

Name(s): _____ Date: _____ Period: _____

Magnetic Field Maps and Electromagnets Lab

Materials:

- Two bar magnets with an identifiable North and South pole
- A horseshoe magnet with an identifiable North and South pole
- Magnet diagram (on Page 4)
- Large piece of cardboard
- Jar of iron fillings (optional – a small dish to momentarily hold them in)
- Piece of paper
- A 12V battery
- Electromagnet (Coil-style)
- Iron-rod
- Wire
- Switch
- Rheostat (initially set to lowest resistance)
- Metal objects (paper clips, pennies, clips, etc.)
- Compass

Purpose: To identify the magnetic field that results from different magnet configurations and to determine the qualities of an electromagnet.

Theory: A magnet consists of two poles – one North and the other South. The North pole attracts the South pole, while identical poles repel one another. How can these poles apply forces on themselves without making contact? The answer can be found in the magnetic field around these poles. This lab will illustrate these magnetic fields and how they interact with other magnetic fields. In addition, through the electromagnet, we will see how current and magnetism are related.

Lab I – Illustrating Magnetic Fields

Note: Do NOT put the iron filling in direct contact with the magnet or on the same level with the magnet. The cardboard is used to keep the iron filling above the magnet. If the iron fillings touch the magnet, they will be very hard to remove.

1. Place the bar magnet on a table.
2. Place the cardboard sheet over the magnet. Then place the piece of paper over the cardboard.
3. Lightly sprinkle the iron fillings in the area around the magnet. The iron fillings should start to illustrate the magnetic field.
4. If needed, lightly tap the cardboard against the magnet. This will cause the iron fillings to move and take the shape of the magnetic field.
5. Record the magnetic field on the magnetic field diagram. Use your knowledge of North and South poles to determine which direction the magnetic field is in.

Now, either use the sheet of paper to place the iron fillings into a holder, or spread the iron fillings around the paper.

6. Repeat steps 1 – 5 again, but replace the bar magnet with: a horseshoe magnet, two bar magnets with opposite poles facing each other, and two bar magnets with the same poles facing each other (consult page 4 for an illustration). If the iron fillings were left on the paper, skip step 3.

Lab II – The electromagnet

1. Get an electromagnet (Instructions for making one: Find a cylinder larger than the iron rod needed for this experiment, like a test tube. Use insulated copper wire and wrap it around the object and complete about 10 loops. Then, remove the insulation from the ends of the electromagnet where the wires can connect to them).
2. Create a circuit consisting of a 12V battery, a switch, a rheostat, and the electromagnet.
3. Place the compass right next to the electromagnet.
4. While observing the compass, close the switch. Then, once the compass point has stopped moving, insert the iron rod into the electromagnet. Remove it once the compass stops moving. Then, open the switch once the compass is steady.
5. Move the rheostat to the highest resistance possible. Repeat step 4.
6. Reverse the terminals of the battery. This will result in the current going in the opposite direction. Repeat steps 4 and 5.
7. Using a magnet, test to see if the other metal objects are magnetic. Then, move them inside the electromagnet while observing the compass.

Conclusion Questions:

1. Does a magnetic field go from North to South, or South to North?
2. Using your magnetic field diagram, explain why identical poles repel each other.
3. Using your magnetic field diagram, explain why opposite poles attract each other.
4. What is the difference in the magnetic fields of a bar magnet and a horseshoe magnet?

The following questions ask about the compass during the electromagnet lab.

5. What occurred when the circuit was turned on? What occurred when the circuit was turned off?
6. When the iron rod was inserted, what occurred? When it was pulled out, what occurred?
7. Did the non-magnetic objects cause the compass to deflect? Did other magnetic objects cause the compass to deflect?
8. When the rheostat was adjusted to maximum resistance, did the magnitude of the compass deflection increase, decrease, or stay the same?
9. What was the difference between the compass deflections when the battery was reversed in comparison to your first trial?
10. Using your answers to the previous questions, prove the theory that current and magnetic fields are related. Support your position with this experiment. Fill out the chart below to help.

Question	Why?
5.	
6.	
7.	
8.	
9.	

