11.8 Electric Discharge

In many hospitals, medical staff members are required to wear shoes with special soles to prevent the buildup of a static charge as they walk. The sudden transfer of a static charge could damage sensitive medical equipment (Figure 1). Damage to electronic devices can occur when a negatively or positively charged object touches the device. What is really happening when static charges are transferred? Are all transfers of static charges dangerous and destructive? Can they be useful?

DID YOU KNOW?

Memory Loss

Electric discharges can damage some forms of computer memory and can also cause damage to computer software. In particular, this can happen when the components of the computer are exposed.

For this reason, computer technicians wear antistatic wrist straps when building computer hardware. This prevents any electric charges that have built up on the body from being discharged onto the delicate parts of the computer.

Figure 1 Electronic equipment in hospitals could be damaged by an electric discharge, potentially harming the patient.

When two objects that have a charge imbalance are brought close together or come in contact, electrons are transferred from one object to the other object. We call this rapid transfer of excess charge an **electric discharge**. Electrons leave one object and pass into another object. Electrons always move from the object with the more negative charge (less positive) to the object with the less negative charge (more positive). Discharges can sometimes be seen as sparks. The greater the charge imbalance, the larger and more noticeable the discharge will be. Small discharges are not dangerous or painful, such as when you remove your sweater and hear a crackling sound. However, a larger discharge can sometimes hurt. When an electric discharge occurs, the air temperature around the discharge increases. If the discharge is large enough, this increase can cause a burn on the skin. Discharges can also damage circuits in electronic equipment, such as medical equipment or computer hardware.

electric discharge the rapid transfer of electric charge from one object to another

To learn more about being a computer technician,
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RESEARCH THIS ELECTRIC DISCHARGE

SKILLS: Researching, Communicating

SKILLS HANDBOOK 4.A.

It is important to prevent electric discharges when repairing electronics. Electric discharge can damage some of the components. This is of particular importance to computers because their sensitive electronics can be ruined by a static discharge.

1. Research how you can prevent an electric discharge.
2. Antistatic devices are items that reduce the buildup of static electricity on objects. Research two different antistatic devices.
3. Research antistatic devices that are specifically used to reduce static electricity in electronic devices.

A. Use a diagram to explain electric discharge. K/U C

B. Explain how each of the antistatic devices you researched in step 2 works. What are the practical applications of each? K/U

C. Which of the antistatic devices in step 3 do you think is most useful for preventing static discharge in electronic devices? Why? T/I

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Have you ever received an electric shock from touching a car door handle? Suppose a car door handle becomes negatively charged. When you reach out to touch the car door handle, you receive a shock. Figure 2 explains why this happens.

Your hand is neutral and the car door handle is negatively charged (Figure 2(a)). When your hand comes close to the car door handle, electrons are transferred from the car door handle to your hand, causing an electric discharge (Figure 2(b)). After the discharge, the car door handle and your hand have the same charge (Figure 2(c)). It is important to remember that the small numbers of symbols in the diagrams represent much larger numbers of charges.

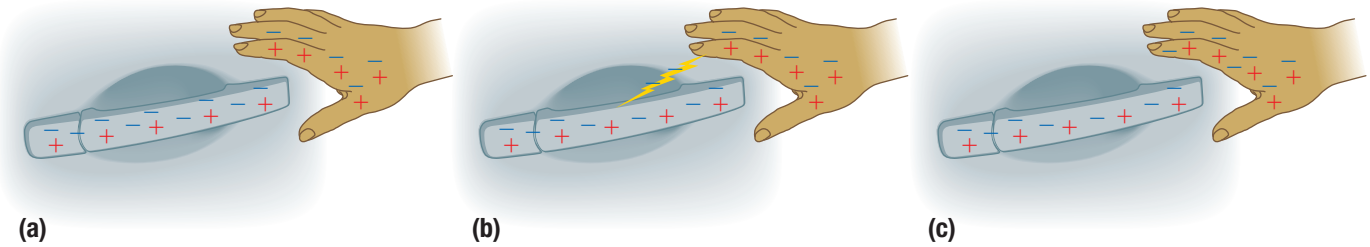

Figure 2 Charged objects, such as the door handle in (a), can cause electric discharges. In (b), coming close to the negatively charged handle enables the excess electrons to be transferred to the hand, producing an electric discharge. (c) After the discharge, the imbalance of electrons between the hand and the handle is gone.

Lightning

Lightning is a very dramatic electric discharge. Although the process is not fully understood by scientists, it occurs because of a charge imbalance between clouds, or between clouds and the ground. One theory suggests that when water droplets in clouds move past one another, they become charged. Electrons are transferred from rising water molecules to falling water droplets. As a result, the negatively charged water molecules collect at the bottom of the cloud (Figure 3).

To learn more about lightning,
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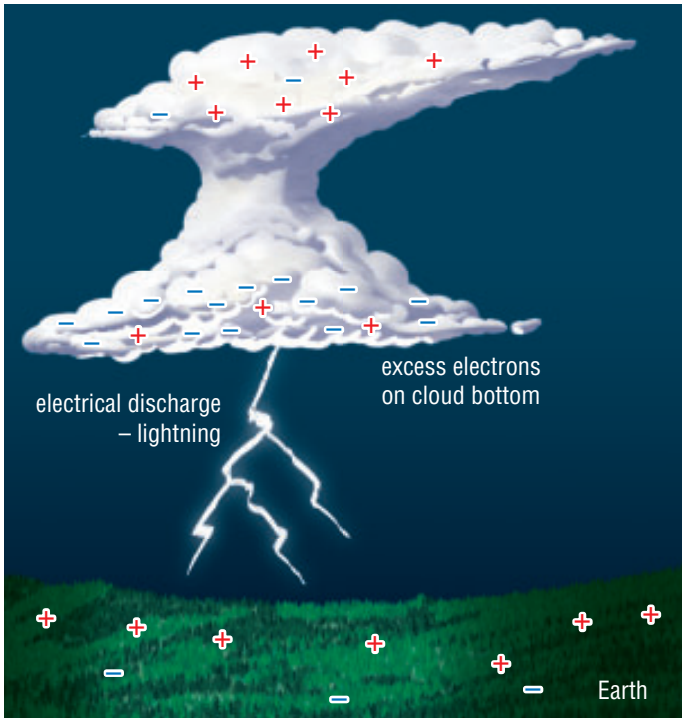

Figure 3 Lightning is an electric discharge that occurs between clouds or between clouds and the ground.

