Magnetism

Equipment

- Hall-effect probe (magnetic field sensor), voltage probe, DMM
- Battery eliminator, assorted resistors, alligator clips, compass
- Optional: High power variable resistor, linear (position) motion sensor

Objective

Physics Concepts

- Magnetic field and electromagnetism
- Hall Effect

Experimental analysis

- Graph time varying functions, combine measurements to graph new quantities
- Fit curves to data to determine mathematical relationships
- Recognizing the uncertainty in measurements

Conceptual (C-Level)

You place a compass above a wire running north-south.

- Draw a picture of the compass and wire when no current is flowing in the circuit.
- Draw a picture of the wire and compass when current is flowing north in the wire.
- Determine the current necessary to deflect the compass needle 45°. Assume the horizontal component of the earth's magnetic field is 3×10^{-5} Tesla.

EXPLORATIONS:

- Use the on-line circuit simulations to examine the magnetic field produced by a bar magnet and electromagnet. Use the compass and/or magnetic field meter to examine the resulting magnetic fields.

Basic Lab (B-Level)

Use a magnetometer to explore the magnetic field around current carrying wires and loops. Compare your measurements to theory where possible.

- Using a cow magnet graph B as a function of distance from one pole
- Using a straight wire graph B as a function of distance
- Using a loop of wire graph B as a function of z (axial distance)

Advanced/Extended Lab Ideas (A-Level)

- Apply advanced error analysis to your results.
- Make a simple DC motor and explain its operation (you may want to play with a St Louis motor).
- Graph the magnetic field as a function of other variables (such as current) and compare with theory.
- Write a VPython program to show the:
    - magnetic field around a current carrying object
    - magnetic field produced by a moving charge
    - dipole pattern of the magnetic field produced by a current loop
- Explore something else that you are curious to investigate.