LAB 6 MAGNETIC FIELDS by R.E. Tremblay

Purpose:

(1) To examine the concept of a field.
(2) To sketch the magnetic field associated with bar and horseshoe magnets.
(3) To locate a point in space where the earth's magnetic field and that of a magnet are the same strength.

Materials: Two sheets of 8.5 by 11 inch paper, 2 bar magnets, 1 horseshoe magnet, centimeter ruler, iron filings, tape, and 1 small compass.

Background Discussion: An object is said to be magnetic, when it is surrounded by a magnetic field. The word 'field' is used to describe a region in space, where a value exists for a measurable quantity at every location. Field lines are a crude way of describing a field. When you see a weather report on TV, it is often accompanied by a map that shows the temperature field near the Earth's surface. The temperature field is drawn by connecting regions of equal temperature with lines called isotherms.

In this lab., we are going to draw lines that represent the magnetic field that surrounds a magnet. On a magnetic field map, lines drawn close together indicate a strong field. By convention, the direction of the field is the direction that a magnetic north pole would travel-North to South. Magnetic fields are of interest to us because their effect on a compass provides us with directional information that may be used to navigate through unfamiliar regions. Magnetic fields may also be employed to change the direction of charged particles, such as electrons, as they move through a television picture tube or through an x-ray tube.

A stationary, charged particle will not have a magnetic field surrounding it. However, a moving charge particle will be surrounded by its own magnetic field. Therefore, any charged object that moves through a magnetic field, will have an electromagnetic force applied to it. The earth is surrounded by a magnetic field that protects the Earth from charged particles that are streaming in from outer space. It deflects the charged particles around the Earth and toward the Earth’s magnetic poles, thus shielding the Earth.

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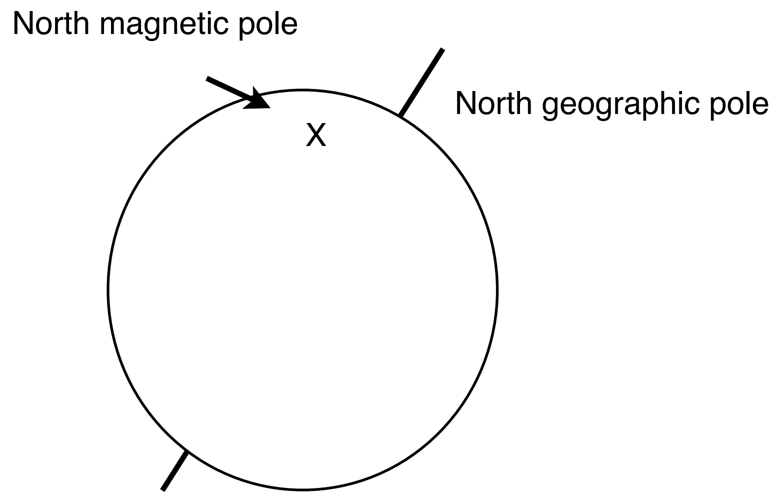

The interactions between the charged particles and the upper atmosphere produce spectacular night displays called the Northern or Southern lights. These auroras, can be seen with the naked eye from northern and southern latitudes during times of increased solar 'sunspot' activity. As mentioned earlier, moving charged objects create magnetic fields and external magnetic fields apply forces on moving charges.

The magnetic field from a piece of iron results from the alignment of regions within the iron known as magnetic 'domains'. The domains are produced by the "spin" of electrons inside the atom.

The Aurora Borealis seen in Alaska

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__**Procedure**__:

Part A-Using iron fillings to reveal the presence of the magnetic field surrounding a magnet.

1) Cover a bar magnet with a piece of paper. Support the paper so that it lies flat over the bar magnet. Gently sprinkle some iron filings over the paper and tap the paper lightly with your hand. You should see distinct lines of iron filings that surround the magnet. The iron filings have lined up with the magnetic field that surrounds the magnet. __**Neatly**__ make a sketch of the magnetic field on the work sheet provided.

2) Repeat step 1 using the horseshoe magnet instead of the bar magnet.

3) Repeat step 1 using 2 bar magnets end to end, with the __opposite poles__ separated by about 2 inches. See data sheet.

4) Repeat step 1 using 2 bar magnets end to end, with the __like poles__ separated by about 2 inches. See data sheet.

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LAB 6 **Part B**-Mapping the magnetic field using a small compass.

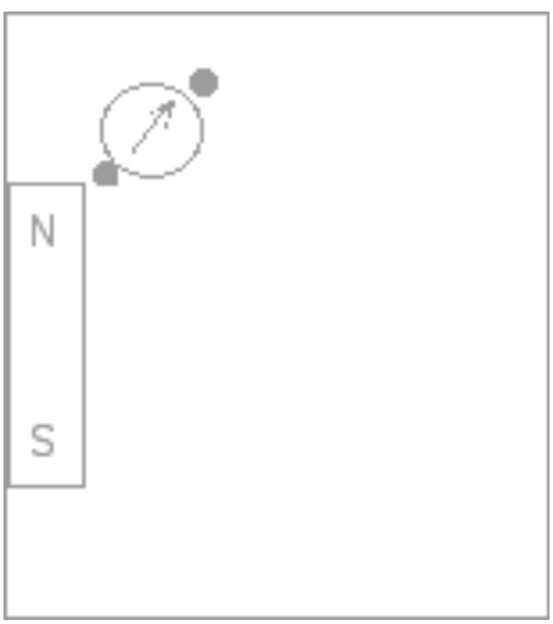
It might be of interest to you to know that a compass is just a magnet that is free to rotate. The earth's magnetic field pushes on the magnet in the compass and aligns it in approximately a North-South direction.

