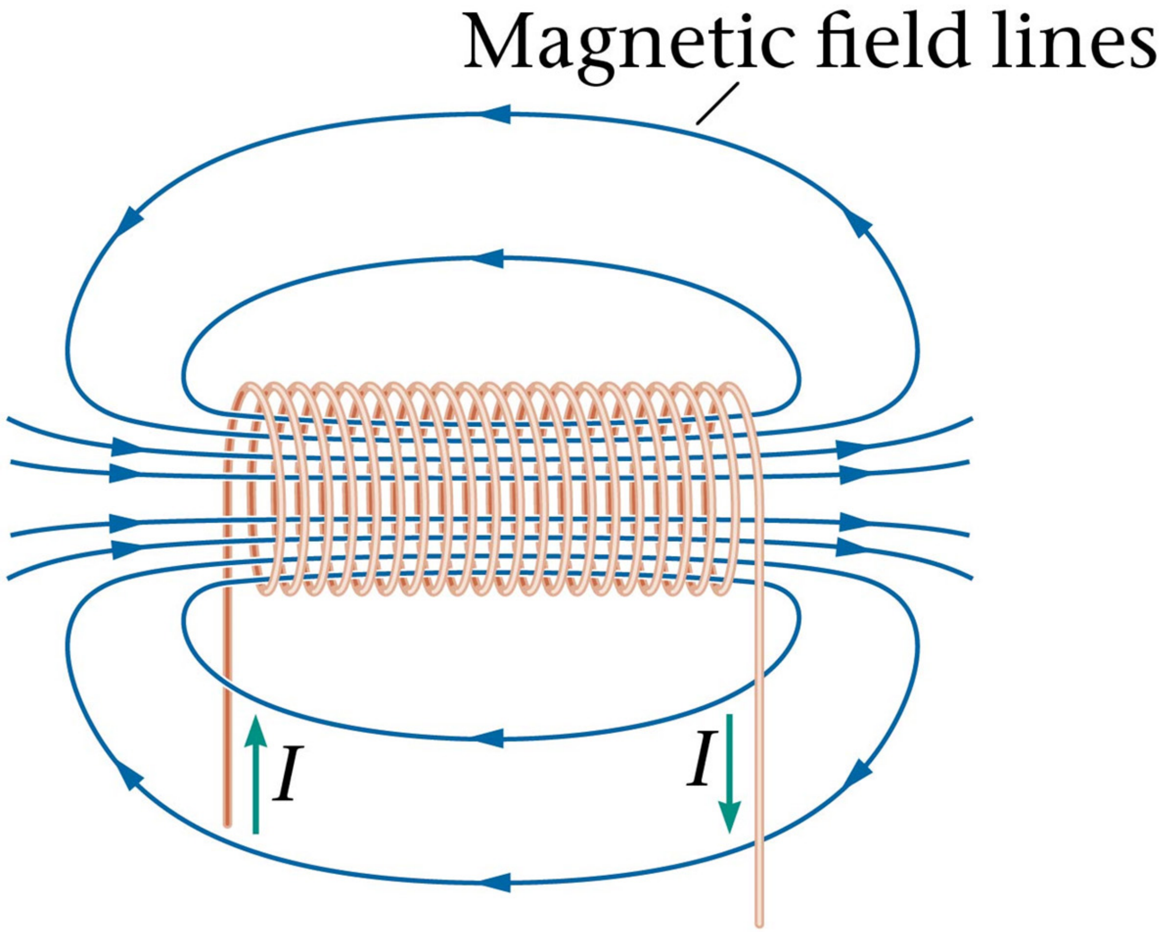
FIGURE 75



A solenoid with current running through it will create a magnetic field around it. Due to the shape of the solenoid, the field will resemble that of a bar magnet, with each end of the solenoid being the opposite poles.

Using Ampere's law, we can derive the following expression for the magnetic field inside a solenoid:

$$B = \mu_o I \left(\frac{N}{L}\right)$$

In this equation, L is the length of the solenoid, and N is the number of loops. Similar to our application of Gauss's law to a sheet of charge, here our result is completely independent of position, as long as the position is inside the solenoid, a constant value that only depends on the physical properties of the object.

Miniature solenoids are used in all kinds of electric circuits (more on that later). On a larger scale, the tube in an MRI machine is a giant solenoid. The currents in an MRI machine are high enough to produce a magnetic field between 1 and 2 teslas, which is actually very powerful. So powerful, in fact, that any metal objects in the vicinity of an MRI machine can become dangerous projectiles while the machine is in operation as these objects become magnetized and pulled by the magnetic field (Figure 76).[11]