9.10

Lightning

Figure 1

Just about everyone has at least one vivid memory of a particularly violent lightning storm. Although lightning and thunderstorms seem to occur infrequently, about 2000 thunderstorms are occurring throughout the world at any given time, generating about 100 lightning strikes every second, or about 8 million strikes daily.

Actually, lightning is part of a natural process of exchanging electric charges between the atmosphere and Earth itself. Electric charges, mostly negatively charged electrons, are continuously being removed from Earth's surface by a variety of processes. Some are natural processes, such as the evaporation of water molecules, and others are related to the production of exhaust gases by vehicles and industrial activities. When thunderclouds form, huge numbers of these negative charges tend to concentrate near the bottom of the cloud. When the negative charge at the base of the cloud moves over tall objects, such as the buildings in **Figure 1**, it is sometimes close enough to return to the ground in a huge spark we call lightning.

Lightning appears to be a jagged path of white light moving toward the ground. The jagged path is caused by the electric charges moving along the path of least resistance in the air. This path is sometimes created by traces of moisture in the air, or by a concentration of positive ions. The electric charge flows in a series of steps as it finds the easiest path to the ground. The charges are more likely to move toward the tallest objects, because it shortens the path to the ground, especially if they are made of metal conductors.

Try This Lightning and Safety

Think about the last major thunderstorm you experienced.

1. During the thunderstorm, what activities did you continue to engage in that you now realize were placing you in danger?
2. When is the appropriate time to stop playing golf, baseball, soccer, or tennis, or to get out of a pool or lake when a thunderstorm is approaching?
3. What safety precautions should you take when indoors during a lightning storm?
4. Make a list of the actions that you will take in the future if you are engaged in an activity or are in a location that could place you in danger during a thunderstorm.

Research and review the Canada Safety Council recommendations on actions to take if you are caught in a thunderstorm. (3A)

Lightning Rods

The diagram in **Figure 2** shows how a lightning rod can protect a house from a lightning strike. A pointed metal rod is attached to the highest part of the building. A thick conductor, usually copper, is connected from the pointed rod to a metal plate buried in the ground. The plate is used to conduct the electric charges between the rod to the ground.

Lightning rods provide two kinds of protection: they help prevent lightning from striking and, if lightning does strike, they direct the charge through the conductor to the ground. To understand the first case, look at the charges indicated in **Figure 2**. The negative charge at the base of the thundercloud induces a positive charge on the things below it, including the building, the lightning rod, and the ground. The lower atmosphere always contains 1000 to 2000 positively and negatively charged ions in every cubic centimetre of "normal" air. The positive ions are repelled by the highly charged (positive) lightning rod toward the thundercloud, thereby neutralizing some of the negative charge. This can prevent a lightning strike. If, however, a lightning strike does occur, the copper conductor carries the negative charges safely to the plate in the ground.

A car is a safe place to be in a lightning storm because most of the car body is made of a metal conductor. Also, because it is usually raining, the outside of the car is wet. When lightning strikes the car, the electric charge travels over the entire body of the car and then easily crosses the short distance from the base of the car to the ground.

Did You Know?

On May 6, 1937, the huge 240-t airship *Hindenburg* burned as it came in to the landing area during a storm at Lakehurst, New Jersey. Research has revealed that the fire was caused by an electrical discharge that ignited the highly flammable coating painted on the cotton-fibre skin.

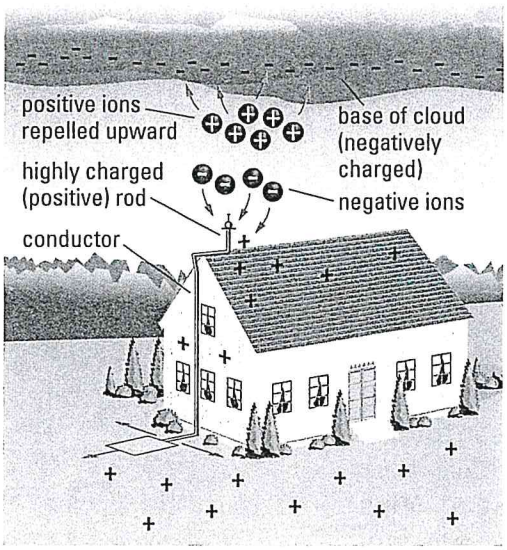

Figure 2
The protection of a building by a lightning rod

Understanding Concepts

1. Why does lightning occur?
2. Why does lightning seem to strike the tallest objects?
3. Draw and label the typical path of (6C) a lightning strike. Explain why it looks as it does.
4. **(a)** What are the two main ways a lightning rod protects a building?
   (b) Explain how each protection method works.

Making Connections

5. What kinds of buildings are most at risk from lightning strikes? What buildings are at the least risk? Explain why.
6. Why are golf courses, parks, and open boats particularly dangerous places to be during a thunderstorm? How would you minimize the safety risks in these public places?

Exploring

7. Use the Internet or a library to (3A) investigate the effects of lightning on the human body. Choose two of the following questions and prepare an artistic or electronic visual presentation for the class:
   - What are the physical signs you might experience to warn that lightning might be about to strike?
   - What parts of the body are most vulnerable to lightning damage?
   - How does lightning cause death?
   - How many people are injured or killed annually by lightning in Canada?
8. What positive results occur because of lightning strikes? Investigate any chemical reactions that might occur as the result of a lightning strike.

Name:_____ Date: _____

Lightning

Textbook reference page 290 – 291

Lightning storms do not seem to occur _____, but at any given time there are approximately _____ thunderstorms happening somewhere in the world. All of these thunderstorms generate about _____ lightning strikes every _____, which is about _____ million strikes every day.

Lightning is really a natural process where the _____ and the _____ exchange electric charges. Electric charges (mostly _____ charged _____) are removed from the Earth in a variety of ways. Some are natural processes (such as the _____ of water molecules), and others are related to the production of _____ gases from vehicles and by other industrial _____.

When thunderclouds form, these negative _____ tend to gather near the _____ of the cloud. If the cloud moves over tall objects, such as buildings or trees, the electrons will "jump" to the ground in a large _____ that is called lightning.

Lightning appears to be a _____ path of white light moving from the sky to the ground. The jagged path is caused by the electric charges trying to find a path of _____ resistance in the air. This path is sometimes created by traces of _____ in the air, or by a concentration of _____. The charges are most likely to move toward the tallest objects because it _____ their path to the ground.

A lightning rod can be used to _____ a house from a lightning strike. A pointed _____ is attached to the highest part of the building. A thick conductor, usually _____, is connected to the metal rod and to a metal _____ that is buried in the ground near the building. The plate is used to conduct the electric charges from the rod to the ground.

A car is a _____ place to be in a lightning storm because most of the body of the car is made of metal, which is a good conductor. If lightning does strike the car, the electric charges travel over the car and then easily crosses to the ground.

Answer questions page 291 # 1 – 3, 5,6