Quick Lab

Polarization

MATERIALS LIST

- **plastic comb**
- **water faucet**

Turn on a water faucet, and adjust the flow of water so that you have a small but steady stream. The stream should be as slow as possible without producing individual droplets. Comb your hair vigorously. Hold the charged end of the comb near the stream without letting the comb get wet. What happens to the stream of water? What might be causing this to happen?

Conductors can be charged by induction

When a conductor is connected to Earth by means of a conducting wire or copper pipe, the conductor is said to be *grounded.* The Earth can be considered to be an infinite reservoir for electrons because it can accept an unlimited number of electrons. This fact is the key to understanding another method of charging a conductor.

Consider a negatively charged rubber rod brought near a neutral (uncharged) conducting sphere that is insulated so that there is no conducting path to ground. The repulsive force between the electrons in the rod and those in the sphere causes a redistribution of negative charge on the sphere, as shown in **Figure 4(a).** As a result, the region of the sphere nearest the negatively charged rod has an excess of positive charge.

If a grounded conducting wire is then connected to the sphere, as shown in **Figure 4(b),** some of the electrons leave the sphere and travel to Earth. If the wire to ground is then removed while the negatively charged rod is held in place, as shown in **Figure 4(c),** the conducting sphere is left with an excess of induced positive charge. Finally, when the rubber rod is removed from the vicinity of the sphere, as in **Figure 4(d),** the induced net positive charge remains on the ungrounded sphere. The motion of negative charges on the sphere causes the charge to become uniformly distributed over the outside surface of the ungrounded sphere. This process is known as **induction,** and the charge is said to be *induced* on the sphere.

Notice that charging an object by induction requires no contact with the object inducing the charge but does require contact with a third object, which serves as either a *source* or a *sink* of electrons. A sink is a system which can absorb a large number of charges, such as Earth, without becoming locally charged itself. In the process of inducing a charge on the sphere, the charged rubber rod did not come in contact with the sphere and thus did not lose any of its negative charge. This is in contrast to charging an object by contact, in which charges are transferred directly from one object to another.

induction

the process of charging a conductor by bringing it near another charged object and grounding the conductor

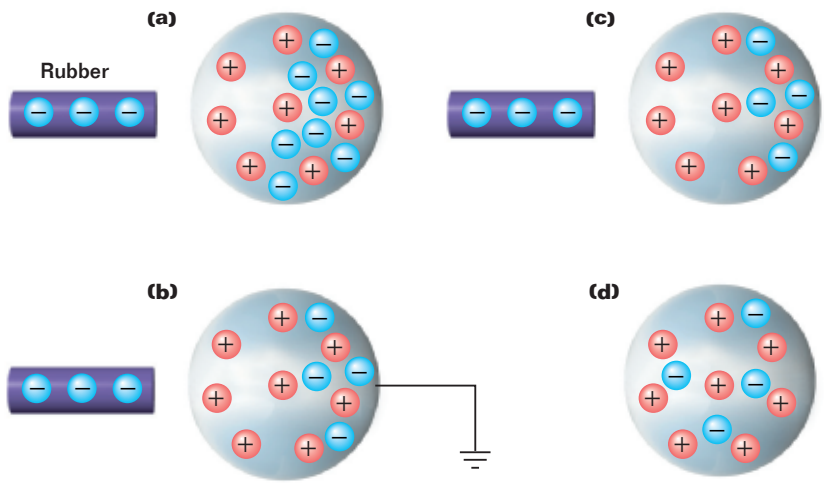

Figure 4
(a) When a charged rubber rod is brought near a metal sphere, the electrons move away from the rod, and the charge on the sphere becomes redistributed. **(b)** If the sphere is grounded, some of the electrons travel through the wire to the ground. **(c)** When this wire is removed, the sphere has an excess of positive charge. **(d)** The electrons become evenly distributed on the surface of the sphere when the rod is removed.