefore, we can count 1001, 1002, 1003 (one finger out, 1 km); 1001, 1002, 1003 (two fingers out, 2 km); 1001, 1002, 1003 (three fingers out, 3 km), and so forth).
- Note that a flash of lightning reaches our eye all but instantly.
 - ✓ Light travels at 310,000 kilometers or 186,000 miles per second. That's about 7 times around the equator of Earth in a second, so we can say that we see the lightning at very, very close to the same instant that it cuts through the sky.
- Have the students work out a method using their newly learned counting skill and knowledge of light and sound to determine how far they are from a lightning strike.
 - ✓ Note that they can also count the number of seconds from the instant they see the lightning to the instant they hear the thunder. Taking the total number of seconds and dividing by 3 seconds per kilometer also gives the distance in kilometers. The number of seconds can also be divided by 5 seconds per mile to give the number of miles.

4. Have the students observe thunderstorms and make generalizations about them.

Ask such questions as

- Where do the lightning bolts seem to start?
 - ✓ The answers will vary with the storm, but usually they start in the cloud. A small percentage travel in the opposite direction.
- How many bolts seem to come from a single source?
 - ✓ Usually several.
- Is precipitation always associated with lightning?
- What kinds of clouds are associated with lightning?

**STUDENT PAGE THE LIGHTNING QUIZ
ANSWER SHEET**

Check all of the statements that correctly complete the statement.

1. Lightning

- is a very big electrical spark.
 travels in a straight line.
 kills several hundred people every year in the United States.
 that strikes the ground comes mostly from very high clouds.

2. Thunder

- is produced when clouds bump together.
 is produced when the air is suddenly heated by lightning.
 is very dangerous if it hits you.
 is only noise.

3. Thunderstorms

- are most common in the winter.
 may occur in the clouds and not involve the ground.
 are most dangerous at night.
 are more common in some places than in others.

4. In a thunderstorm it is usually safe to

- stay in a car.
 be in a house.
 stand in the middle of a field.
 be in an airplane.
 stay under a tree.

5. Lightning

- may be hotter than the surface of the sun.
 tends to strike the highest object below the cloud it comes from.
 can be safely detected by flying a kite into a storm.
 can strike a power line and burn out electronic equipment.

Name _____

Date _____

STUDENT PAGE THE LIGHTNING QUIZ**Check all of the statements that correctly complete the statement.****1. Lightning**

- is a very big electrical spark.
- travels in a straight line.
- kills several hundred people every year in the United States.
- that strikes the ground comes mostly from very high clouds.

2. Thunder

- is produced when clouds bump together.
- is produced when the air is suddenly heated by lightning.
- is very dangerous if it hits you.
- is only noise.

3. Thunderstorms

- are most common in the winter.
- may occur in the clouds and not involve the ground.
- are most dangerous at night.
- are more common in some places than in others.

4. In a thunderstorm it is usually safe to

- stay in a car.
- be in a house.
- stand in the middle of a field.
- be in an airplane.
- stay under a tree.

5. Lightning

- may be hotter than the surface of the sun.
- tends to strike the highest object below the cloud it comes from.
- can be safely detected by flying a kite into a storm.
- can strike a power line and burn out electronic equipment.