SECTION 1

Electricity from Magnetism

SECTION OBJECTIVES

- **Recognize that relative motion between a conductor and a magnetic field induces an emf in the conductor.**
- **Describe how the change in the number of magnetic field lines through a circuit loop affects the magnitude and direction of the induced electric current.**
- **Apply Lenz's law and Faraday's law of induction to solve problems involving induced emf and current.**

electromagnetic induction

the process of creating a current in a circuit loop by changing the magnetic flux in the loop

ELECTROMAGNETIC INDUCTION

Recall that when you were studying circuits, you were asked if it was possible to produce an electric current using only wires and no battery. So far, all electric circuits that you have studied have used a battery or an electrical power supply to create a potential difference within a circuit. The electric field associated with that potential difference causes charges to move through the circuit and to create a current.

It is also possible to *induce* a current in a circuit without the use of a battery or an electrical power supply. You have learned that a current in a circuit is the source of a magnetic field. Conversely, a current results when a closed electric circuit moves with respect to a magnetic field, as shown in **Figure 1.** The process of inducing a current in a circuit by changing the magnetic field that passes through the circuit is called **electromagnetic induction.**

Consider a closed circuit consisting of only a resistor that is in the vicinity of a magnet. There is no battery to supply a current. If neither the magnet nor the circuit is moving with respect to the other, no current will be present in the circuit. But, if the circuit moves toward or away from the magnet or the magnet moves toward or away from the circuit, a current is induced. As long as there is relative motion between the two, a current is created in the circuit.

The separation of charges by the magnetic force induces an emf

It may seem strange that there can be an induced emf and a corresponding induced current without a battery or similar source of electrical energy. Recall from the previous chapter that a moving charge can be deflected by a magnetic field. This deflection can be used to explain how an emf occurs in a wire that moves through a magnetic field.

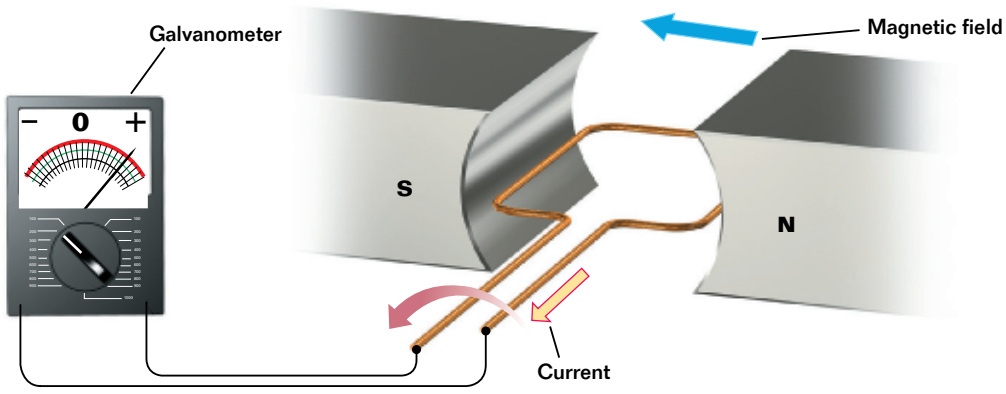

Figure 1
When the circuit loop crosses the lines of the magnetic field, a current is induced in the circuit, as indicated by the movement of the galvanometer needle.