mobile inquiry technology
Teacher Notes

Moving Magnets Introduction

In this activity, the students will make a home-made galvanometer. Galvanometers are used by electricians, electrical engineers, circuit designers, and repair people to measure electrical voltage and current. The scientific principle behind the galvanometer is electromagnetism, or in other words:

1. an electric current running through a wire creates a magnetic field.

2. a magnetic field near a wire creates an electric current.

This activity is focused on exploring the connection between magnetic and electric fields. Students will be asked to develop a hypothesis that relates the voltage produced in coils of different number of wraps while in the presence of a magnet. In this activity, students will use a multimeter to test this hypothesis. Using the multimeter will also afford them the opportunity to compare voltage output as the number of wraps increases since the multimeter allows readings in the milliVolts.

Students will use a spreadsheet to record and compare data.

Students will develop a number of key concepts related to electromagnetism including:

1. an electric current is produced in a conductor forming part of a closed circuit when the conductor moves so that it cuts the lines of force of a magnet field.
2. the force of an electric current can be measured in volts using a multimeter.

In addition students will gain experience with inquiry skills, including:

1. identifying variables that can affect the outcome of an experiment.

2. gaining skills and confidence in using a scientific measurement tool, the multimeter, as well as the spreadsheet and graphing capacity of a computer to represent and analyze data.

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Discussion Guide

Review a basic circuit with the students by having them construct one within their groups. Have the students use wires, a switch, a battery, and a bulb. Have each group move a compass around the circuit while the switch is closed and opened. Have the students write down their observations. Have the students draw a diagram of the circuit and small compass showing any change in the direction of the magnetic needle as they move the compass around the circuit. Each group should be invited to present their drawing to the class and to trace the change in direction of the magnetic needle around the circuit. A number of questions might be appropriate:

1. Which way does the magnetic compass needle point when you are away from any electrical circuit?
2. What do you notice about the magnetic needle of the compass as you move it around the circuit when the switch is closed?
3. Does the direction of the magnetic needle of the compass change when it is on one side or another of the circuit?
4. What do you notice about the magnetic needle of the compass as you move it around the circuit when the switch is open?
5. Does this give you any clues about the relationship between a electric and magnetic field?

At this point some students may have developed a hypothesis that connects electric and magnetic fields. Explain to the students that an electric current running through a wire creates a magnetic field and that this is called electromagnetism.

Indicate that scientist use a tool to measure electric current and voltage. Tell the class that electricity is measured using a variety of kinds of units. Show the class the multimeter. Demonstrate how to test the voltage a simple circuit.

Direct the students to "Thinking About the Question". After about 10 minutes allow the student to share their predictions and reasoning.

Explain to the students that a current is produced in a coil while in the presence of a moving magnet is called an induced current. The magnet provides the force necessary to do the work in moving the electrons through the conductor. When a magnet is pushed into a coil in one direction the voltage will be either positive or negative. When it is pushed into the coil in the other direction, the voltage will be the opposite in charge. This shows that the direction of the flow of the current has been reversed.

Direct the students to "Investigation I".

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Additional Teacher Background

Some students may question the concept of voltage. It is not necessary that they develop a sophisticated understanding of electrical units of measure. You might propose the following analogy: An electrical circuit is much like water running through a hose from a faucet. In this model the water represents the current flowing through the hose that represents the wire. If you turn the faucet on full, the pressure needed to push the water through the hose is at maximum. The pressure need to push the water represents the **voltage**. The hose offers **resistance** to flow. How much resistance is dependent on the length or the narrowness of the hose. (In electrical components resistance is also dependent on the nature of the conducting material.) The resistance of the hose and the pressure from the faucet will determine how much water (**current**) passes out of the end of the hose in a unit of time. This quantity is measured in amps.

Large generators in power stations step down the voltage to different levels for use in industry and in the home by the use of transformers. A transformer changes the voltage of an alternating current through the use of coils. The input voltage goes to a primary coil wound around an iron core. The output voltage emerges from a secondary coil also wound around the core. The degree of change in voltage depends on the ratio of turns in the coils.

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Moving Magnets Suggested Timeline

The amount of time you spend on introductory discussions, data collection, and analysis, will determine your overall timeline. The following represents a possible timeline.

- One class period - Introductory Discussion
- One class period - Investigation I: Testing a ten wrap coil
- One class period - Investigation II: Testing a twenty wrap coil
- One class period - Investigation III: Testing a thirty wrap coil
- One class period - Analysis

Additional days can be used for further investigations.

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