Magnetic Fields

A great deal can be learned about the action of a magnet and the nature of magnetic forces by studying the space surrounding the magnets and plotting the magnetic lines of force.

On Earth, we think of magnetism as the property possessed by certain substances of attracting pieces of iron, nickel, cobalt, and certain alloys. The poles of a magnet are regions where the magnetic properties are concentrated. We define magnets to have north and south poles in the following way: poles which are attracted toward the north magnetic pole of the Earth are called north poles, and those attracted to the south magnetic pole of the Earth are called south poles. Experiments show that like poles repel each other and unlike poles attract each other.

The region surrounding a magnet is called the magnetic field; it is a region in which the magnetic forces due to the magnet are noticeable. The intensity of the magnetic field at any point is the force per unit north pole placed at that point. The direction of the magnetic field is the direction in which the north pole of a compass needle points, if placed at that point. A line whose direction at any point is the same as the direction of the magnetic field at this point is called a line of force. Magnetic lines of force are imaginary lines which show the direction of he magnetic field at that point. The magnetic field at any point near a magnet placed in the Earth's magnetic field will be the resultant, or vector sum, of the field due to the magnet alone and the field due to the earth itself.

Experiment #1

Materials

Magnets (bar, optional: horseshoe, round)
Iron filings
Piece of paper

Procedure

It is best to put your magnet in a plastic container of some sort so that the filings can't come into contact with it. Otherwise, prepare for a mess.

Put the magnet in the center of a piece of paper. Lightly sprinkle the filings around the magnet on all sides. Gently shake the paper and watch the field lines emerge.

• Describe the pattern made by the field lines.
• What is behind the field lines being revealed by the filings? In other words, why do more filings clump along a field line?

Experiment #2

Materials

Magnets (bar, optional: horseshoe, round)
Compass
Paper
Tape

Procedure

1. Use the compass to determine the n-s direction of the earth's magnetic field. Make sure to keep all magnets and other iron objects away form your compass while you do this.
2. Place the long edge of your paper on the table, parallel to the direction of the Earth's field. Tape down the corners of your paper. (Think about why you want to orient your experiment in this way!)
3. Place the bar magnet in the center of your paper with its south pole pointing north. Outline the magnet on the paper and indicate its polarity and the direction of the earth's field.
4. Place the small compass near the north pole of the magnet and make a dot on the paper at each end of the needle.
5. Move the compass forward until its south pole is directly over the dot previously made at the north pole and make another dot at the north pole.
6. Repeat Step 5 until the series of dots reaches the south pole of the magnet or the edge of the paper.
7. Draw a smooth curve through the points and use arrows to indicate the direction of the lines of magnetic force.
8. Repeat Steps 4-7 starting at different places along the top and sides of the magnet.
9. Optional: Try this for magnets with different shapes.

Closure for Both Experiments

Answer these questions.

A. Do lines of force ever cross one another?
B. What do the lines of force represent about the strength of the magnetic field?
C. What does this method of investigating magnetic fields show you that the iron filings investigation did not? What did the iron filings investigation show you that the compass investigation did not?