Science Unit: ***Electricity with Applications***

Lesson 5: ***Speakers***

School Year:	2008/2009
Developed for:	General Gordon Elementary School, Vancouver School District
Developed by:	Scott Morgan (scientist); Bernard Wan and Nathalie Menard (teachers)
Grade level:	Presented to grade 6; appropriate for grades 5 - 7 with age appropriate modifications
Duration of lesson:	1 hour and 30 minutes (revise as needed)
Notes:	This unit assumes that the class has had a lesson on circuits. See the Scientist in Residence Program *Electricity with Applications* science unit, *Lesson 2, Series and Parallel Circuits*. http://scientistinresidence.ca/science-lesson-plans/ Keep the magnets away from any magnetic media such as credit cards, video or cassette tapes. **Safety:** Handle with care when working with two or more magnets at the same time; magnets can cause pinches; do not place near your head or eyes. Students should be asked to bring in a music playing device such as an iPod, MP3 player, or cell phone. There should be at least one for each two students or group. If there are not enough, groups can share. Earphones are not needed. **Vancouver Elementary School Teachers:** Please contact info@scientistinresidence.ca if you would like to inquire about the availability of materials and supplies for this science lesson.

Objectives

1. To learn how electromagnetism can be used to create motion that can be then applied to converting electrical energy into sound.
2. To learn how to make a simple speaker using only a piece of paper, magnet wire and a magnet.

Background Information

Sound – a definition

When you travel up a mountain or in an airplane, you feel it in your ears due to a change in air pressure. The air presses less in your ear than it does at sea level. The pressure inside your ear pushes more on your eardrum than does the air outside your ear. Only when you yawn or swallow does your body open a pathway from the outside air to the air inside your ear so that the air pressure can again become the same. Sound is created when something vibrates. The vibration moves the air around it back and forth which creates changes in air pressure. The air pressure changes move out in all directions. We call these *sound waves*. The speed of sound is 340 meters per second (1224 kilometers per hour). When the pressure changes reach your ears they move your ear drum, which your inner ear and brain receive as sound.

Speaker

One of the main uses of electrical energy is to create mechanical movement. In a speaker, electrical current in a wire creates a varying magnetic field that interacts with a stationary magnetic field, usually created by a magnet. The force created by the interacting field moves an element (typically paper) that moves the air, creating fluctuations in air pressure (sound).

In this lab we will build a speaker using the simplest possible components, paper, magnet wire and a magnet.

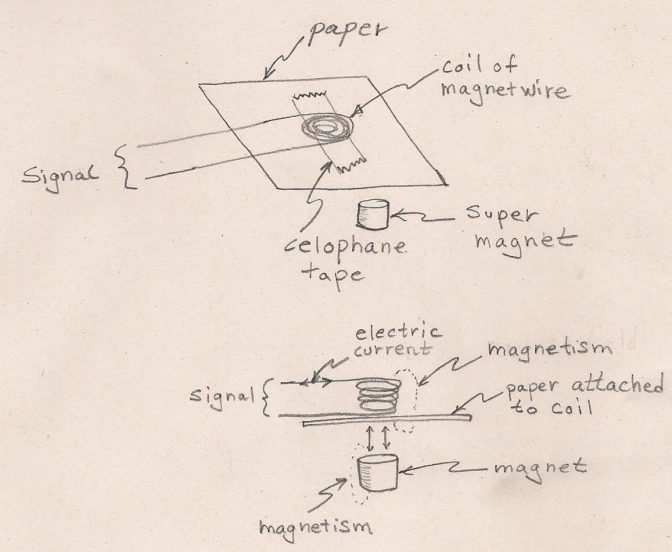

Diagram of Lab Speaker

Vocabulary

Sound	Vibrations that the ears can detect.
Sound waves	Pressure fluctuations that move through a medium (air, liquid, solid)
Speaker	A device for converting electrical energy into sound.
electromagnet	A magnet that can be turned on and off by with electrical current.
Magnet wire	Wire that is coated with an insulating lamination. It is used so that adjacent wires can touch without shorting.
Force	Something that changes the movement or shape of an object.

Materials (per group)

- 5 cm x 5 cm piece of paper
- 2 meter length of 34-gauge magnet wire, with lamination stripped 1 cm at ends.
- Music player (iPod, cell phone etc.) Earphones are not needed.
- Xacto knife or razor to bare ends of wire (teachers only!)
- Neodymium Magnets 1 cm high x 2 cm diameter
- scissors
- Cellophane tape
- Example of commercial speaker
- Patch cord with 3.5-mm audio plugs at one end and alligator clips at the other.

Material Sources

Main Electronic Supplies Ltd
4554 Main St.
Vancouver B.C. V5V 3R5
604 872 0267
www.mainelectronics.com

Lee Electronics
4522 Main St.
Vancouver, B.C. V5V 3R5
604 875 1993
www.leeselectronic.com

In the Classroom

Introductory Discussion

1. What Is sound (see definition above)? How fast does sound travel? Does it travel faster or slower than light? During a thunder storm, do you see the lightning first of hear the thunder? How do we hear sound? How do humans create sound with their voices? Activity: place hand on throat and speak. Do you feel vibrations? Can you make the sound of your voice more directional (cup hands around mouth to form a cone).

2. What is a speaker? How does it create vibrations? Are there any speakers in the room (PA system, CD player, computer speaker, television, cell phone). Show the commercial speaker.

Review that electrical current creates magnet fields and that magnet fields create forces (north attracts south, repels north, etc.). Current flowing in a coil of wire creates a magnetic field. More coils give a stronger magnet field.

3. Students will work in pairs to create a simple speaker.

Science Activity/Experiment

1. Each group will cut a 5 cm x 5 cm square of paper and tape a coil of magnet wire with 1-cm diameter at the centre. Leave 5cm uncoiled at the each end of the coil.

2. Connect an alligator clip to each of the coil wires. Plug in the 3.5-mm plug into the music source (iPod, etc.).

3. Play a music or sound program on the music device.

4. Hold the speaker directly over the magnet and put your ear over the speaker.

5. Sketch the circuit and label the parts.

6. Students will be asked if there is anything they can do to make the sound louder (turn up volume on music device, add magnets, add more loops in the coil).

Closure Discussion

1. How did you make the speaker louder (more coils, larger electrical signal, bigger or more magnets).
2. Can you think of a way to make your speaker more directional?
3. What did you learn? Did anything surprise you?

References

Lauw, Darlene and Cheng Puay Lim. 2002. Science Alive: Electricity. Crabtree Publishing, St. Catharines.

Meiani, Antonella. 2003. Electricity Experimenting with Science. Lerner Publications. Minneapolis.

Riley, Peter. 2008. The Real Scientist Investigates Electricity. Sea to Sea Publications. Manakato, Minnesota.

DK Science Encyclopedia. 1998. Pp. 128-137.DK Publishing Inc.

e.encyclopedia Science. 2004. DK Publiishing and Google.