The excess negative charge at the bottom of the cloud repels the electrons at Earth's surface. Electrons move away from the area on Earth's surface near the cloud, causing it to become positively charged. The overall result is a charge imbalance between the bottom of the cloud and Earth's surface. If the charge imbalance becomes great enough, the excess electrons may be rapidly transferred from the cloud to the ground in the form of lightning. The resulting large transfer of electrons causes the surrounding air to become superheated. This produces both the flash of light and the rumbling sound of thunder. Lightning strikes can occur from cloud to cloud, from cloud to Earth, and from Earth to cloud (Figure 4).

Figure 4 Notice that the lightning is travelling between clouds as well as to the ground.

Lightning Rods

Lightning is dangerous to people, structures, and technology. To minimize these dangers, lightning rods are often placed on top of buildings to provide a safe path for lightning to follow to the ground (Figure 5). Although tall objects such as trees and towers get hit by lightning more often than shorter objects, lightning can also sometimes strike the ground beside tall objects. When lightning strikes, it usually travels along the path that most easily transfers electrons to or from the ground.

A lightning rod is usually made of metal, such as iron or copper. There is also a wire that goes from the rod into the ground.

Figure 5 The lightning rod on this home directs any lightning strikes safely into the ground.

Figure 6 shows the typical placement of a lightning rod on a house. When lightning strikes, the house is protected. The lightning safely passes through the rod and down the wire into the ground, instead of through the building.

To learn more about lightning rods, GO TO NELSON SCIENCE

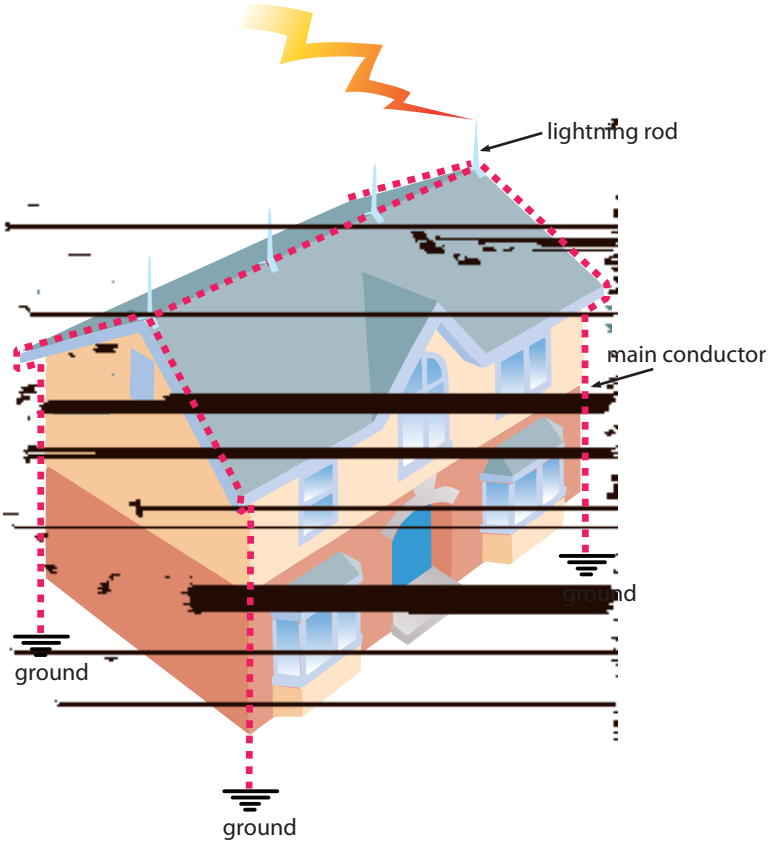

Figure 6 Lightning rods are common on homes and barns in the country, where large open areas make these buildings more vulnerable to lightning strikes.

UNIT TASK Bookmark

How can you apply what you have learned about grounding and releasing charges to the Unit Task described on page 586?

IN SUMMARY

- An electric discharge is the rapid transfer of electrons from one object to another.
- Electric discharges can produce visible sparks.
- Lightning is a visible and dramatic electric discharge.
- Lightning rods are used to safely direct lightning into the ground.

CHECK YOUR LEARNING

1. What precautions should you take before working with electronic equipment? Explain why. K/U
2. Suppose that you took off your sweater and noticed that your hair was standing up. Using six electrons as an example, and assuming that the electrons are transferred from the sweater to your hair, draw a series of diagrams showing how the excess electrons in your hair could be discharged
   (a) to your neutral hand
   (b) to the neutral ground K/U C
3. Recall a personal experience that involved an electric discharge. Explain how the information in this section has helped you understand your experience. C
4. What role does lightning play in nature? How do you think this might affect the economy? K/U A
5. Lightning sometimes happens between clouds. Suggest a possible way that a discharge can occur between clouds. K/U