

20-1 What is electric charge?

INVESTIGATE



Observing Electric Charges

HANDS-ON ACTIVITY

1. Blow up a rubber balloon. Tie the end into a knot.
2. Rub the balloon with a piece of wool or nylon.
3. Dim the lights in your classroom. Bring your finger near the balloon. Observe what happens between the balloon and your finger.

THINK ABOUT IT: What did you observe between your finger and the balloon? Has something like this ever happened to you before?



Objective

Explain how objects become electrically charged.

Key Terms

proton: atomic particle with a positive electric charge

electron: atomic particle with a negative electric charge

neutron: atomic particle with neither a negative nor a positive electric charge

static electricity: buildup of electric charges in an object

Atoms You have learned that all matter is made up of atoms. The three basic parts of an atom are protons, neutrons, and electrons. Protons and neutrons are found in the nucleus of an atom, and electrons are found in the electron cloud that surrounds the nucleus.

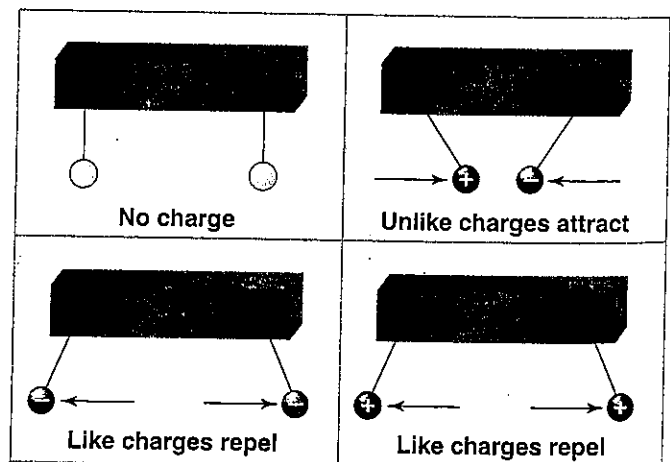
1 NAME: What are the three main parts of an atom?

Electric Charge Protons and electrons have a property called electric charge. Protons have positive electric charge (+). Electrons have negative electric charge (-). The strength of the positive electric charge on a proton is the same as the strength of the negative electric charge on an electron. Neutrons do not have charge. They are neutral.

Electric charge is not a physical property that can be seen or touched. However, electric charge exerts a force that affects the behavior of matter. Matter that is electrically charged follows these rules:

- Objects with like charges repel, or push away, from each other.
- Objects with unlike charges attract each other.

Because they have opposite charges, protons and electrons attract each other. However, because they have the same electric charge, protons do not attract each other. They repel, or push away, from each other. Electrons also repel each other.



▲ Figure 20-2 How electric charges behave

2 EXPLAIN: How do protons and electrons affect each other?

Neutral Objects Although an atom is made up of electrically charged particles, the atom as a whole has no electric charge. The number of protons and the number of electrons in an atom is always the same. Therefore, the electric charges cancel each other. The atom is neutral.

Most matter is electrically neutral. However, neutral objects can become electrically charged. An object becomes electrically charged when its atoms lose or gain electrons. The electrons in the atoms of some matter are held loosely to the atoms. If these electrons are separated from their atoms, the atoms become electrically charged. For example, when you walk across a carpet, your feet can rub off and pick up electrons from the carpet. Your body then gets a small electric charge. If you then touch a metal doorknob, electrons can jump from your hand to the doorknob. You can see a spark.

3 DESCRIBE: Why are atoms usually neutral?

Static Electricity Protons are held tightly in the nucleus of all atoms. However, electrons are free to move from a region of negative electric charge to a region of positive electric charge. The buildup of electric charges on an object is called **static electricity**. The word *static* means "not moving." In static electricity, electrons do not flow. They remain at rest for a time but will eventually leave the object.

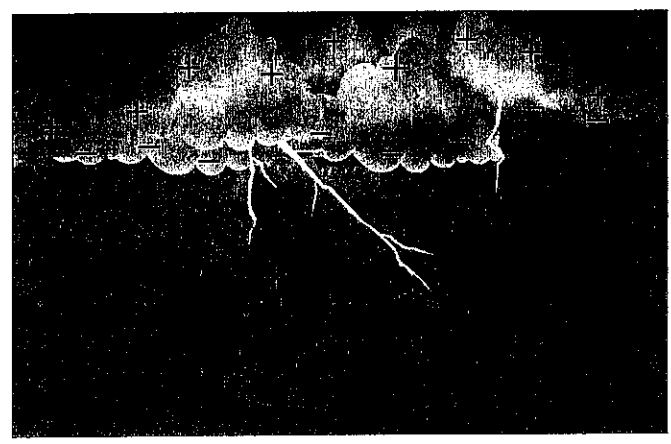
Static electricity can be produced when different materials rub against each other. For example, if a sock and a shirt rub against each other in a clothes dryer, electrons may be transferred between both items. The sock may lose some of its electrons to the shirt and become positively charged. The shirt gains these electrons and becomes negatively charged. Because the sock and the shirt have opposite charges, they stick to each other. This attraction is called static cling.

4 INFER: Why can a sock stick to a shirt after coming out of a clothes dryer?

Static Discharge Objects that have static electricity will eventually lose their charge. The extra electrons will move onto other objects, and the original object will return to its neutral condition. The loss of static electricity is called static discharge.

A dramatic example of static discharge is lightning. During a storm, water particles in clouds swirl around and rub against each other. This

friction produces electric charges in different areas of the clouds. The negative area of the cloud repels the negatively charged electrons on the surface of the ground below. The surface of the ground then becomes positively charged. An attraction develops between the negatively charged area of the cloud and the positively charged ground. If the force of attraction becomes great enough, electrons from the cloud will jump to the ground. When this happens, a spark of lightning is produced.



▲ Figure 20-3 The force of attraction between charges in clouds and the ground can produce lightning.

5 EXPLAIN: How does lightning occur?

✓ CHECKING CONCEPTS

1. An electron has a _____ charge.
2. A _____ object has neither a positive nor a negative charge.
3. Static electricity is the buildup of _____ on an object.
4. Two electrons will _____ each other.

💡 THINKING CRITICALLY

5. **EXPLAIN:** What can happen if you walk across a carpet and then touch a metal doorknob?
6. **INFER:** Why is the buildup of electric charge on an object called static electricity?

INTERPRETING VISUALS

- Use Figure 20-2 to answer the following questions.
7. **INFER:** How do like charges behave?
 8. **EXPLAIN:** How do objects without a charge behave?