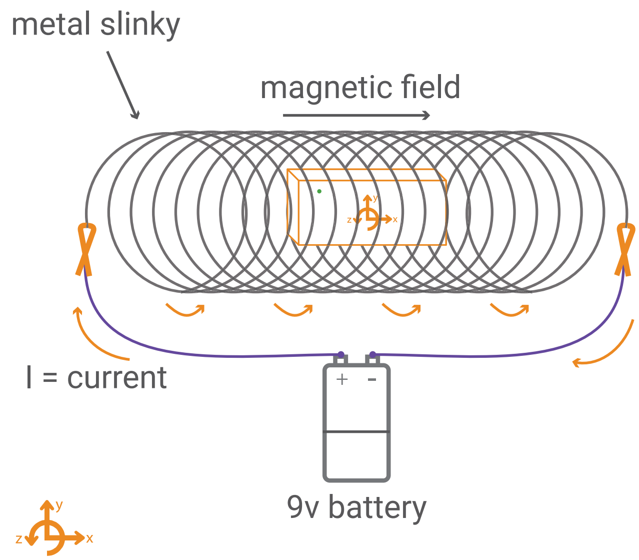
Magnetic Field in Slinky

Exploration

Until the late 1800's, electricity and magnetism were regarded as separate forces. A number of scientists, including Michael Faraday and James Clerk Maxwell, made important discoveries which led to our current understanding of electricity and magnetism. The interaction between positive and negative charges is in fact one force, the electromagnetic force, which results in both electrical currents and magnetic fields. With a PocketLab and an electric current running through a metal Slinky, this connection between electricity and magnetism can be observed.

Materials

- PocketLab
- Metallic Slinky
- 9V battery
- 2 alligator wires
- Hand-crank generator
- Tape



Objective

In this experiment, students will:

1. Explore magnetic field changes as an electrical current flows through a slinky.
2. Determine how the magnetic field changes as the direction of the current changes.

3. Determine how the magnetic field changes as the strength of the current changes.
4. Explain how electricity and magnetic fields are related.

Part A

1. Spread the Slinky out on a table and tape each end down so it doesn't retract.
2. Connect the PocketLab to the PocketLab app and select the Magnetic Field graph.
3. Place the PocketLab inside the Slinky so the PocketLab logo is facing up and "Zero" the graph in the app.
4. Attach an alligator wire to each end of the Slinky.
5. Before you attach the other ends of the alligator wires to the battery, answer the prediction questions below:

Prediction Questions:

a. Draw a prediction of what you think the graph will look like when the battery is first hooked-up to the Slinky. Explain your prediction.

b. How will the graph change when the terminals are switched? Draw a prediction of what you think the graph will look like.

c. Write a hypothesis statement that predicts how you think the magnetic field will change when the direction of the electrical current changes.

6. Attach the loose end of one of the alligator wires to the "+" terminal of the 9V battery.
7. Begin recording data.
8. Attach the loose end of the other alligator wire to the "–" terminal of the 9V battery.
9. Take note of what is being displayed on the graph.
10. Swap the connection of the alligator clips and see how the graph changes.
11. Detach the battery.
12. Stop recording data.

Data Analysis and Observations

a. Draw a sketch of the recorded graph. On your sketch label when there was no electric current flowing through the Slinky, when there was electric current flowing in a positive direction (relative to the PocketLab), and when there was an electric current flowing in a negative direction.

b. Describe the graph when the slinky was first hooked up to the battery. How did it change when the terminals were switched? Compare the results to your prediction.

Part B

1. Set up the PocketLab, Slinky, and alligator wires in the same way as Part A.
2. Connect the loose end of each alligator wire to the hand crank generator instead of the battery.
3. Before you turn the hand crank generator, answer the prediction questions below.

Prediction Questions:

a. Draw a prediction of what you think the graph will look when you are turning the hand crank slow versus fast and when you change the direction that you are turning the hand crank.

b. Write a hypothesis statement that predicts how you think the magnetic field will change based on the strength of the electric current.

4. Zero the data in the Magnetic Field graph and begin recording data.
5. Start by turning the crank slowly. Observe how this affects the magnetic field graph.
6. Speed up the turning of the crank and and observe how this affects the magnetic field graph.
7. Stop turning the crank.
8. Turn the crank in the other direction, starting slowly. Observe how this affects the magnetic field graph.
9. Speed up the turning of the crank and and observe how this affects the magnetic field graph.
10. Stop recording data.

Data Analysis and Observations

a. Draw a sketch of the recorded graph. On your sketch label each change in the graph with what the electrical current flowing through the Slinky was doing. Explain how you observed this connection between the electrical current and the magnetic field (hint: think about what you were doing with the hand crank generator at each change in the graph).

Conclusions

- Was your hypothesis about the relationship between the direction of the magnetic field and the direction of the electric current valid or invalid. Use data to support your conclusion.
- Was your hypothesis about the relationship between the strength of the magnetic field and the strength of the electrical current valid or invalid. Use data to support your conclusion.

- When the electrical current was traveling through the coil of the Slinky, along what axis was the direction of the magnetic field? Draw a diagram that illustrates an electrical current through a coil and the resulting vector of the magnetic field.
- Electricity and magnetism were once thought of as completely separate forces. Scientists Michael Faraday and James Clerk Maxwell are commonly credited with illustrating how electricity and magnetism are actually controlled by one force called electromagnetism. Explain how the observations and data you collected support Faraday and Maxwell's work.