Physics 221 – Lab 13
Magnetism and induction

More Fun with Tape!

You will use T and B tapes again, this time to investigate magnetism. Below are the directions for making T and B tapes:

> Each member of your group should press tape onto the surface and write a “B” (for bottom) on it. Then press another tape on top of each B tape and write “T” (for top) on it. Slowly pull each pair of tapes off the table as a unit. After they are off the table, separate the T and B tapes quickly.

Materials:
Scotch tape, clear plastic strip, pair of bar magnets, 1 neodymium magnet, compass, large nail, small pieces of paper (torn ~1 cm per side)

<u>Static Electricity Refresher:</u>

1. Do the T and B tapes attract or repel one another.
2. Are the T and B tapes charged opposite, the same or neutral?
3. Does the T tape attract or repel the nail?
4. Does the B tape attract or repel the nail?
5. Does the T tape attract or repel the bits of paper?
6. Does the B tape attract or repel the bits of paper?
7. Rub the clear plastic strip with a paper towel vigorously. Now check it with the T and B tapes. Describe how each reacts to it.

Use the terms *conductor*, *insulator* and *polarized* where appropriate to answer the following three questions:

8. Does the nail have the same or opposite charge as the T tape or is it neutral? Why?
9. Do the bits of paper have the same or opposite charge as the T tape or are they neutral? Why?
10. Does the plastic strip have the same or opposite charge as the T tape or is it neutral? Why?

<u>Static electricity versus magnetism – Are they the same??</u>

1. Use your T and B tape plus the bits of paper and carefully test how each reacts to the different magnets.

	T – Tape	B – Tape	Bits of paper
N end of bar magnet			
S end of bar magnet			
Neodymium magnet top			
Neodymium magnet bottom			

Now play with the different magnets investigating if they attract or repel each other and the nail.

2. Explain exactly how you can get two magnets to attract each other.

3. Explain exactly how you can get two magnets to repel each other.

4. Did either the T tape or the B tape repel any part of the magnets? Explain.

5. Compare the strength of the force between the two bar magnets to the strength of the force between one of the bar magnets and the neodymium magnet. Is there a difference?

6. Compare the strength of force between the nail and a bar magnet versus a nail and the neodymium magnet?

7. Based on these experiences, what would you say about the strength of the magnetic field of your neodymium magnet versus your bar magnet?

8. Now compare the strength of the force between the tape strips and the bar magnet versus the tape strips and the neodymium magnet. Is there a difference?

9. Did either of the tape strips repel any part of the magnets? Based on your observations so far, do you think the force between the tape strips and the magnets is the same type of force as the force between a magnet and another magnet? Use the terms *electrostatic force* and *magnetic force* in your description.

Open the PhET (phet.colorado.edu) simulation ***Faraday's Electromagnetic Lab***. Investigate the simulation and use the simulation to answer the following questions.

1. Draw the shape of the magnetic field around a bar magnet.

2. Why does/What makes a compass needle point North?

3. A student suggests that the needle of a compass must simply be a magnet. Does this fit with your observations?

Go back to your real equipment for a moment.

4. Use your compass to investigate both one of your bar magnets and your neodymium magnet. Draw each below and map out the magnetic field for each.

5. Use your compass to investigate how it reacts to the tape strips, the charged clear plastic strip and the bits of paper. (recharge your strip so it's as strong as possible)
    a. Carefully check and re check to see if you can get the needle to always point the same direction at various points of the strip.
    b. Check the compass with the magnets again. Does the needle always point the same direction at a given location? For example can you get both the arrow point and the end of the arrow to point at the N end depending on how you approach the magnet?

6. Based on your observations, use the words *conductor, magnet, electrostatic force*, *magnetic force* and *direction* to describe how a compass reacts to a charged strip and to magnets.

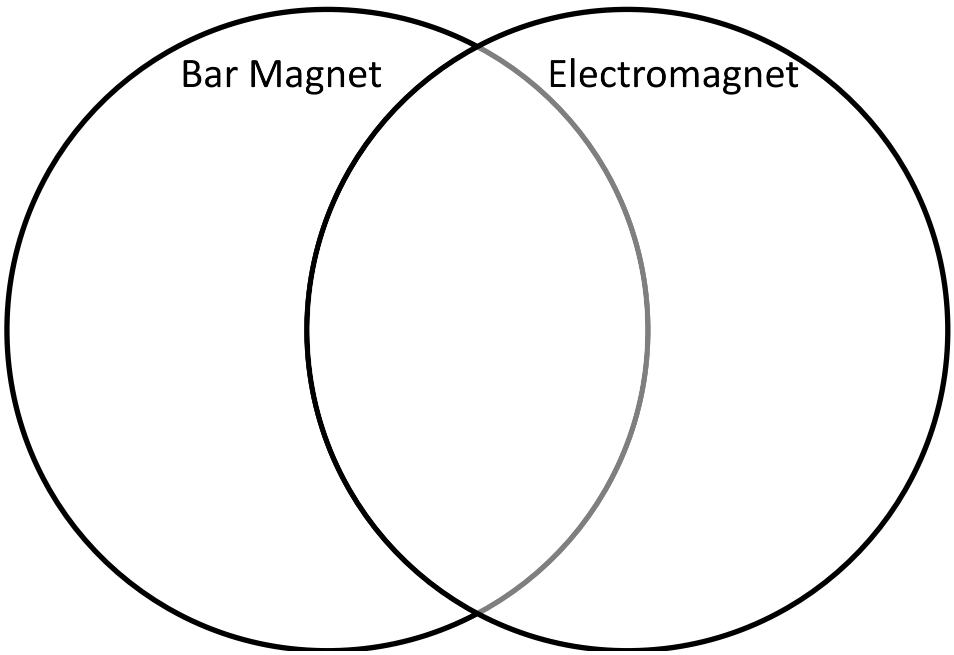
Induction

Continue investigating **Faraday's Electromagnetic Lab**

1. Make a list of ways to make a light bulb light.

2. How can you make the light bulb brighter?

3. Investigate tabs 3 and 4 (electromagnet and transformer). Make a Venn diagram to show the similarities and differences between a bar magnet and an electromagnet.



4. How does a compass respond when you use AC current on the electromagnet? Why?

5. Experiment with the Transformer tab and describe how to get the most light out of the bulb.

6. The phenomenon of lighting a light bulb with a magnet is called **<u>induction</u>**. Describe, in your own words, what **induction** means, include step by step instructions of how to accomplish it using terms such as *magnetic field, change, direction, electrons* and *current.*

7. What is the story of light production on the Generator tab? Organize and connect the "plot elements" listed below and add any key elements that were omitted from the list to construct the complete story.

- Light radiated from the bulb
- changing magnetic field
- induced electric current
- Motion of the bar magnet
- kinetic energy of the water
- heat the filament