LET'S DO IT!

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Teacher Edition

Science Is A Verb!

Part 5

Teacher Edition

Contents

Introduction to the lab manual:

This lab manual provides structure for teachers who wish to engage students in hands-on interactive learning but also provides support for teachers who are more comfortable with enquiry based learning. If you are a teacher who is taking his or her first "dive" into hands-on Science, the background material is designed to provide enough structure to help support the organisation of the lab and its materials. Most of the materials are commonly found in local supermarkets and department stores at a nominal cost. A few materials, like scales and hand microscopes can be found on-line. The lab sheets can be given to students so they follow step-by-step or they can be told a general structure to follow.

The critical portion of any lab is to have a thorough discussion of the results and their thinking after the experiment is completed. It is suggested that you take as much time as the experiment to have this discussion with students. The real learning occurs not from the hands-on experiment, but from a deep discussion of the experiment, while making connections to the concept they are learning. For this reason, it is suggested that the students do the experiment FIRST and then have the students learn the concepts. They will have a better understanding of the concept if they first conduct an experiment, gain the experience and then discuss a new concept.

Even without a strong Science background, get into the habit of asking questions. The process of asking questions and being inquisitive will generate more excitement for students and will engage them in a deeper way of learning Science. "I don't know" is as important to learning as having all the answers. Together you can learn Science and discover the major ideas that Scientists' research.

If you are an experienced teacher, the Teacher Guided Questions to Enquiry are designed to provide prompts for students. These questions are not intended to be assessment questions, but ones that will engage students in the general direction of the benchmark. The teacher may select one or two, but not all of them, to have students start on an open enquiry approach to learning. The students will engage in their own experiment, create their own procedures and make conclusions from their data. For this reason, there are no answers to those questions. They are open ended and can be used to formulate interesting experiments for advanced students. The slight variation in some of the questions in each of the labs is designed to provide a sufficient number of prompts at various levels of Bloom's Taxonomy to engage students.

Throughout the year, encourage questioning, student dialogue and the scientific process. There is no one exact scientific method as is often suggested. The process of learning about the world and universe, drawing conclusions from facts and building these facts into strong scientific theories is the work of Science. Science is always growing, stretching and expanding its knowledge base. It is about challenging well-supported ideas to discover weakness. This is exactly what students should be encouraged to do! And in the end, Science is not something to study, it is something to do!

Science is a VERB!

Science is a Verb

Physical Sciences

HOW CAN ELECTRICITY CAUSE MAGNETISM?

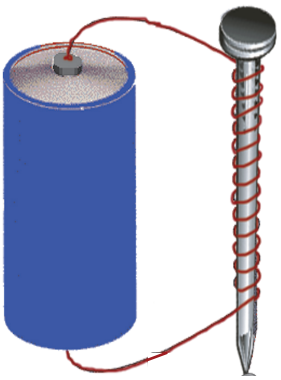
Description: Students will build a simple electromagnet and examine devices that utilise electromagnets to make things move.

Student Materials (per group):
- 50 cm of wire
- 1 iron nail
- 1 C or D battery
- 1 box of paperclips

Additional Teacher Materials:
- Doorbell
- Generator
- Motor
- Earphones

Background and Misconceptions:

Electromagnets utilise a simple rule of electricity: The follow of electricity can create a magnetic field, and a moving magnetic field causes electricity to flow. This simple interaction of electricity is what causes an electromagnet to operate. As electricity flows out of a battery through wires, a magnetic field is formed. The strength of the magnetic field is amplified by wrapping the wire around an iron nail. The more turns of wire, the greater the magnetic effect. The magnetism only lasts while electrons are flowing through the wire.



This helpful interaction is what allows engineers to build objects like electric motors, generators, doorbells, and earphones. In each case, the interaction between electricity and magnetism is utilised to cause motion. Inside of an electric generator, an outside power source is used to move an arm that is connected to a moveable magnet. In the picture below, this magnet is seen connected to the arm in the core. As the magnet moves past the wires that are in a ring surrounding the core, electricity starts to flow. (The outside power source can be anything! It can be moving water, steam from a coal or nuclear power plant, or wind pushing on the blades of a turbine).

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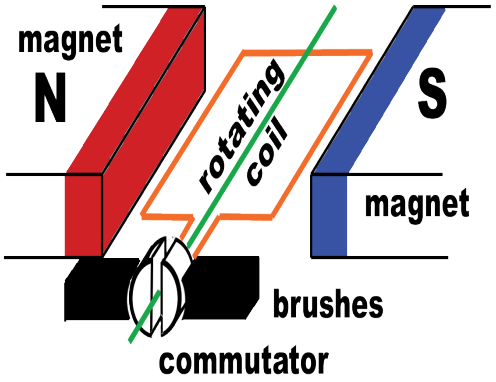
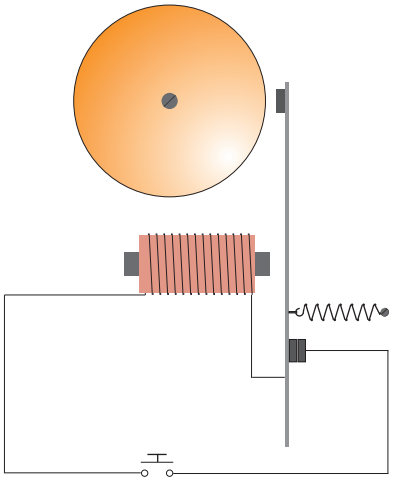
An **electric motor** is exactly the opposite of an electric generator. It is just operating in reverse. Instead of the outside energy moving the magnet, electricity flows into the wires, creating a magnetic field, and the magnet then moves in response to it.





