The right-hand rule can be used to determine the direction of the magnetic field

These observations show that the direction of **B** is consistent with a simple rule for conventional current, known as *the right-hand rule:* If the wire is grasped in the right hand with the thumb in the direction of the current, as shown in **Figure 6,** the four fingers will curl in the direction of **B.**

As shown in **Figure 5(a),** the lines of **B** form concentric circles about the wire. By symmetry, the magnitude of **B** is the same everywhere on a circular path centered on the wire and lying in a plane perpendicular to the wire. Experiments show that **B** is proportional to the current in the wire and inversely proportional to the distance from the wire.

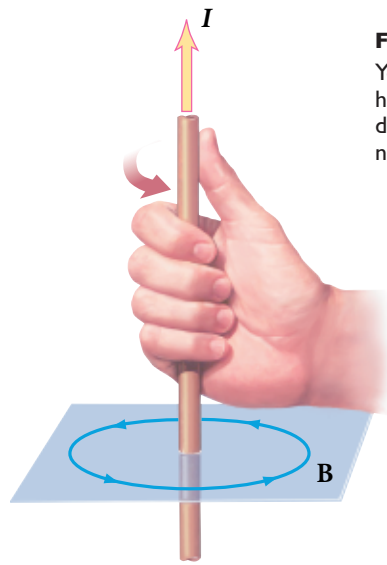


Figure 6
You can use the right-hand rule to find the direction of this magnetic field.

MAGNETIC FIELD OF A CURRENT LOOP

The right-hand rule can also be applied to find the direction of the magnetic field of a current-carrying loop, such as the loop represented in **Figure 7(a).** Regardless of where on the loop you apply the right-hand rule, the field within the loop points in the same direction—upward. Note that the field lines of the current-carrying loop resemble those of a bar magnet, as shown in **Figure 7(b).** If a long, straight wire is bent into a coil of several closely spaced loops, as shown on the next page in **Figure 8,** the resulting device is called a **solenoid.**

solenoid
a long, helically wound coil of insulated wire

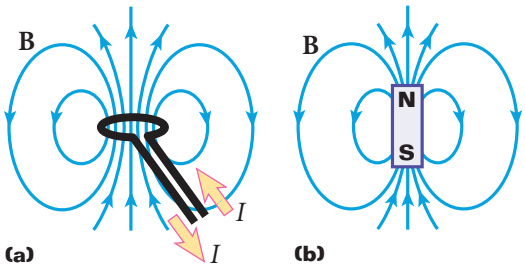


Figure 7
(a) The magnetic field of a current loop is similar to **(b)** that of a bar magnet.

Quick Lab

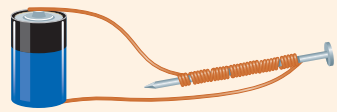
Electromagnetism

MATERIALS LIST

- **D-cell battery**
- **1 m length of insulated wire**
- **large nail**
- **compass**
- **metal paper clips**

Wind the wire around the nail, as shown below. Remove the insulation from the ends of the wire, and hold these ends against the metal terminals of the battery.

Use the compass to determine whether the nail is magnetized. Next, flip the battery so that the direction of the current is reversed. Again, bring the compass toward the same part of the nail. Can you explain why the compass needle now points in a different direction?



Bring paper clips near the nail while connected to the battery. What happens to the paper clips? How many can you pick up?