

# 9.2

## Charging by Friction, Conduction, and Induction

There are three ways in which objects become electrically charged: by friction, by conduction (contact), and by induction. **Charging by friction** occurs when two objects are rubbed together. For example, large amounts of electric charge build up on clothes as they tumble against each other in a dryer. Friction causes electric charges to be transferred from one object to another. **9A Investigation**

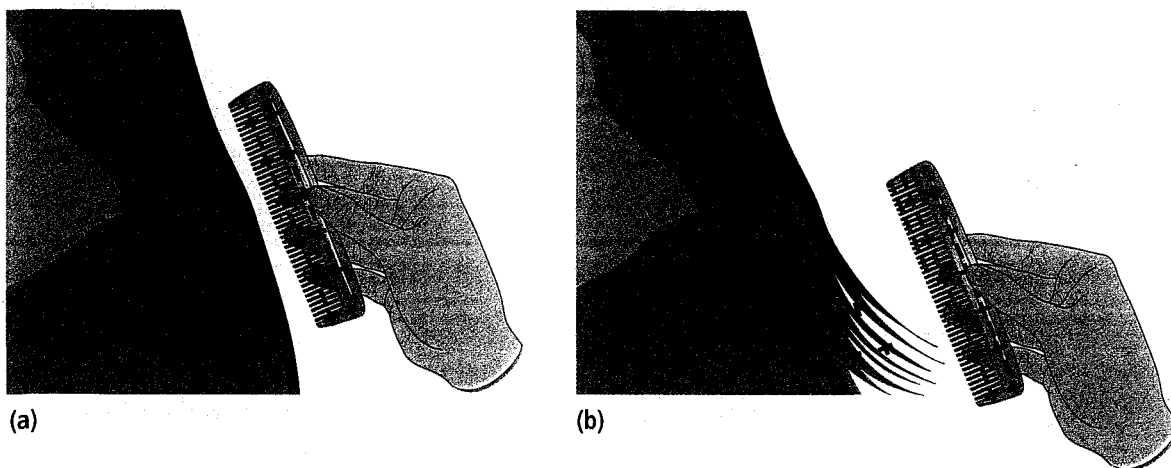
For example, in Figure 1(a), the hair and the comb have equal numbers of protons and electrons, and are both neutral. When they are rubbed together, the polyethylene atoms that make up the comb have a stronger attraction for electrons than the atoms that make up the hair. The rubbing brings more of the hair in contact with the comb, allowing the transfer of significantly more electrons. The excess negative charge builds up on the comb, while the hair becomes positively charged because it loses some electrons (Figure 1(b)).

### 9A Investigation

#### Charging by Friction

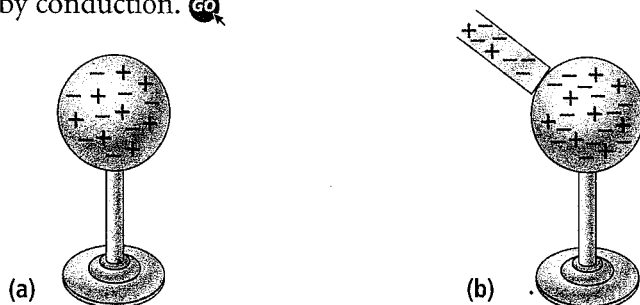
To perform this investigation, turn to page 292.

In this investigation, you will use friction to charge objects, and then determine if there is a positive or negative charge.



**Figure 1** (a) The comb and the hair are both neutral (b) After being rubbed together, the comb is negatively charged and the hair is positively charged. Only the electrons move during the transfer of electric charge.

Objects also become charged through conduction, or contact. **Charging by conduction** occurs when objects touch and an electric charge is transferred from one object to the other. For example, if you walk across a carpet and get a spark by touching a metal doorknob, you are transferring some of your charge to the doorknob by conduction. Figure 2 shows a metal sphere being charged by conduction. **GO**



If you would like to learn more about charging by conduction, go to [www.science.nelson.com](http://www.science.nelson.com)

## TRY THIS: Induced Charges

**Skills Focus:** creating models, observing

In this activity, you will determine if an object can be charged without direct contact.

**Materials:** 2 aluminum spheres on stands, vinyl strip, paper towels, pith ball on a thread

1. Position the 2 aluminum spheres so they are touching each other.
2. Rub a vinyl strip with a paper towel. The vinyl strip is now negatively charged. (Refer to the electrostatic series on page 276.) Bring the negatively charged vinyl strip close to one of the spheres (Figure 3).

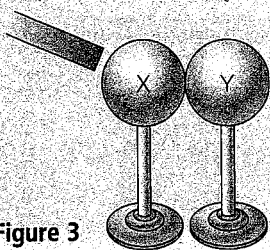


Figure 3

3. Move the two spheres apart, and then take the vinyl strip away.

4. Rub the vinyl strip with a paper towel to charge it negatively. Use the strip to give a hanging pith ball a negative charge. Bring the negatively charged pith ball close to sphere X (Figure 4). Record what happens to the pith ball.

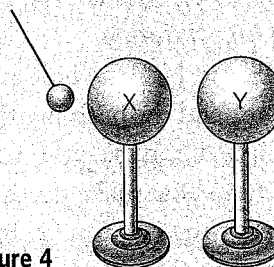


Figure 4

5. Now bring the negatively charged pith ball near sphere Y. Record what happens to the pith ball.
  - A. What happened when you moved the charged pith ball toward sphere X and toward sphere Y? Explain your observations.
  - B. Draw a series of diagrams to show the movement of charge on the spheres in steps 2, 4, and 5.

