

LAB E4: MAGNETIC FIELD LINES

2/17/03

Goal: To investigate the phenomenon of magnetism by plotting the magnetic field lines around a bar magnet.

Equipment:

Lucite square
1 bar magnet
2 small compasses
air table paper
large cardboard box

Prelab: After reading P³ pp. 556-559 and studying the figure of the Earth on p. 576, answer these questions:

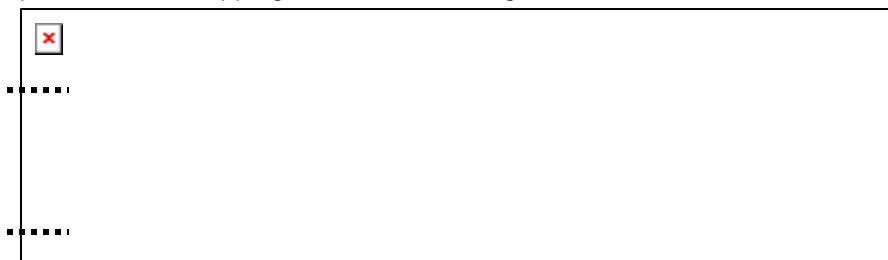
1. Which direction does the N magnetic pole of a compass needle point?
2. In which direction is geographic north (if you are standing in our classroom)?
3. In what geographic location is Earth's magnetic north pole ? south pole ?

Part I: Mapping the magnetic field lines of a single bar magnet using a compass:

Pay particular attention to the instructions (especially bold sections)!

1. Place a bar magnet at the **center** of a large sheet of air table paper on top of a large square of Lucite on top of a large box high off the floor and far from a wall (both of which could contain current-carrying wires). **Make sure you are not near any magnetic materials, including possibly magnetic materials in the walls, floor and tables of the room you are in, and possible magnetic materials in your calculator, pen, etc.** Orient the magnet so that its long axis is exactly perpendicular to the earth's magnetic field direction.
2. **Label** the directions to earth's geographic N and magnetic S poles on the paper. Remember that the earth's south magnetic pole is in the northern hemisphere! **Position the magnet so that when you are facing toward the earth's magnetic south the S pole of the bar magnet is on your right. (see picture below)**
3. **Trace** the magnet shape onto the paper and correctly **label** the bar magnet's N and S poles. Do **NOT** move the magnet or the box that it is on until the end of the experiment!
4. Starting near each corner of the NORTH end of the magnet, place 5 tick marks spaced about 4 millimeters apart down the long axis of the bar magnet. (See figure below.)

one partner starts mapping on this side of magnet



other partner starts mapping on this side of magnet

1. Now each partner takes one of the **very small** compasses (diameter = 1 cm) and places it such that one of the tick marks lies on the circumference of the compass and such that the S end of the needle points directly to the tick mark. With a pen, make another tick mark on the opposite side of the compass, i.e., at the place to which the N end of the compass needle points.
2. Now move the compass so that the S end of the needle points at the new tick mark you just made, and again make a new tick mark on the opposite side of the compass, at the place to which the N end of the compass needle points. Keep repeating this process until the trail of tick marks reaches the edge of the paper or returns to the south end of the magnet.
3. Connect the tick marks with a smooth curve to produce a magnetic field line.
4. Repeat steps 5 - 7 for each of the remaining tick marks at the N end of your side of the magnet.
5. Look at your field plot. Be sure there are no major gaps in your mapping---you want "enough" lines but not "too many".
6. Magnetic field lines have direction. Add the arrows to the field lines.

Interpreting your magnetic field plot

1. What did you would expect the magnetic field of a bar magnet to look like? Use your text as a reference as needed. In an unused corner of your paper, make a large sketch of the pattern you expected.
2. Compare the expected diagram with the field lines you plotted using the compass. You should notice a distinct asymmetry in your actual field lines. How can you account for this ? Hint: the compass points in the direction of the net magnetic field. Consider a location on your paper that lies along the perpendicular bisector of your magnet (the bisector that forms a N-S line). Draw a vector diagram to show how the two magnetic fields at locations on that bisector are combined to form the net field. **CALL TEACHER OR LAB ASSISTANT OVER TO CHECK AT THIS POINT**

Your field mappings are your lab report. Be sure both partner's names and your block are clearly in the upper right corner of all mapping papers.