Worksheet: Magnetism

Name: ____ Group name: ______________________

1. Take your compass and move it around the table and the room a little bit. Also move it close to other objects, such as cell phones, laptops, metal cabinets. What do you observe?

2. Draw a diagram of the lecture room indicating the blackboards and entry doors below.

   (a) Use a cell phone maps program to find the direction north while standing in the center of the room – away from all other magnets and magnetic materials. indicate true NORTH with an arrow in your diagram.

   (b) Indicate your compass needle NORTH with another arrow. Are they different – and if so WHY?

   (c) You know that magnets have two poles; for example the red end of the most compass needles is the **north** pole. What does this tell you about the magnetic field of the Earth, i.e. where is the Earth's magnetic north pole?

3. Set a compass in a region, where it is, as much as possible, influenced only by the Earth's field, avoiding all other magnetic interference. Turn the wheel until the red arrow points towards the top of the compass, then turn the compass until the aligns with the compass until the red arrow aligns with the needle.

   (a) Carefully approach the compass with a permanent magnet from the west or east with one of the larger faces facing the magnet (**Do not touch** the compass with the magnet!). What do you observe as you get closer? Which magnetic fields are "competing"?

   (b) Face different faces of the magnet towards the compass. What happens? Draw the magnet, and indicate which faces are the north and south pole. Draw some magnetic field lines.

4. Repeat the previous setup. Approach the north pole of your compass with the north pole of your permanent magnet until the needle is deflected due east or west.

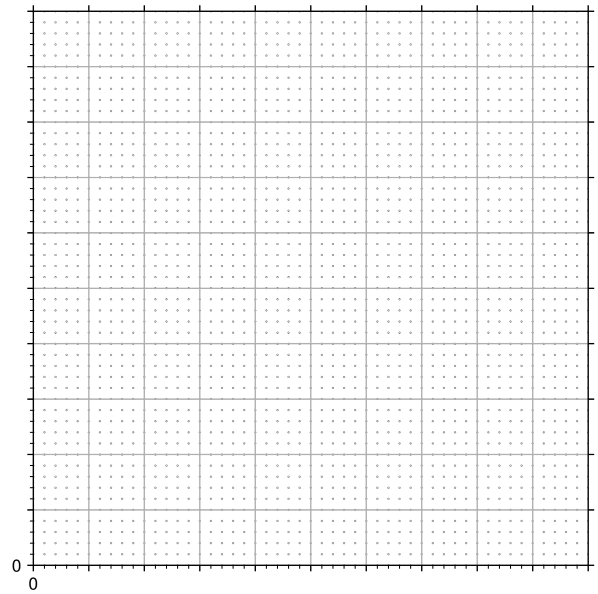
   (a) Measure the distance from the needle to the magnet:

   d = _______________ ______

   (b) How strong is the magnetic field of the permanent magnet at the needle?

   M = ______________ ______

(c) Repeat the experiment with 2, 3, 4 magnets in series. Assume that 2 magnets in series double the strength of the magnetic field. Graph magnetic field strength per magnet *M* over distance *d*.



5. Lift a paper clip and a steel bolt with a magnet. Place the north pole of your permanent magnet about 10 cm above your object. Place a ruler next vertically next to your object. Carefully approach the object from above and record the distances at which they attract.

   (a) Distances: Bolt: ________________ Clip: __________________

   (b) Which forces are competing in this scenario? Why is it harder to lift the bolt than the clip?

   (c) Do you expect your results to change if you use the south pole of your magnet? Run the experiment and explain!

6. Build an electromagnet: Take the spool of wire and use all the wire to wind a uniform coil around the bolt. Leave at least 10 cm ($\approx$ 4 inches) of extra wire at the beginning and finish of your coil for making connections.

   Place the wire on top of the wood block and scrape 2 cm ($\approx$ 1 inch) of insulating enamel off the end of each of the leads coming from your coil. The copper wire is coated with insulating enamel which must be removed to reveal expose the copper metal before a good electrical connection can be made.

   Now that you have finished winding the coil and have scraped 2 cm of insulation off the ends of the 10 cm wires, build a circuit with a 3V battery and a switch in series with the bolt-coil assembly

   (a) Do not close the switch, and bring the compass next to the bolt's head. What do you observe?

   (b) Now close the switch and do the same. What changed?

   (c) Given what you've observed, is the head end of the bolt acting as a north or a south magnetic pole? Explain! Confirm by approaching the tail end of the bolt.

   (d) What is causing the bolt to act as a magnet?