### LEARNING TIP

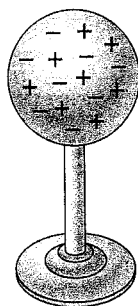
If you find yourself reading without understanding, stop and ask why. Do you understand the key terms? Slowly reread the part that you did not understand.

If you would like to learn more about charging by induction, go to

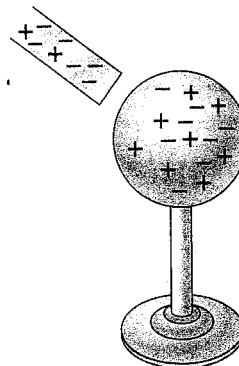
[www.science.nelson.com](http://www.science.nelson.com)



When objects are charged without touching or making any direct contact, the process is called **charging by induction**. An example of this process is the buildup of dust on the screen of a television or computer monitor. When a screen is turned on, it begins to build up a charge. When a neutral dust particle comes near the screen, the screen induces an opposite charge on the near side of the dust particle and a similar charge on the far side. The dust is attracted to the screen. Figure 5 shows a metal sphere being charged by induction.



(a)



(b)

**Figure 5** (a) A neutral metal sphere (b) When a negatively charged bar comes near the sphere, the charge on the bar causes, or induces, the electrons on the sphere to change their position.

**CHECK YOUR Understanding**

1. Explain how an object becomes charged by friction. Use diagrams in your answer.
2. Write your own definition of charging by conduction.
3. Write your own definition of charging by induction.
4. When an object is charged by contact, what kind of charge does the object have compared with the charge on the object giving the charge?
5. Use a diagram to show the result when a negatively charged object touches an uncharged pith ball.
6. What are the differences between charging objects by conduction and by induction? Give an example of each method.
7. Can a positive object be used to give a second object a negative charge by conduction? Can induction be used to make the second object negative? Explain your answers using words or diagrams.
8. When you are in bed at night in the dark and rub your feet on the sheets, you may observe tiny flashes of light. Give an explanation for this observation. You may also see this effect if you pull clear tape from a roll in the dark. How are these two effects the same?
9. Describe how you could determine whether the static charge on a sock from a clothes dryer is positive or negative (Figure 6).

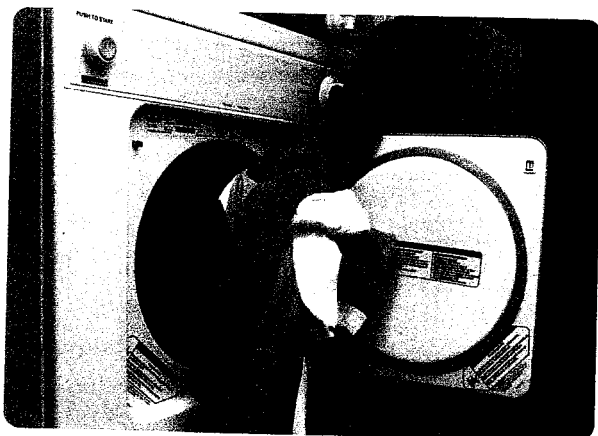


Figure 6

10. Figure 7(a) shows a metal sphere being charged by induction using a positively charged rod. Figure 7(b) shows a finger touching the metal sphere to discharge it. In Figure 7(c), both the rod and the finger have been taken away. Copy the three diagrams into your notebook. Using red positive signs and blue negative signs, show how the sphere becomes charged in each diagram.

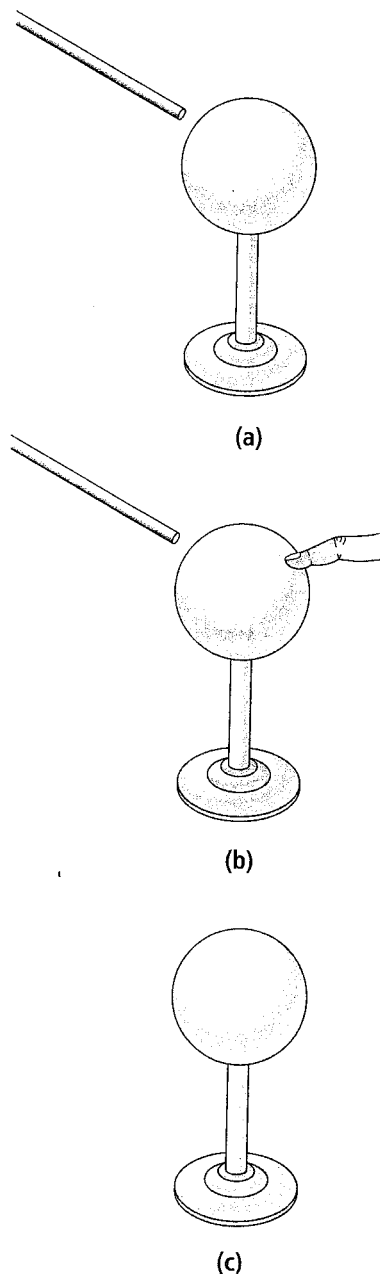


Figure 7