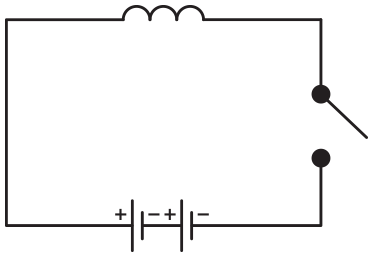
# **Investigation: Electromagnets**

**Essential question: How are electricity and magnetism connected to each other?**

If a current is present in a wire, a magnetic field is produced. Magnetic fields created by long straight wires are not very strong, so in this investigation we will be using a coil of wire. A magnetic compass will be used to investigate the direction of the magnetic field produced and a permanent magnet will be used to test the strength of the field.

Part 1: Magnetic field direction



1. Build the circuit shown in the diagram.
2. Place a compass on top of the coil, close the switch, and observe the compass for a few seconds. Note the direction it points.
3. Gently move the compass around other locations around the coil, observing the direction the compass points. Fill in the diagram below with arrows to record your observations.
4. Move a compass around a bar magnet and observe the direction the compass points at various locations around the magnet.
5. Turn the batteries upside down to change the direction of the current and repeat the experiment.

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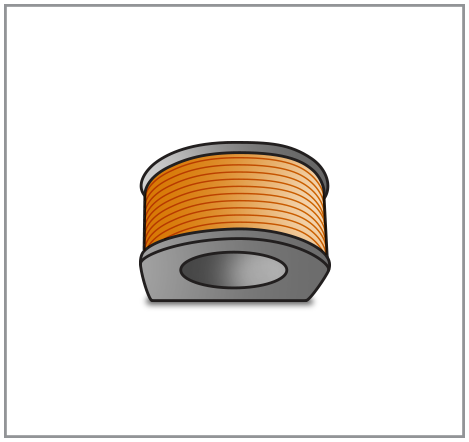
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Questions

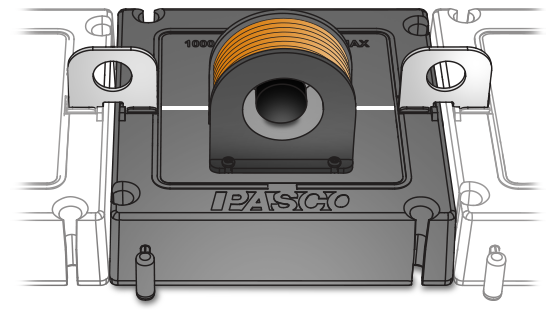
1. How does the magnetic field produced by a coil compare to the magnetic field produced by a bar magnet? What are some significant differences and similarities between them?

Answer: The magnetic field pattern produced by a coil is very similar to the pattern produced by a bar magnet. Like a bar magnet, a compass points towards the “south end” of the coil and away from the “north end.”

1. What effect does changing the direction of current in the circuit have on the magnetic field?

Answer: Changing the direction of current reverses the direction of the magnetic field.

Part 2: Magnetic field strength

1. Place a single disk magnet in the coil, sitting up on the rounded side, as shown in the diagram.
2. Close the switch and observe the magnet.
3. Rotate the magnet 90 degrees and repeat the experiment. Repeat this two more times to experiment with a different side of the magnet facing out from the coil.
4. Place the magnet at various locations around the coil and repeat the experiment.
5. Remove one battery from the circuit and replace it with a 100 ohm resistor to reduce the current through the coil. Repeat the experiment.

Questions

1. How does the magnet respond when current is flowing through the coil? Describe and similarities or differences when you rotated the magnet 90 degrees after each trial.

Answer: The magnet responds when it is initially rotated by 90 degrees. When current is flowing through the coil, the magnet turns 90 degrees to align itself with the magnetic field.

1. Does the magnetic field appear to be strongest inside the coil, outside the coil, or the same everywhere? Explain how you came to your conclusion.

Answer: The magnetic field is strongest inside of the coil. You can observe this by how the magnet responds at different locations. The magnet turns more easily when it is placed inside of the coil.

1. How does the magnet respond when you significantly reduced the current in the circuit? Why?

Answer: The magnet does not turn as easily when the current is significantly reduced. This is because the strength of the magnetic field produced by the coil is also reduced.