ACTIVITY CONTENTS:

Moving Magnets

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Moving Magnets Introduction

Discovery Question:

Can I measure the change in voltage of a coil in the presence of a moving magnet?

In this activity you will generate and measure a voltage of a current produced by moving a magnet through a wire coil.

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Thinking About the Question

Can I measure the change in voltage of a coil in the presence of a moving magnet?

Have you ever wondered how vending machines check the values of coins you place into their coin slots? A vending machine detects the amount of voltage produced while the coin moves through a magnetic field. An electric current is produced in the metal coin when the conductor cuts the lines of force of the magnetic field inside the vending machine. The size of the coin is determined by the amount of voltage detected by the vending machine.

If, for example, the conductor is a coil of wire instead of a coin, a voltage may be generated in the wire by moving a magnet through the coil. In this activity, you will make coils of different sizes and measure the amount of voltage produced in the different numbers of coils as a magnet is moved through them. In your group, predict how increasing the number of wraps of a coil will change the amount of voltage produced. Write down your ideas about what might explain your prediction.

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Moving Magnets Materials

- CC DMM (digital multimeter)
- block of wood (2.0 cm x 9 cm x 9 cm) or thick cardboard
- bar magnet
- wire cutters and strippers
- masking tape
- magnetic compass
- simple circuit (wires, a switch, a battery, and a bulb)

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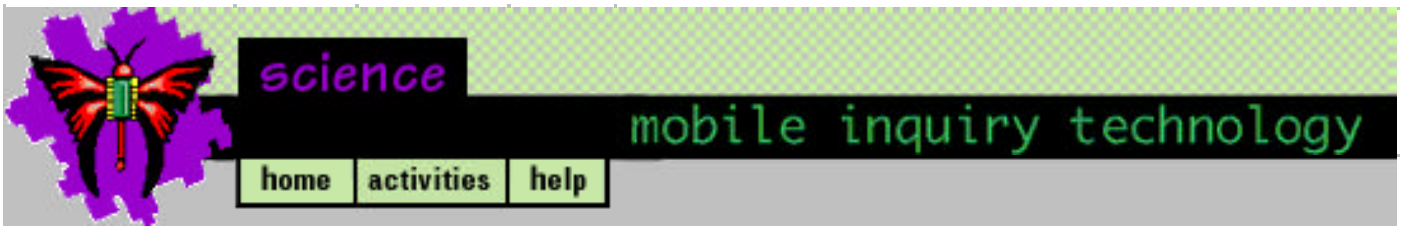


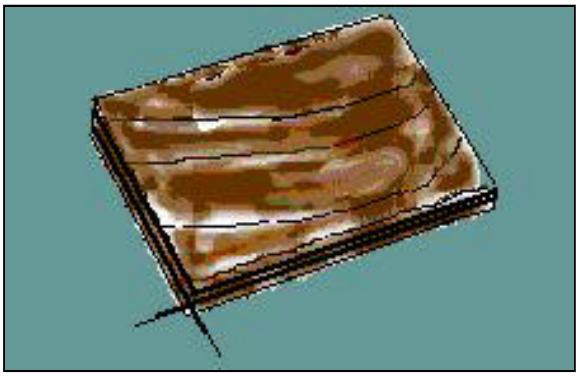
Moving Magnets Safety

No specific safety features needed for this activity.

Moving Magnets Investigation I

Testing a ten wrap coil

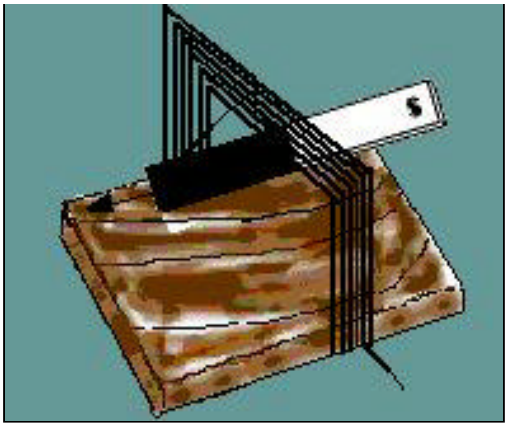
1. Wrap wire with stripped ends around the wood block to create ten large, square coils. Cut and remove the coil from the block.



2. Use the masking tape to keep the coil together. Strip the ends of the coil. Place the block inside the coil so that the coil stands up.

3. Using your spreadsheet program, make a chart to record the highest positive voltage of this coil. Refer to Technical Hints to see how to make a spreadsheet.

4. After the multimeter is connected to the ends of the wire coil with masking tape, move the magnet through the coil as shown. Record the voltage. Refer to Technical Hints to see how to use the CC DMM (digital multimeter).



5. While the CC DMM (digital multimeter) is still running reverse the direction of the magnet.

6. Go to Question 1 in "Analysis".

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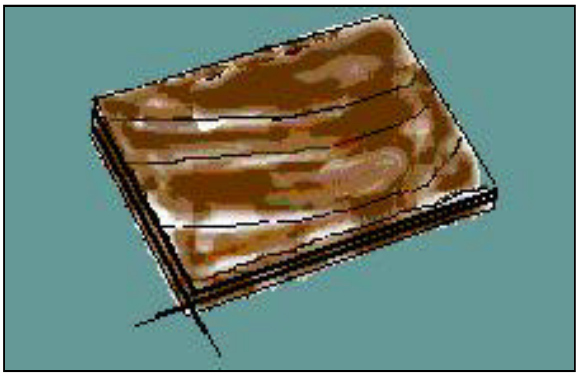
Moving Magnets Investigation II

Testing a twenty wrap coil

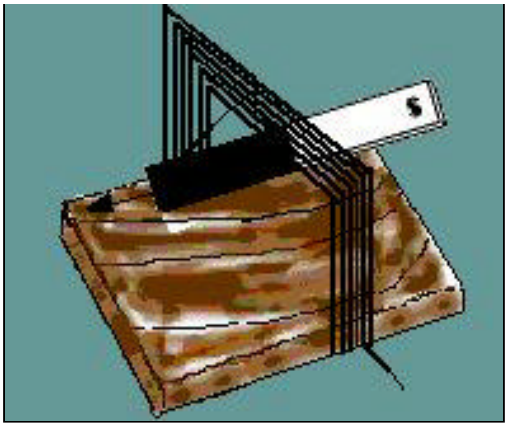
1. Wrap wire with stripped ends around the wood block to create twenty large, square coils. Cut and remove the coil from the block.



2. Use the masking tape to keep the coil together. Strip the ends of the coil. Place the block inside the coil so that the coil stands up.

3. Using your spreadsheet program, make a chart to record the highest positive voltage of this coil. Refer to Technical Hints to see how to make a spreadsheet.

4. After the multimeter is connected to the ends of the wire coil with masking tape, move the magnet through the coil as shown. Record the voltage. Refer to Technical Hints to see how to use the CC DMM (digital multimeter).



5. While the CC DMM (digital multimeter) is still running reverse the direction of the magnet.

6. Go to Questions 2 and 3 in "Analysis".

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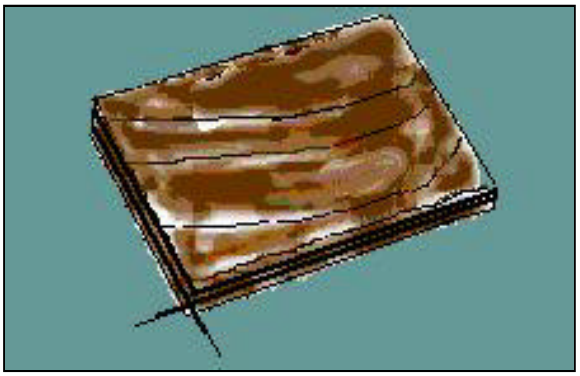
Moving Magnets Investigation III

Testing a thirty wrap coil

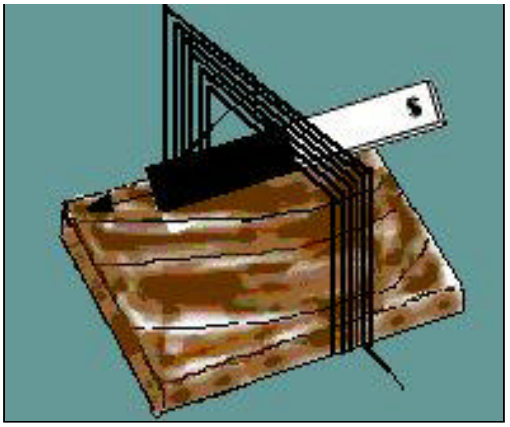
1. Wrap wire with stripped ends around the wood block to create thirty large, square coils. Cut and remove the coil from the block.



2. Use the masking tape to keep the coil together. Strip the ends of the coil. Place the block inside the coil so that the coil stands up.

3. Using your spreadsheet program, make a chart to record the highest positive voltage of this coil. Refer to Technical Hints to see how to make a spreadsheet.

4. After the multimeter is connected to the ends of the wire coil with masking tape, move the magnet through the coil as shown. Record the voltage. Refer to Technical Hints to see how to use the CC DMM (digital multimeter).



5. While the CC DMM (digital multimeter) is still running reverse the direction of the magnet.

6. Go to Questions 4, 5, 6, and 7 in "Analysis".

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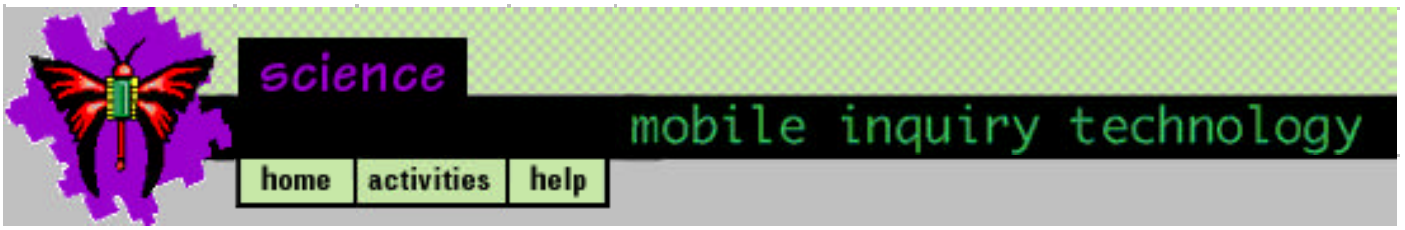

Moving Magnets Technical Hints

- Making a spreadsheet
- Using the CC DMM program
- Creating a x-y ling graph

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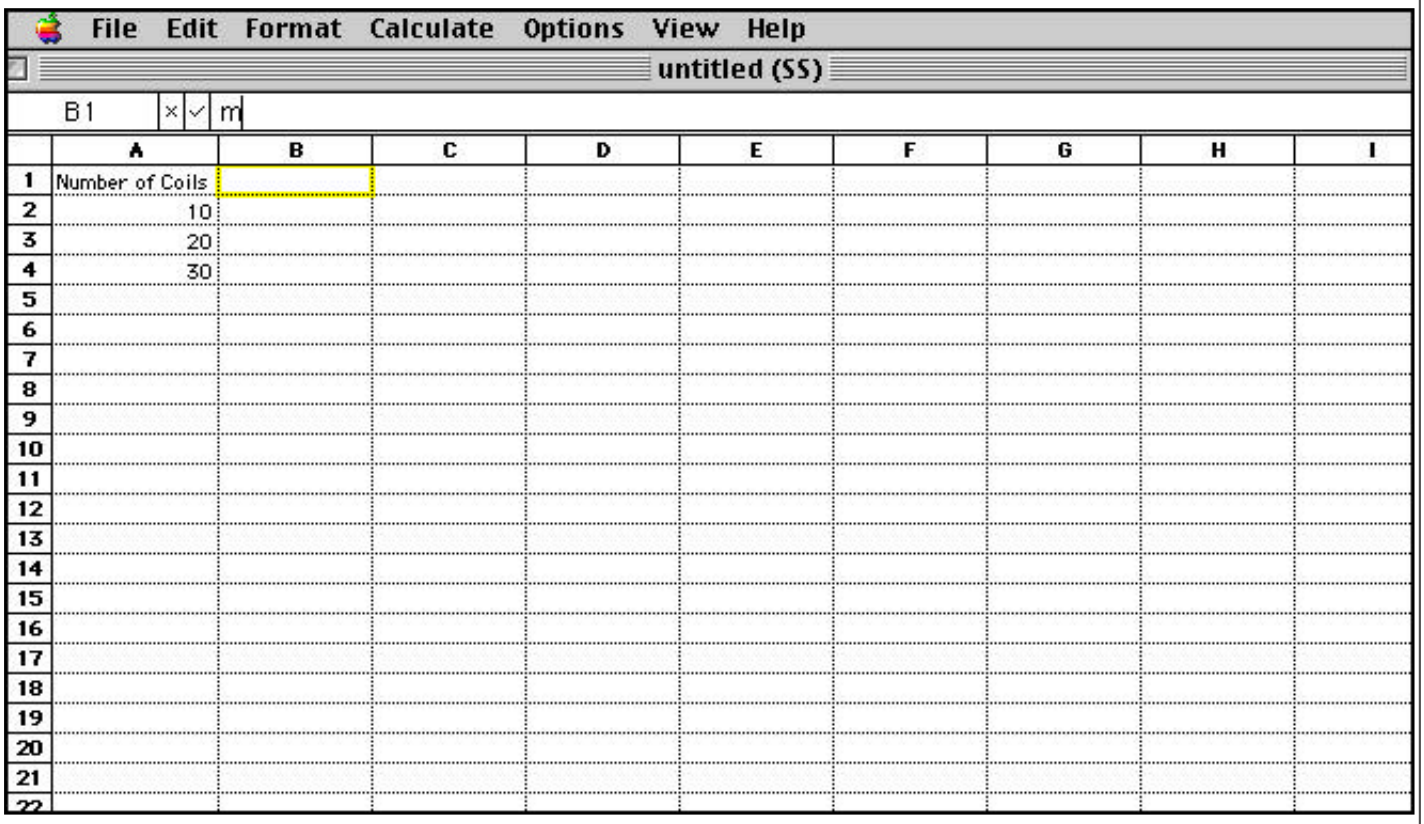
Moving Magnets Technical Hints

To make a spreadsheet:

1. Open the ClarisWorks spreadsheet program by selecting it from the opening menu.
2. Title the first column for Number of Coils in Cell A1. Title the second column for your type of coil in milliVolts in Cell B1.



	A	B	C	D	E	F	G	H	I
1	Number of Coils								
2	10								
3	20								
4	30								
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
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21									
22									

CLOSE

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Moving Magnets Technical Hints

To use the CC DMM program:

1. Set the knob on the multimeter to the 200 mV (in yellow region) scale.
2. Turn on the multimeter.
3. Observe the readout on the multimeter screen. The multimeter will not need to be connected to the computer. (Remember that the readings will be in millivolts. So a value of 0.2 mV equals 0.0002 mV.) Select the highest positive reading and record for each coil.

CLOSE

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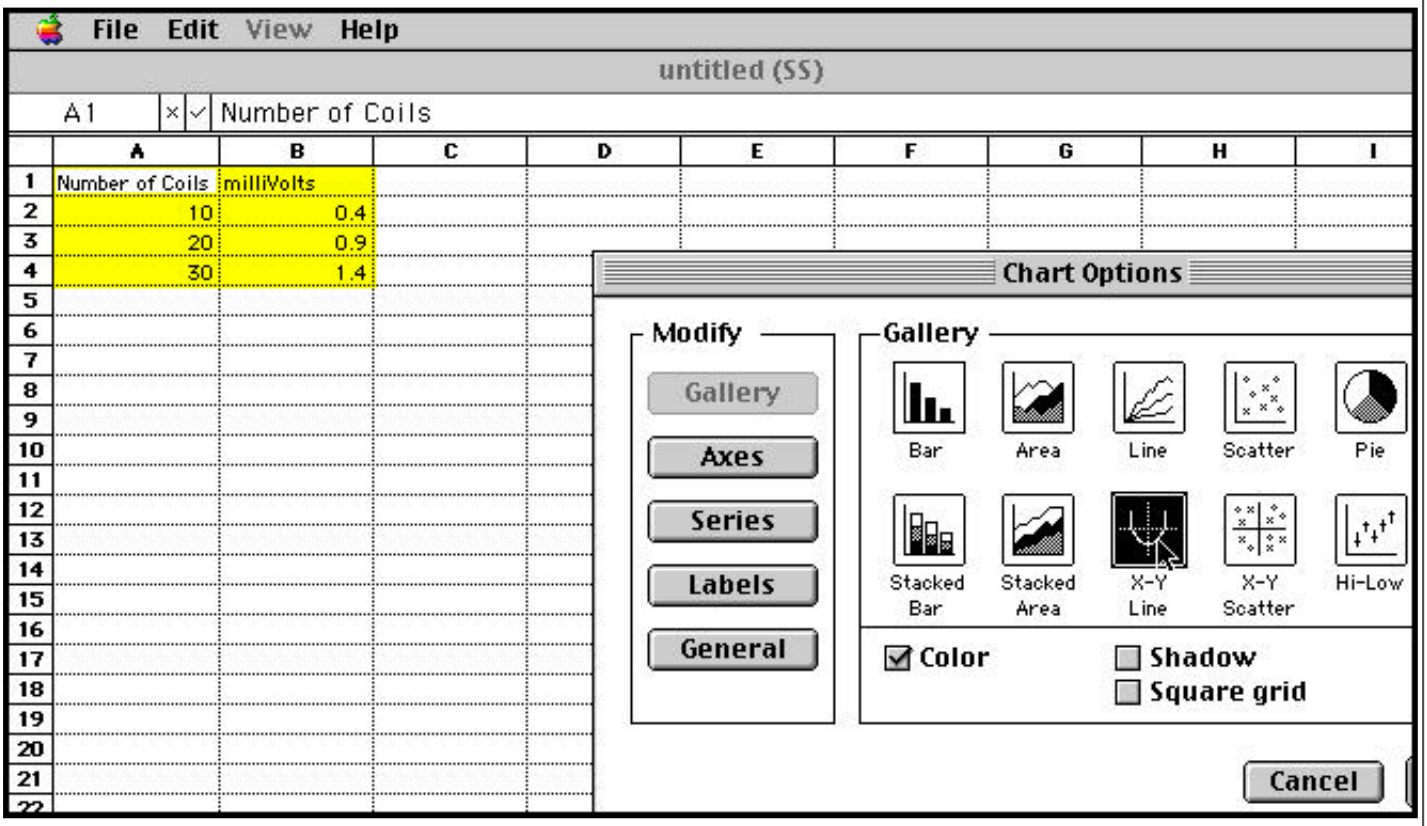
Moving Magnets Technical Hints

To create a x-y line graph:

1. Highlight your data starting with Cell A1.
2. Select Make Chart from the Options menu. Click on x-y Line graph. If you want to title the graph, double click on the chart and select the Label button. Type MilliVolts versus Number of Coils.



3. To change from x marks the spot to solid circles, double click on the graph and select series. Choose the solid circle.

CLOSE

Moving Magnets Analysis

Answer the following questions on paper:

1. How did the voltage change when the direction of the magnet was changed? Explain your reasoning.

2. How did your prediction about the change in voltage compare to the voltage shown on the multimeter after testing the ten and twenty wrap coils?

3. Reread the ideas your wrote down about the how the voltage would change with an increase in wraps of a coil in "Thinking About the Question". Think about the data you have gathered. Does this data support your original idea or does it suggest to you a different explanation? Revise your original explanation. Include evidence from Investigation I and II in your revised explanation.

4. How did your prediction about the change in voltage compare to the voltage shown on the multimeter after testing the ten and thirty wrap coils?

5. Reread the ideas your wrote down about the how the voltage would change with an increase in wraps of a coil in "Thinking About the Question". Reflect on the data you have gathered. Does this data support your original idea or does it suggest to you a different explanation? Revise your original explanation. Include evidence from Investigation I, II, and III in your revised explanation.

6. Create a x-y line graph for the highest positive voltages for each coil constructed. Refer to Technical Hints to see how to make a bar chart. Describe the differences in voltages.

7. Make a general statement about the relationship between magnetism and electricity.

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Moving Magnets Further Investigation

Research how to build a simple motor that is operated by battery. Design and test your motor for voltage output with different batteries.

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