A doorbell is an application of the motor. As the electricity moves into the motor, the magnet moves. But in this case, the magnet has a lever arm attached to it. The magnet and arm move back and forth causing the hammer to strike the bell. The motion back and forth is a result of oscillating electricity. Electricity can either flow all in one direction (called DC or Direct Current electricity) or it can move back and forth (called AC or alternating current). The doorbell hammer vibrates back and forth because of AC electricity.

Vibrating electricity and vibrating magnets may be common to students. When they think about what causes sound, they should know that sound is a result of vibrations. Instead of a lever arm and a hammer attached to a magnet (as is the case with the picture of the doorbell above) there is a paper or plastic cone attached.. To reproduce sound in a speaker, the electricity is varying its strength and direction. The electrical current causes the interaction between a coil of wires and the magnet to create vibrations. These vibrations push the speaker cone and the sound is reproduced.

Electromagnets and the interaction between electricity and magnetism is what cause motion. The motion can be used to pick up paperclips, move a motor arm or recreate sound.

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Teacher Guided Questions to Enquiry:

Use these questions to get the students started on their own enquiry!

1. What is an electromagnet?
2. What are uses for electromagnets?
3. What creates magnetism?
4. How can electricity flowing through a wire be used to create magnetism?
5. What do you need to do to make the strongest electromagnet?
6. What devices use electromagnets or interactions between electricity and magnetism?

Additional Hints:

- When using the battery, monitor to ensure the batteries do not overheat.
- If you have the resources, allow students to deconstruct a motor, generator, doorbell, and earphones so they can examine the electromagnets found within.

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HOW CAN ELECTRICITY CAUSE MAGNETISM?

TEACHER ANSWER KEY

Description: When electricity moves through a wire, it turns the wire into a magnet. The magnet is not very strong so using a nail and looping the wire around the nail will help make it stronger.

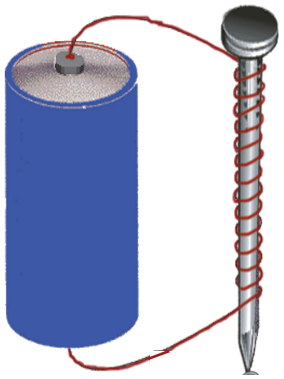
In this lab, you are going to find out how to make a magnet using electricity and how to make it stronger. What you are making is called an ELECTROMAGNET.

Materials:

50 cm of wire
1 C or D battery
1 iron nail
1 box of paperclips

Procedures:

1. Wrap the wire around the nail 10 times. This will leave a large part of the wire unwrapped.
2. Connect the battery to the wires. One end of the wire will be connected to the + side of the battery and the other end of the wire will connect to the – side of the battery. (Look on the battery for the + and – marks)
3. Bring the end of the nail near paper clips. How many are picked up? Write the number picked up in the table below.
4. Wind the wire around the nail 10 more times. The nail will be wrapped with wire 20 times. Try to pick up the paper clips. Write down the number picked up in the table below.
5. Repeat this for other amounts that you pick. How can you pick up more paper clips?

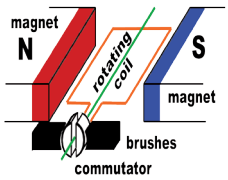
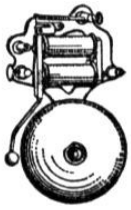


Number of times nail is wrapped	10	20	Students answer will vary, but in general, as more wire is wrapped around the iron, more paper clips will be picked up.
Number of paperclips picked up	5	7	

HOW CAN ELECTRICITY CAUSE MAGNETISM?

Extension:

Electromagnets are used in a variety of home devices. Your teacher will have on display the following items. Write in the box below how an electromagnet is used in each device.

Device	How is an electromagnetic used?
Earphones 	There is a small magnet in each earbud and a coil of wire. The electricity moving through the wire causes the magnet to move. The magnet is attached to the speaker cone. The speaker cone moves, producing sound.
Motor 	Electricity moves through the wire, causing the magnet attached to the arm to start to move. The motor arm will spin.
Generator 	A magnet is moved past a set of wires, causing electricity to move in the wires. This is what is used to produce electricity.
Doorbell 	When the doorbell is pushed, a circuit is completed, and electricity moves through the wire causing the magnet attached to the arm with the ball to vibrate back and forth.

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HOW CAN ELECTRICITY CAUSE MAGNETISM?

Questions:

1. How does the number of times you wrap the nail with wire change the number of paper clips that are picked up?

The more times the nail is wrapped, the more paper clips that are picked up.

2. What travels through the wire when you connect the two ends of the wire to the battery?

Electricity. The electricity is the flow of charge through the circuit.

3. Electricity is flowing through the wires from the battery. When electricity travels through a wire, what else does it do?

It creates a magnetic field that can be used to move things.

4. How are electromagnets used in various types of devices?

The electromagnets are used to make things move. In each of the examples in this activity, by using an electromagnet, something turns or moves.