1) Use the compass to determine the direction of magnetic north. Tape a piece of paper so that **its length is in the North-South direction**. Tape another piece of paper to the right of the first piece of paper.

2) Place the bar magnet on the left edge(as you face north) of the paper. The north pole of the magnet must face north. Tape the magnet in place and trace around it with a pencil.

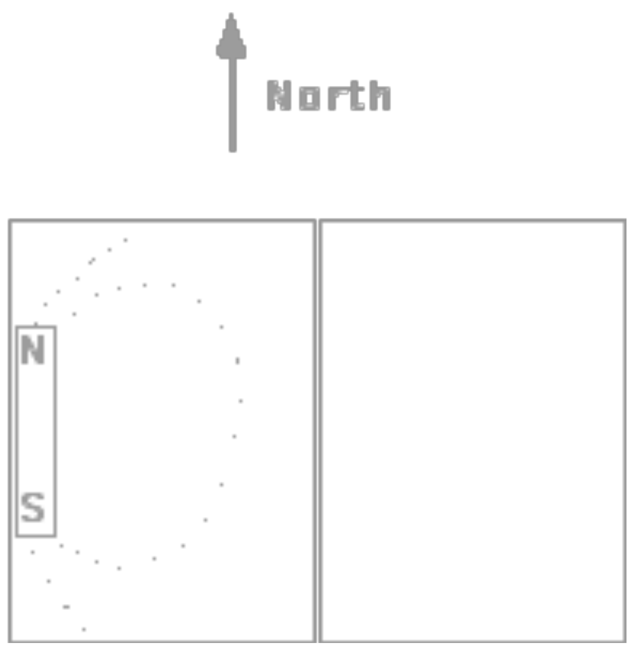
3) Make a dot near the north end of the magnet and place the end of the compass needle next to it. See diagram below.

4) Make a dot on the paper at the other end of the compass needle. See diagram below.



5) Move the compass so that the end of the needle is next to the new dot and again mark the location of the tip of the needle.

6) Continue going back to step 5 until you are off the paper or have arrived at the other end of the magnet.



Run a smooth line through the dots. You may have to tape another piece of paper to the right edge.

7) Make a new starting dot at near the north end of the magnet and again place the end of the compass needle next to it.

8) Repeat steps 4-7 until you have a detailed map of the magnetic field.

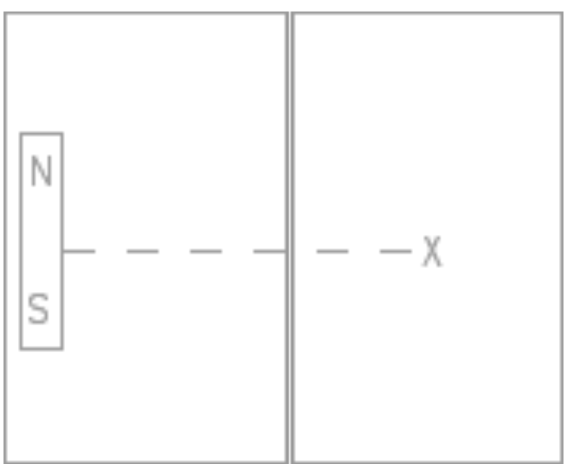
9) Save this setup and diagram for part C.

Part C-We will locate the region near the magnet, where the earth's magnetic field is the same strength as the magnets magnetic field.

1) Draw a line perpendicular to the magnet in part B. It must go from the middle of the magnet out across the paper.

2) Place the compass near the magnet, on the perpendicular and slowly move it away from the magnet.

3) Find the region where the compass needle has no preferred direction- the needle is not pulled strongly in any particular direction, and mark it with an 'x'. The 'x' marks the spot where the earth's magnetic field and the magnet's magnetic field have the same strength but are in opposite directions. They have cancelled each other out.



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Name:________________________

Lab preparation: Please complete the following exercise before coming to lab. Hand this page in, before the beginning of the lab.

1. What is a field?

2. What surrounds a moving charge?

3. How are magnetic fields useful?

4. What is the relationship between a compass and a magnet?

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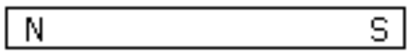
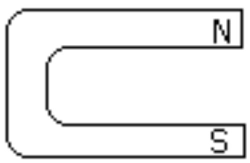
LAB 6 Name____________________ section___

<u>Work sheet for part A:</u> Make your sketches **<u>neatly</u>** below.

Sketch the magnetic field of a bar magnet.



Sketch the magnetic field of a horseshoe magnet.



Sketch the magnetic field between two bar magnets with opposite poles near each other.

Sketch the magnetic field between two bar magnets with like poles near each other.

(8)