## PHYS 183 Activity: Initial Magnet Group Investigation with "Faraday's Electromagnetic Lab"

(earliest birthday)
(next earliest birthday)
Learning Goals: You will be able to

- Predict the relative strength and direction of the magnet field for different locations around a bar magnet and electromagnet.
- Determine the effects of changing an electromagnet's voltage, polarity and number of turns on the produced magnetic field strength and magnetic field direction.


## Bar Magnet Tab

1. Go to http://phet.colorado.edu/en/simulation/faraday, the simulation called "Faraday's Electromagnetic Lab". Click "Run Now". Click in the Bar Magnet tab at the top of the simulation. Set the field strength to $100 \%$.
2. Explore the different items in the menu on the right-hand side.
3. How can you use a compass to determine the south pole of a magnet? A north pole?
4. Use the simulation to determine the relationship between the distance from the magnet and the strength of the magnetic field at that point. Use a ruler to measure distance on the screen. Use a power fit to determine the B vs. r relationship for each location. To simplify your data collection, chose a data-collection axis where either $B_{x}$ or $B_{y}=0$. Measure the distance from the nearest edge of the magnet. You will need to obtain a ruler for collecting data.

| Distance from <br> magnet (cm) | Field strength measured <br> straight out from the south <br> end of the magnet (G) | Field strength measured <br> straight out from the north <br> end of the magnet (G) | Field strength measured <br> straight up from the center <br> of the magnet (G) |
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| B vs. r <br> relationship |  |  |  |

Attach a graph of your results. Properly label the graph. Compare each graph to a power fit ( $\mathrm{Bar}^{\mathrm{n}}$ ) and include each fit and $\mathrm{R}^{2}$ value on the graph. Put all three of these curves on the same set of axes.
5. Is the B vs. r relationship the same (or similar) for the different axes you tested? Why or why not?

## Electromagnet Tab

1. Click on the Electromagnet Tab. Explore the different items in the menu on the right-hand side.
2. Explore field strengths at different locations around the electromagnet (coils of wire). How does the general pattern of the magnetic field compare to the bar magnet?
3. Use the simulation to determine the relationship between the distance from the south end of the electromagnet and the strength of the magnetic field at that point. Put your data on the table below. To simplify your data collection, chose a data-collection axis where $B_{y}=0$. Measure the distance from the nearest edge of the electromagnet. How does this relationship compare to the ones you found in the bar magnet section?

Attach a graph of your results for the electromagnet section. Compare the graph to a power fit ( $\mathrm{B} \alpha \mathrm{r}^{\mathrm{n}}$ ).

| Distance from the <br> electromagnet <br> $(\mathrm{cm})$ | Field strength measured <br> straight out from the south <br> end of the electromagnet (G) |
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| B vs. r <br> relationship |  |


| Number of <br> loops | Field strength measured <br> straight out from the south <br> end of the electromagnet (G) |
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| B vs. loop <br> relationship |  |

4. Use the simulation to determine the relationship between the number of loops of wire and the strength of the magnetic field at a point used above. Put your data on the table above. Chosen battery voltage:_. Chosen distance away: $\qquad$
5. Use the simulation to determine the relationship between the battery voltage and the strength of the magnetic field at the point chosen above. (When you vary the voltage, do not flip the polarity of the battery.) Put your data on the table below. Chosen number of loops: _. Chosen distance away:

| Voltage | Field strength measured straight out <br> from south end ___ away (G) |
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| B vs. V <br> relationship |  |

6. Chose one of the other simulations (Pickup Coil, Transformer, Generator). Use this simulation to determine a relationship between two parameters similar to the ones you found above.
Simulation chosen:

| Independent variable (the one varied <br> or manipulated) | Dependent variable (the one that responded to <br> the variation) |
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Attach a graph of your results. Properly label the graph. Compare each graph to a power fit ( $\mathrm{B} \alpha \mathrm{r}^{\mathrm{n}}$ ) and include each fit and $\mathrm{R}^{2}$ value on the graph.

One copy of this sheet plus all attached graphs is due from each group.

