

## Cup Speaker

With a wire coil, a headphone plug, and a few magnets, make your own simple speaker, which will transmit sound from a radio or MP3 player.

### What Do I Need?

- At least 2 feet (about 60 cm) coated copper magnet wire, 24 gauge or higher (thinner)
- 2 (or more) ceramic donut magnets (we recommend 1 1/8" magnets)
- MP3 player, CD player, or radio with headphone jack
- a mini mono-phone plug (purchased or recycled from another item that fits into a headphone jack; you just need the wire with the plug on it that fits into an MP3 player, CD player, or radio)
- 2 alligator clip connectors (we recommend 1/4" clips)
- a cup (plastic or paper)
- sandpaper
- scissors
- tape
- pen, pencil, or marker (used for winding the magnet wire).

### What Do I Do?

- 1.** Cut a length of about 2 feet (about 60 cm) of wire.
- 2.** Since the wire is coated, use the sandpaper to scrape away about one inch (2 cm) of the coating on both ends of the wire.
- 3.** Wrap the coated part of the wire around the pen, pencil, or marker to make a coil, leaving 4 inches (10 cm) of magnet wire free at each end.
- 4.** Twist the bare ends of the wire together several times to fix the coil in place.
- 5.** Remove the coil from the pen, pencil, or marker. You should now have a loop of wire with two bare ends sticking out from the twisted section.
- 6.** Tape the coil flat to the outside bottom of the cup, making sure to keep the loose ends of wire free.

- 7.** Connect one end of each alligator clip to each loose end of the wire.
- 8.** With the scissors, strip the plastic coating off the end of the mini mono-phone plug wire and separate the two strands. (If there's a third ground wire in there, just bundle it with one of the other strands.)
- 9.** Connect the free ends of each alligator clip to each wire on the mini mono-phone plug.
- 10.** Turn on the MP3 player, CD player, or radio.
- 11.** Plug the mini mono-phone plug into the MP3 player, CD player, or radio. Turn the volume up a bit louder than you normally would.
- 12.** With one hand, hold the cup to your ear.
- 13.** With your other hand, bring the magnets near the coil of wire.
- 14.** You should now be able to hear music coming from your cup speaker.

## How does it sound?

You might notice that the sound in your homemade cup speaker isn't as good as the sound from a speaker you'd buy. But there are ways to make the sound quality better. The sound quality of your cup speaker is affected by

- how many times you wrap your coil and how tightly the coil is wound
- the quality of the magnet wire (thinner is better, and coated is a must, since uncoated wire creates a short-circuit)
- the quality of your magnets (strong neodymium magnets are best)
- how many magnets you use (we suggest two, but you can use more)
- what your cup is made of (cardboard and Styrofoam, for example, produce different sounds).

Experiment with various types of materials and different ways of putting it all together to see if you can improve your homemade cup speaker!

## What's Going On?

When you plug the headphone cable in to your sound source, the sound (in the form of an electric current) goes out the wire, through the coil, and out the other end. When electric current goes through a coil of wire, the coil of wire becomes an electro-magnet. When electric current goes around the loop clockwise there is a south magnetic pole nearest you; when the electric current reverses there is a north magnetic pole.

When the south magnetic pole of a magnet is near the coil of wire it will attract a north pole and repel a south pole of the coil electromagnet. The coil will move toward and away from the magnet, depending on the direction of the electric current. Because the coil is attached to the cup, the cup will also move toward and away from the magnet.

The paper bottom of the cup will push air back and forth, creating sounds that will travel through the air to your ear. The bare wire itself does not move much air, and so does not make much sound. However, if the coil is attached to a large, low-mass material, it will vibrate that material, which in turn will vibrate the air, making a louder sound.