Module 6: Waves
Topic 5 Application: The Electromagnetic Spectrum

Before you begin the scientific investigation, make sure to download the Faraday's Electromagnetic Scientific Investigation Report. As you complete this scientific investigation, fill in any needed information on the report template. If you need more information about each section of the report, please visit the Developmental Module.

Introduction

Electromagnetic waves can have wavelengths much shorter or much longer than those that are visible to the human eye. This simulation will explore the electric and magnetic properties of electromagnetic waves and how these properties allow them to travel through space.

Objectives

In this scientific investigation, you will:

- identify the characteristics of electromagnets that are variable and the effects each variable has on the magnetic field's strength and direction.
- predict how the current will change when the conditions are varied.

Hypothesis

Using the three **Procedure and Data Collection** sections below, read through the procedural information for this scientific investigation. Based on your understanding of the procedure, develop your own hypotheses which describe your expected results. What do you think is the relationship between motion of an electric charge and the direction of a magnetic field? Record these hypotheses in the **Hypothesis** section of your Faraday's Electromagnetic Scientific Investigation Report.

Required Simulation

Faraday's Electromagnetic Simulation

Provided by:
PhET Interactive Simulations
University of Colorado
http://phet.colorado.edu

Procedure and Data Collection

Bar Magnet Simulation Set-Up

1. Open the Faraday's Electromagnetic Simulation.
2. Make sure that the Bar Magnet tab is the current page
3. On the right side of the simulation window, be sure that "Show Field" and "Show Compass" are checked.

Procedure and Data Collection

1. Move the magnet and compass around to various positions noticing the impact on the direction the compass points.
2. Using the slider near the upper right of the screen, change the Bar magnet strength to 0% noticing the impact on the magnetic field.
3. Answer the questions regarding your observations on the Faraday's Electromagnetic Scientific Investigation Report.

Pickup Coil Simulation Set-Up

1. Click on the Pickup Coil tab.
2. On the right side of the simulation window, be sure that "Show Field" is checked.
3. Select the picture of the light bulb as the "indicator."

Procedure and Data Collection

1. On this view, you have a bar magnet and a coil of wire attached to a bulb. On the coil of wire, the dots represent electrons.
2. Move the magnet and the coil of wire around with respect to each other and describe what you see.
3. Now, place the bar magnet so that the red side (N) is just touching the coil. Quickly change the strength of the bar magnet between 0% and 100% and back again. Describe what you see, paying particular attention to the electrons.
4. What does a changing electric field do to electric charges?
5. Electric charges are actually directly influenced by electric fields, not magnetic ones, so what must a changing magnetic field produce?
6. Record all of your observations on the Faraday's Electromagnetic Scientific Investigation Report.

Electromagnet Lab Set-Up

1. Click on the Electromagnet Lab tab.
2. On the right side of the screen, make sure that "Show Field," "Show Compass," and Show Electrons" are checked.
3. Select the picture of the battery on the right side of the screen as the Current Source.

Procedure and Data Collection

1. On this screen you see a compass, which we used to measure the direction of the magnetic field, and a coil of wire attached to a battery. Again, you see the electric charges in the wire. Using the slider on the battery, vary the voltage of the battery from 10 Volts to 0 Volts to 10 Volts in the other direction.
2. What happens to the motion of the charges?

3. What happens to the magnetic field when the charges are at rest?
4. What can you conclude about how magnetic fields can be produced?

Conclusion

Using the Conclusion section of your Faraday's Electromagnetic Scientific Investigation Report, compose three to four sentences describing an overall conclusion about the relationship between the characteristics of electromagnets that are variable and the effects each variable has on the magnetic field's strength and direction. Were your hypotheses true or false, and how do you know? Use the data and notes that you collected from your simulation experience to form your conclusion. Make sure that you include information that you gained from data analysis to support your conclusion.

Experimental Sources of Error

On your Faraday's Electromagnetic Scientific Investigation Report, provide responses to the following questions: **Are there any sources of error? If so, what are they and what could be done to minimize error?**

Once you have completed the One Dimension Collisions Scientific Investigation Report, please submit your work to the dropbox.