Two parallel conducting wires exert a force on one another

Because a current in a conductor creates its own magnetic field, it is easy to understand that two current-carrying wires placed close together exert magnetic forces on each other. When the two conductors are parallel to each other, the direction of the magnetic field created by one is perpendicular to the direction of the current of the other, and vice versa. In this way, a force of $F_{magnetic} = BI\ell$ acts on each wire, where B is the magnitude of the magnetic field created by the other wire.

Consider the two long, straight, parallel wires shown in **Figure 12.** When the current in each is in the same direction, the two wires attract one another. Confirm this by using the right-hand rule. Point your thumb in the direction of current in one wire, and point your fingers in the direction of the field produced by the other wire. By doing this, you find that the direction of the force (pointing out from the palm of your hand) is toward the other wire. When the currents in each wire are in opposite directions, the wires repel one another.

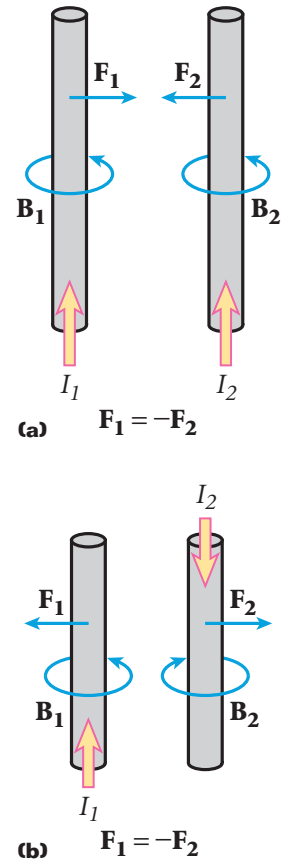

Figure 12
Two parallel wires, each carrying a steady current, exert magnetic forces on each other. The force is **(a)** attractive if the currents have the same direction and **(b)** repulsive if the two currents have opposite directions.

Loudspeakers use magnetic force to produce sound

The loudspeakers in most sound systems use a magnetic force acting on a current-carrying wire in a magnetic field to produce sound waves. One speaker design, shown in **Figure 13,** consists of a coil of wire, a flexible paper cone attached to the coil that acts as the speaker, and a permanent magnet. In a speaker system, a sound signal is converted to a varying electric signal by the microphone. This electrical signal is amplified and sent to the loudspeaker. At the loudspeaker, this varying electrical current causes a varying magnetic force on the coil. This alternating force on the coil results in vibrations of the attached cone, which produce variations in the density of the air in front of it. In this way, an electric signal is converted to a sound wave that closely resembles the sound wave produced by the source.

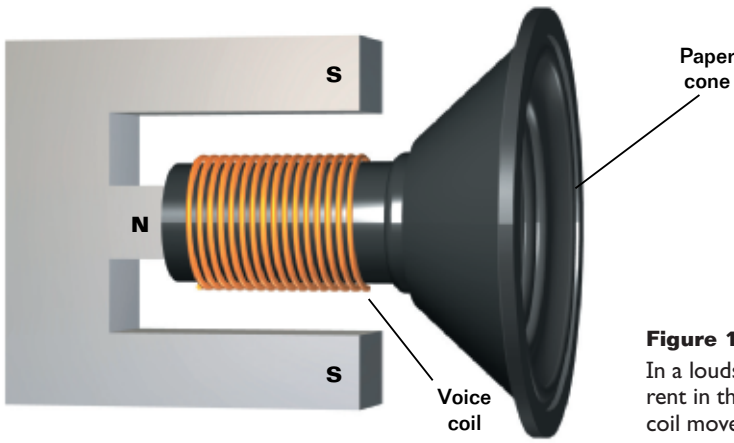

Figure 13
In a loudspeaker, when the direction and magnitude of the current in the coil of wire change, the paper cone attached to the coil moves, producing sound waves.