Synopsis: Compass Tweak

In this activity we will observe the magnetic field produced when a current is passed through a wire using a simple compass.

Standards

4th Grade

1a. Students know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.

1b. Students know how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.

1c. Students know electric currents produce magnetic fields and know how to build a simple electromagnet.

9-12th Grade

5f. *Students know* magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.

5g. *Students know* how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.

Driving Question

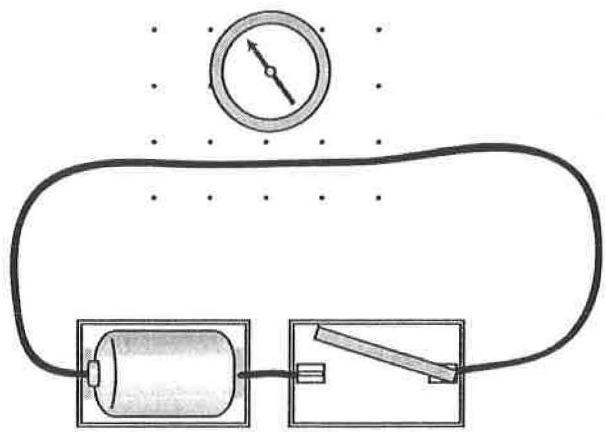
1.) How do we know current produces a magnetic field?

Learning Objectives

1.) Students will observe that a current moving through a wire produces a magnetic field. (This is the foundation for electromagnets and the dynamic interplay between electricity and magnetism).
2.) Students will learn that a compass needle can be used as a magnetic field detector.

Compass Tweak

Work in groups of two.



Part A: Tweak a Compass

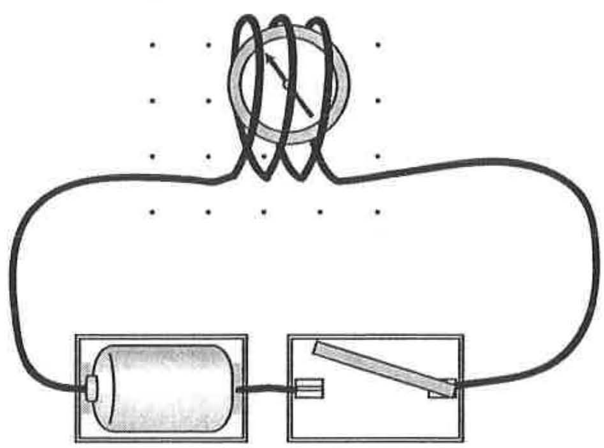
Make sure you have access to the following:

- Battery and battery holder.
- Long jumper wire with alligator clips
- Compass or set of compasses
- Switch
- Field graphing paper

1.) Make a circuit. (see diagram to the right)
   a. Connect one end of the long jumper wire to the battery holder and the other end to a switch.
   b. Complete the circle by connecting the battery to the switch. Note: the circuit will only really be complete when the switch closed.
2.) Straighten out one side of the circle to form a "straight wire" on top of the field graphing paper. Tape in place.
3.) Place a compass (or set of compasses) near the wire.
4.) Close the circuit and observe what happens to the compass needle. Record the direction the compass arrow(s) point when the circuit is open and closed in your notebook.
5.) What happens if your switch the direction of the battery? Make a prediction, then try it.

Follow up questions:

1.) Can you explain what you have seen?
2.) If you are using multiple compasses, was the effect the same for each? If there were differences, do you see a trend? Can you explain the trend?



Part B: Compass Wrap

To see a larger effect, you can coil the long jumper wire around the compass, and repeat Part A. See diagram to the right. Use a field slinky to see if this makes sense.

Again, see what happens when you flip the direction of the battery.

Part C: Get Systematic (Optional)

1.) Start with the simple circuit from Part A.
2.) Place a piece of field graphing paper beneath the straight section of the wire. Rows of dots should be parallel to the straight wire (columns perpendicular). Label rows numerically and label each column alphabetically.
3.) Place a compass on one of the dots closest to the straight wire. Close the circuit and record your observation.

4.) Measure the effect of closing the circuit on the compass at few dots in the same row (~same distance from the straight wire). Record your observations.
5.) Measure the effect of closing the circuit on the compass at few dots in the same column (each at a different distance from the straight wire). Record your observations.
6.) Repeat with 2 or 3 batteries in a row.

Follow up questions:

1.) Sum up your finding. Can you make any general rules?
2.) Can you explain your observations?
3.) Make a couple of predictions and justify your answers.
    a. How will the compass response at point A1 compare with point A5?
    b. How will the compass response at point A2 compare with point E2?
    c. Which point or points will have a compass response most like C3?

Instructor Notes: Compass Tweak

This activity is relatively bullet proof. It does rely on completing a "circuit", which we will not officially introduce until later in the week.

Safety
This activity has little to no risk associated with it. Students may be a little apprehensive, thinking they may get a shock from the battery. They will not be shocked by a D cell or any other 1.5 V battery.

Materials
- Battery and battery holders.
- Long jumper wire with alligator clips
- Compass or set of compasses
- Switch
- Field graphing paper

Notes