SECTION 2

Magnetism from Electricity

SECTION OBJECTIVES

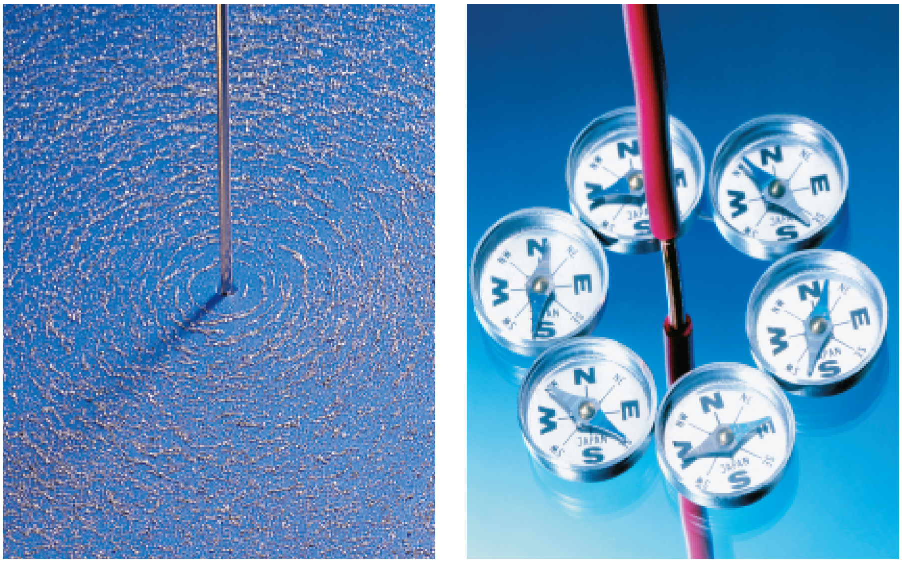
- **Describe the magnetic field produced by current in a straight conductor and in a solenoid.**
- **Use the right-hand rule to determine the direction of the magnetic field in a current-carrying wire.**

MAGNETIC FIELD OF A CURRENT-CARRYING WIRE

Scientists in the late 1700s suspected that there was a relationship between electricity and magnetism, but no theory had been developed to guide their experiments. In 1820, Danish physicist Hans Christian Oersted devised a method to study this relationship. Following a lecture to his advanced class, Oersted demonstrated that when brought near a current-carrying wire, a compass needle is deflected from its usual north-south orientation. He published an account of this discovery in July 1820, and his work stimulated other scientists all over Europe to repeat the experiment.

A long, straight, current-carrying wire has a cylindrical magnetic field

The experiment shown in **Figure 5(a)** uses iron filings to show that a current-carrying conductor produces a magnetic field. In a similar experiment, several compass needles are placed in a horizontal plane near a long vertical wire, as illustrated in **Figure 5(b).** When no current is in the wire, all needles point in the same direction (that of Earth's magnetic field). However, when the wire carries a strong, steady current, all the needles deflect in directions tangent to concentric circles around the wire. This result points out the direction of **B,** the magnetic field *induced* by the current. When the current is reversed, the needles reverse direction.



(a) (b)

Figure 5
(a) When the wire carries a strong current, the alignments of the iron filings show that the magnetic field induced by the current forms concentric circles around the wire. **(b)** Compasses can be used to show the direction of the magnetic field induced by the wire.