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

Lesson 3: ***Buzzer***

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 series circuits. See the Scientist in Residence Program *Electricity with Applications* science unit, *Lesson 2, Series and Parallel Circuits*. http://scientistinresidence.ca/science-lesson-plans/
	It is highly recommended that power adapters be used instead of batteries. Batteries are not recommended because they can explode when shorted, are expensive and have a short life. Power adapters, on the other hand, are safer, last for years, contain circuits that protect them when shorted and cost much less per year of use. The typical 6-V battery used in schools costs $10 and lasts 1-2 years. A power adapter costs $20 - $30 but lasts for many years.
	Safety precaution: If using batteries, be careful not to short the terminals of the battery as it will damage the battery and there is a danger of explosion. In other words, do not connect the terminals of the battery directly with a low resistance element such as a wire or any piece of metal.
	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 electrical current creates a magnetic field.
2. To learn that practical applications, such as a buzzer, can arise from switching the electric field.

Background Information

Electrical current will flow from a source of electrical power, such as a battery or generator, back to its source if a path for current flow, such as a wire or conducting element. The arrangement of the electrical power source and the elements that allow current to flow back to it is called a circuit. Drawing current through a wire creates a magnetic field that encircles the wire. If the wire is formed in a coil the magnetic field is magnified by the number of turns of the coil. Placing the coil around an iron nail intensifies the magnetic field because the iron has the effect of making less resistance for the magnetic field. In this lab we use the coil of wire and a battery to create a magnetic field that can be turned off using a switch made from a piece of steel strapping. Steel strapping is used in the circuit in such a way that closing the circuit causes the magnetic field to pull on the strapping, which breaks the circuit. With the circuit broken, the steel strapping returns to its original position and again completes the circuit. In this way the circuit continually opens and closes, making a buzzing sound.

Vocabulary

Current	The movement of electrical charge.
Insulation	A material that does not conduct electricity.
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.

Materials per group

- Large iron nail (about 10-12 cm)
- 7.5 m of 28 gauge magnet wire
- Wood slat, 1”x4”x12”
- 5-volt, 5-amp power supply (A six volt battery may be used but see safety note above)
- 2 leads with alligator clips at each end.
- 30-cm strip of steel strapping
- 7-cm strip of steel strapping
- Xacto knife or razor to bare ends of wire (teachers only!)
- 3 x 2-cm wood screws
- 15-cm piece of insulated 12-gauge wire

