Change in the number of magnetic field lines induces a current

So far, you have learned that moving a circuit loop into or out of a magnetic field can induce an emf and a current in the circuit. Changing the size of the loop or the strength of the magnetic field also will induce an emf in the circuit.

One way to predict whether a current will be induced in a given situation is to consider how many magnetic field lines cut through the loop. For example, moving the circuit into the magnetic field causes some lines to move into the loop. Changing the size of the circuit loop or rotating the loop changes the number of field lines passing through the loop, as does changing the magnetic field's strength or direction. **Table 1** summarizes these three ways of inducing a current.

Did you know?

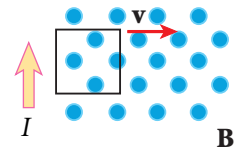
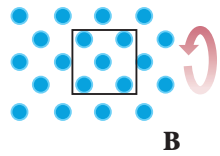
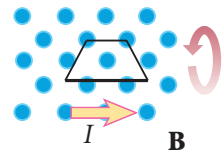
In 1996, the space shuttle *Columbia* attempted to use a 20.7 km conducting tether to study Earth's magnetic field in space. The plan was to drag the tether through the magnetic field, inducing an emf in the tether. The magnitude of the emf would directly vary with the strength of the magnetic field. Unfortunately, the tether broke before it was fully extended, so the experiment was abandoned.

CHARACTERISTICS OF INDUCED CURRENT

Suppose a bar magnet is pushed into a coil of wire. As the magnet moves into the coil, the strength of the magnetic field within the coil increases, and a current is induced in the circuit. This induced current in turn produces its own magnetic field, whose direction can be found by using the right-hand rule. If you were to apply this rule for several cases, you would notice that the induced magnetic field direction depends on the change in the applied field.

As the magnet approaches, the magnetic field passing through the coil increases in strength. The induced current in the coil is in a direction that produces a magnetic field that opposes the increasing strength of the approaching field. So, the induced magnetic field is in the opposite direction of the increasing magnetic field.

Table 1 Ways of Inducing a Current in a Circuit

Description	Before	After
Circuit is moved into or out of magnetic field (either circuit or magnet moving).		
Circuit is rotated in the magnetic field (angle between area of circuit and magnetic field changes).		
Intensity and/or direction of magnetic field is varied.