Demonstrating Magnetism

Electricity All Around Us
Activity
Grade Level: 5-8

Main Objectives

This activity is designed as an educator demonstration rather than a learner activity, recognizing the difficulties learners might have working with magnets and iron fillings, and that schools may not have class sets of bar magnets. The overhead projector provides a clear view of the demonstration. The clear base compass can help learners visualize the nature of the magnetic field around these two types of magnets.

Learning Outcomes

By the end of this activity, learners will:

- describe the shape of a magnetic field around a permanent magnet in terms of:
    - having 2 poles, north and south
    - having greater field strength near the poles, and weaker strength away from the poles
- describe how reversing the flow of electricity changes the polarity of an electromagnet
- describe electromagnets as temporary magnets which are "on" only when current flows
- compare electromagnets and permanent magnets

Length of Activity

1.5 hours

Materials List

Demonstrating Magnetism Backgrounder
Demonstrating Magnetism Learner Worksheet
Clear transparency film
Permanent bar magnet
4 inch (10 cm) iron nail
Enamelled magnet wire (approximately 1.5 metres)
Weak dry cell battery with battery holder
Iron fillings
Matches or blade for stripping the ends of the wire
Sandpaper (small piece)
Compass (clear base orienteering style)
Overhead projector

Procedure

Step 1: Preparation

a. Make a small electromagnet. Wrap the nail with the magnet wire (about 100 turns). Leave about 20 cm of wire at each end so you can make connections.
b. An easy method for stripping the insulation is to melt it with a lit match. Another method is to scrape the insulation bare with a thin blade. Sand the bare ends with sandpaper.
c. Test your electromagnet with the battery to be sure it works.

Step 2: The magnetic field around a permanent magnet

a. Place your bar magnet on the overhead projector (OHP). Focus the projector so that the magnet comes sharply into view.
b. Lay a sheet of clear transparency film over the magnet.
c. Sprinkle a few iron fillings onto the transparency film.

d. Point out the shape of the field to you learners as shown by the iron fillings. Give them time to draw the field in their worksheets.
e. Demonstrate the polarity of the field by moving the compass around the magnet. Indicate to the learners when the needle reverses as it comes under the influence of the other pole on the magnet.

Step 3: The magnetic field around an electromagnet

a. Lay the unconnected electromagnet on the OHP, covering it with the transparency film.
b. Sprinkle a few iron fillings randomly around the nail. If the nail has been used as an electromagnet before, it may have a small amount of residual magnetism. If necessary, explain this to your learners.
c. With the learners watching closely, connect the battery to the electromagnet. The particles of iron should jump visibly, aligning themselves around the nail as if it were a bar magnet.
d. Compare the shape of this magnetic field to that of the permanent magnet (they are similar). Have the learners draw this field into their worksheets.
e. As you did with the permanent magnet, demonstrate the polarity of the field by moving the compass around the magnet. Note especially when the needle reverses as it comes under the influence of the other pole on the magnet.

Step 4: Changing the polarity of the electromagnet

a. Place the compass near one end of the electromagnet displayed on the OHP, with iron fillings scattered around it to demonstrate its field. The compass needle should be indicating either north or south.
b. With your learners watching, switch the wires connected to the battery. This will reverse the flow of electrons through the electromagnet. Ask you learners to observe what happened to the compass needle.
c. Provide time for the learners to answer the "Think about" questions on the worksheet.

Step 5: Worksheet

a. Provide time for learners to complete the worksheet.
b. Review the answers with the learners.
c. Use the comprehension questions to check learners' understanding.

Tips and Extensions

- If equipment permits, this could be a hands-on learner activity. If you have enough materials, learners could do this individually. The learners could use the worksheet to trace the shape of the magnet. They can sprinkle iron fillings over it and draw the shape of the field by tracing lines of iron fillings with a pencil. Learners could also be divided into groups with materials provided to each group.
- Introduce or wrap up this activity by taking apart an old speaker or electric motor, with your learners gathered around. Point out the electromagnets and/or permanent magnets that are part of the device.

Comprehension

- What are some devices you can purchase that might contain permanent magnets?
  Direct current motors such as those found in remote control toys and computers, audio speakers, bicycle generators etc.
- What is the main difference between a permanent magnet and an electromagnet?
  Electromagnets are built with wraps of wire around a metal core, whereas permanent magnets have no wire. The permanent magnets contain metallic crystals within them that are polarized, meaning their electrons are spinning with their axes all pointed in the same direction, like little tops all pointing up.
- What are some devices that have electromagnets in them?
  Anything with an electric motor, a mechanical relay, a solenoid, a microwave oven, etc.