5-cm piece of insulated 12-gauge wire

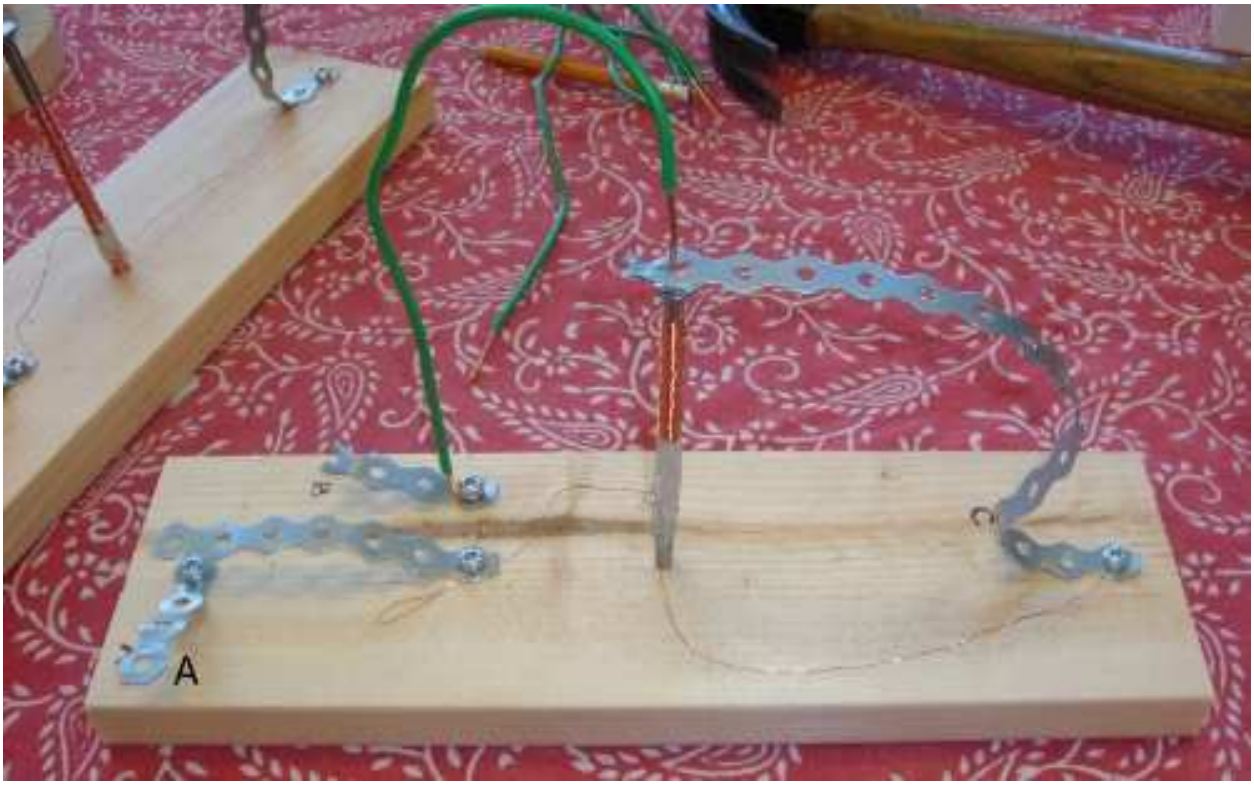
Tin snips or metal shears

Building the Kits

Refer to the kit layout in the figure below. Make the electromagnet by tightly wrapping the magnet wire around the nail, starting and finishing at the sharp end of the nail. Leave about 10 cm of magnet wire loose at each end. Use masking tape to keep the wire on the nail as shown. Scrape the lamination off of the last 2 cm of each end so that it will make electrical contact when attached to the switch and strapping C as shown in the figure. When wrapping the magnet wire, leave enough space at the sharp end of the nail so that it can be hammered into the board.

Cut the steel strapping with tin snips or metal shears and attach the strapping and wiring to the board as shown in the figure.

If using a power adapter, remove any connector on the low voltage side so that alligator clips may be attached. Spread the leads so they do not touch.



In the Classroom

Introductory Discussion

1. Through experimentation we know that electric currents create magnetic fields. Magnetic forces created by electric current can be used to do work for us. Creating movement through creating magnetic fields with electric current is called *electromechanics*. Can you think of anything in this room that uses electromechanics (clock, watches, vibrator motors in cell phones, computer hard drive motors, fan motors)? Ask students to think about the applications of buzzers. Do you have any buzzers in your house (motors in dishwashers, refrigerators, microwave ovens, clocks, electric toothbrushes, buzzer in doorbells)? Do you use any in your daily life? Are they used in your school? Did you know that the US Navy recently used electromagnets to create a cannon whose projectile moves at Mach 8 (eight times the speed of sound)?

- Review the fact that electrical currents create electric fields.

Science Activity/Experiment

Safety Precaution: If using batteries, be careful not to short the terminals of the battery as it will damage the battery and there is a danger of explosion. In other words, do not connect the terminals of the battery directly with a low resistance element such as a wire or any piece of metal.

Students will wire a buzzer using magnet wire, a nail and steel strapping. See the figure above.

Part 1 Electromagnet

1. Using a test lead, connect one wire of the power supply to the steel strapping at point A.
2. Using another test lead, connect the other end of the power supply to the steel strapping at point C.
3. Make sure the steel strapping lies about 0.5 cm above the nail.
4. Predict what will happen if you close the switch near point A (which will cause electric current to flow through the coil)?
5. Hold down the switch near point A for no longer than 3 seconds. What happened and why?
6. Sketch your electromagnet.

Part 2 The Buzzer

1. Using the test lead, connect one wire of the power supply to the steel strapping at point A
2. Using another test lead, connect the other end of the power supply to the steel strapping at point B.
3. Make sure the steel strapping lies 0.5 cm above the nail.
4. Make sure the insulated green wire gently touches the top of the steel strapping above the nail.
5. Predict what will happen when the circuit is closed. Predict what will happen if the distance of the steel strapping to the electromagnet is changed.

6. Students will observe that the electromagnet attracts the steel strapping and that when the steel strapping moves towards the electromagnet the movement of the steel strapping breaks the circuit, causing the steel strapping to return to its original position. When the steel strapping returns to its original position, the circuit is closed and the cycle repeats.

7. Students will sketch a diagram of the circuit in both open and closed positions.

Closure Discussion

1. Did the circuit behave as you predicted?
2. Did changing the distance of the strapping from the electromagnet change the sound of the buzzer? How?
3. Can you think of any more applications of electromagnets?

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.

Name_____Date_____

Electricity: The Buzzer

Purpose:

To use electricity to create an electromagnet.

To use an electromagnet to make a buzzer.

Materials:

Buzzer kit

5 volt 5-amp power supply

2 leads with alligator clips

Vocabulary:

Word	Meaning
Steel strapping	A thin ribbon of steel with holes
Electromagnet	A magnet created by electric current
Magnet wire	A copper wire with an insulating lamination (coating)

Can you think of ways that magnetism is used to help us?

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_____

Name two sources of magnetism:

_____

_____

Procedure:

Part 1: Electromagnet

1. Using a test lead, connect one wire of the power supply to the steel strapping at point A
2. Using another test lead, connect the other end of the power supply to the steel strapping at point C.
3. Make sure the steel strapping lies about 0.5 cm above the nail.

What do you think will happen if you close the switch near point A (which will cause electric current to flow through the coil)?

_____

_____

4. Hold down the switch near point A for no longer than 3 seconds.

What happened and why?

_____

_____

Sketch your electromagnet:

Part 2: Buzzer

1. Using a test lead, connect one wire of the power supply to the steel strapping at point A
2. Using another test lead, connect the other end of the power supply to the steel strapping at point B.
3. Make sure the steel strapping lies about 0.5 cm above the nail.
4. Make sure that the insulated green wire gently touches the top of the steel strapping above the nail.

What do you expect will happen if you close the switch near point A (which will cause electric current to flow through the coil)?

_____

_____

5. Close the switch near point A

What happened and why?

_____

_____

_____

Sketch your buzzer: