Brady Kondek **4.06 Honors Electromagnetism**

Part One: Faraday's Investigation

Section 1: Data Collection
Plan the order you will test your magnetic and electric current interactions. For example, you can use the small or the large coil and you can change the magnet's orientation. Observe what happens with the voltmeter when you change the direction of the magnet. Record the interactions between the magnet and the electric current in the Faraday's law simulation below. An example is provided for you.

Trial	Magnet's Orientation	Size of Coil	Movement of Magnet	Voltage Reading
Example	*North to south*	*Large*	*Placed magnet on right side of coil and moved it left into the coil all the way through.*	*Negative when the magnet entered the coil.* *Positive when the magnet left the coil.*
Trial 1	South to north	Large	Moved magnet from the right side to the left side through the coil.	**Positive** when the magnet entered the coil, and **negative** when the magnet left the coil.
Trial 2	North to south	Small	Moved magnet from the right side to the left side through the coil.	**Negative** when the magnet entered the coil, and **positive** when the magnet left the coil.
Trial 3	South to north	Small	Moved magnet from the right side to the left side through the coil.	**Positive** when the magnet entered the coil, and **negative** when the magnet left the coil.

Section 2: Questions

Please answer all questions using complete sentences and referring to data collected as evidence in your answers.

1. From your observations, how do you know the movement of the magnet is causing an electric current in the wire?

    I can notice this mainly due to the lightbulb placed within the circuit. As the magnet went in and out of the coil, the lightbulb grew brighter from the electric current.

2. How did changing the magnet's orientation affect the magnetic field lines around it?

    By changing the magnet's orientation, the direction of the of the conventional current flipped. This can be seen by the fact that the arrows change direction as the orientation is changed between north to south and south to north.

3. How did changing the magnet's orientation affect the direction of current flow? (Hint: The direction is shown by the + and − in the voltmeter.)

    The change in the magnet's orientation resulted in the directions swapping when the magnet went in through the coil from right to left. In trial 1 (south to north) instead of going in positive and coming out negative, it would go in negative and come out positive for north to south.

4. How did the number of coils affect the strength of the current?

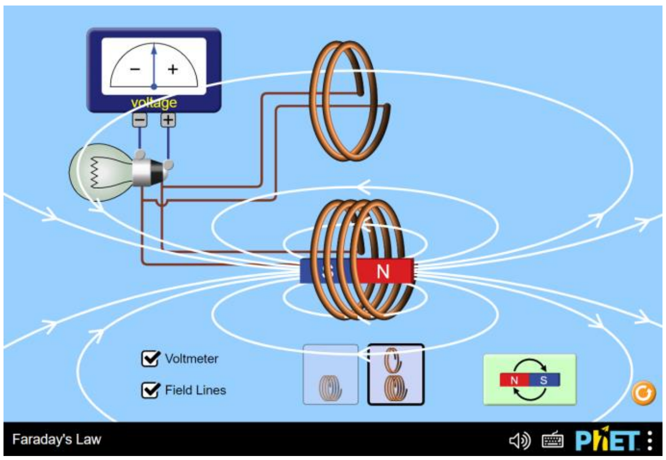
    The more coils there were present, the stronger the current was. The larger coil had a much stronger current than the smaller one did.

5. Place the magnet inside one of the coils. Select to change the magnet's orientation only. Do the same for the other coil. Record your observation regarding the effect on the bulb and explain what this tells you about the effect the number of loops in a coil has on electric current.

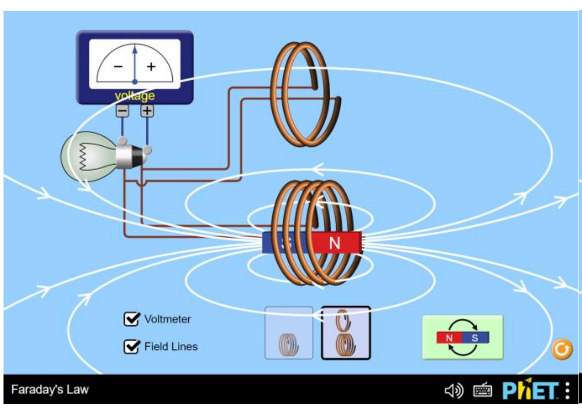
   As the magnet's orientation is changed while it is located within the coil, a sudden increase in current is observed. A much higher increase is seen when the magnet is within the larger coil, thus proving that more coils results in a much higher electric current.

Section 3: Model Cause and Effect Relationship

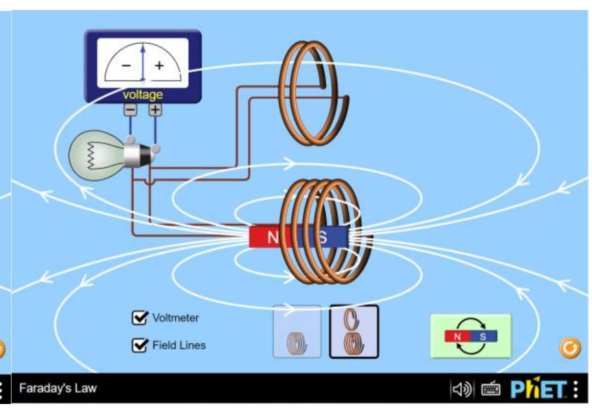
Take a screenshot or draw an illustration of the magnetic field lines (forces) between the magnet and the coils of one of your trials. Be sure to include the electrical circuit in the screenshot or illustration.



Use your screenshot or illustration to model the cause-and-effect relationship between changing magnetic and electric fields. Label the direction of electrical current (energy) in your circuit. Place your screenshot or illustration with labeling below. (Hint: Does the current move from the positive to the negative node of the voltmeter or vice versa during your trial?)



South to North (positive to negative)



North to South (negative to positive)

Changing fields results in how the current flows and what direction it flows. For example, as we saw in the trials above, changing from north to south -> south to north resulted in a change from negative to positive -> positive to negative.

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Part Two: Electromagnets

Section 1: Hypothesis and Data Collection
Form a hypothesis that reflects which material, voltage, and number of wraps you think will produce the strongest electromagnet.

Large copper with 100 volts will produce the strongest electromagnet.

Data Collection:
Plan five trials to test the strength of your electromagnet by varying the voltage, materials, gauge size, and number of wraps of the wire. Observe what happens with the voltmeter and number of paper clips collected with each trial. Record your observations below.

Trial	Size of Wire Gauge	Material of Wire	Voltage	Number of Wraps	# of Paper Clips Picked Up
Trial 1	Large	Copper	100 V	6	4
Trial 2	Large	Copper	50 V	6	2
Trial 3	Medium	Aluminum	100 V	6	1
Trial 4	Medium	Aluminum	50 V	6	0
Trial 5	Small	Yarn	100 V	6	0

Section 2: Questions

Please answer all questions using complete sentences and referring to data collected as evidence in your answers.

1. The voltage provides the push for an electric current within the electromagnet. What is your evidence that a magnetic field is also present?

    It can be proven that a magnetic field is present as magnetic force is distributed in the space around the electromagnet. Electromagnetism is the magnetic effect of current, and current within a wire produces a magnetic field; thus making the object a magnet itself.

2. Did the number of wraps or the size of the coil influence the strength of the electromagnet? If so, how?

    The number of wraps/the size of the coil increased the strength of the magnet when the material was aluminum and copper. I did some other trials beyond what I did in the table where I had 100 wraps and it picked up 60 and 30 paper clips for copper and aluminum versus the 4 and 1 I listed in the table.

3. How did changing the voltage affect the strength of the electromagnet?

    The voltage affected the strength especially when it came to how many paper clips were picked up by the copper and aluminum wires. The same wires with 100 V and 50 V had a difference of 2 paper clips.

4. Which materials worked best as electrical conductors for your electromagnet? Which molecular properties of these materials made them more suitable for use in an electromagnet? (Hint: Review conducting materials in your lesson.)

    Aluminum and copper worked as the best electrical conductors for my electromagnet. This is because of the fact that the atoms in these materials have a very loose hold on the electrons.

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5. Was your hypothesis correct? What changes could you make to create a stronger electromagnet?

    My hypothesis was correct. To make it stronger, I could make the magnetic field stronger/increase the current.

Section 3: Model Fields and Forces

Using the right-hand rule from your lessons, determine the directions of the electrical current and magnetic field of the electromagnet. Create an illustration of these perpendicular forces and include it below. (You can take a picture of your illustration or use an online drawing program to make your illustration.)