Build a Plate Speaker

In this activity from Make Magazine, students build a speaker out of a foam plate, wire, and a magnet. Through this, they learn how sound truly is a series of vibrations, and how speakers take those vibrations and send them to our ears!

Materials

- Foam plate (paper or plastic just don’t work well!)
- 2 strips of paper (0.5” by 11” each)
- 2 Business cards
- Copper wire (32 gauge, enameled)
- Tape
- Hot glue
- Scissors
- Wire cutters/stripers
- 1 Neodymium magnet (or 3 stacked together, if they are thin)
- Audio plug
- Flat piece of wood or cardboard (large enough to fully cover the foam plate)
- Old headphones

Instructions

Take one of the two paper strips and wrap it tight around the magnet. Tape the coiled paper closed, but be careful not to tape the paper to the magnet. Next, repeat by rolling the second paper strip around the first. Tape this strip closed, too, but again, be careful not to tape it to the magnet or to the first strip of paper. Then remove the magnet from the paper coils.

You now have a cylinder made of paper. Use the hot glue and glue the paper cylinder to the center of the back of the foam plate. It should stand upright, so the magnet can slide back into it. Once it is glued down and the glue is dry enough, slide the magnet back into the cylinder.

Next, take the copper wire (remember that it must be enameled and 32 gauge) and begin to wind it around the paper cylinder...
the cylinder, leaving some extra wire at the end. Wrap the wire 50 times around the cylinder, and then cut it with a few inches extra sticking out. Now, there should be coiled wire around the cylinder with a few inches of spare wire on either side. Use tape to secure the wire to the coil you just made.

Next, remove the magnet once again. Then, carefully remove the inner roll of paper. It’s okay if the inner roll rips when you remove it, but do not damage the outer roll.

Now, take the two business cards and fold them accordion-style into W shapes. Glue one end of each business card to the back of the foam plate on either side of the wire cylinder. Make sure the business cards are parallel and stick up symmetrically. Also make sure each card is completely glued, with no corners sticking up. This will eventually allow for the plate to bounce up and down as it vibrates.

Put the magnet back into the cylinder. Dab a few drops of glue onto the free end of the magnet and also onto the free ends of the business cards. Position the piece of wood or cardboard on top of all of this, evenly covering the foam plate and resting on the now-glue-covered ends of the magnet and business cards. The wood or cardboard is going to act as the speaker’s base.

Flip everything over so that the wood or cardboard is now on the table and the foam plate is face up. The magnet should fall down to the wood/cardboard, hitting it with its glue-covered side and sticking to the wood/cardboard base. The magnet must not touch any of its surrounding paper coil.

Make sure the two ends of the wire coming from the coil are separated and stripped. This can be tricky, so look for the color change when the wire has been properly stripped. A lighter can also be used to assist in stripping the enamel.

Take the audio plug, use wire cutters to cut and strip the two wires within it as well, and then connect each wire to one of the coil wires.

Once the glue has dried, the speaker is ready to be used!

Visit this youtube video for visual instruction: Styrofoam Plate Speaker

Visit this web page for additional instructions: Make Magazine’s Styrofoam Plate Speaker
To Use

Plug the audio jack into an mp3 player or stereo and turn the volume up to max. Put your ear close to the plate and feel for vibrations to see if you were successful or not. Experiment with plate shape and materials for different results!

Troubleshooting

Test your speaker by touching the speaker wires to the ends of a AA or AAA battery. Do not hold the wires directly! Just touch them to the ends of the battery. If the speaker makes a noise, it is working. If it doesn’t, there might be an issue with the wiring.

If the speaker sounds awful, make sure nothing is touching the wires. Also check to make sure the business cards are completely glued down with no corners sticking up. Finally, make sure the paper coil is not touching the base of the speaker and that the magnet is not touching the paper coil (though do make sure the magnet is as close as possible to the paper coil!).

Once working, cover the stripped wires with a bit of hot glue to keep them safely protected!

How it Works

The paper plate speaker works for two reasons:

1) Electricity and magnets are related
2) Sound is vibration

What’s the connection?

The most important parts of your paper plate speaker are the coil of wire and the magnet. Many people know that magnets have a north pole and a south pole, and that like poles repel while opposite poles attract. What is less well known is that you can turn a coil of wire into a magnet by sending an electric current through it. When the
current flows, your coil is a magnet. When the current stops, it goes back to being just a regular coil of wire. The stronger the current, the stronger the magnetic force. Also, if you change the direction of the current, you change which side of the coil is the north pole and which is the south pole. If you could hook your coil up to a machine that would send an electric current through your coil in one direction and then in the other then you could make your coil push on another magnet and then very quickly pull as the current changed direction. If your machine could flip-flop the current really fast, then you could make lots and lots of little pushes and pulls, one right after the other. If your machine could also send a strong current or a weak current, then you could push or pull with more force or less force. Well, that’s what an MP3 player or a stereo does. It turns a computer file or the information stored on a CD and turns it into a series of pulses of electrical current, first in one direction and then the other. When you crank up the volume, the current gets stronger and the coil in your speaker pushes and pulls with more force.

Your coil is attached to the plate, so when your coil moves back and forth, it carries the plate with it. Remember, sound is vibration. When you wiggle the coil and plate back and forth you’re making a vibration, and if those wiggles are fast enough then you’re making vibrations our ears can hear. Enjoy!