Date _____ Period _____ Name _____

24-1 Design Your Own Physics Lab

The Nature of Magnetism

Objectives

- Determine the polarity of a magnet.
- Observe the magnetic fields around magnets.
- Experiment with induced magnetism.

Many substances have magnetic properties. For example, liquid oxygen can be attracted by a magnet. However, only iron, nickel, and cobalt, and alloys that contain them, make strong permanent magnets. A magnet close to an object that contains one of these metals will induce magnetism in the object. This induced magnetism shows up as an attraction between the magnet and the object; that's why a magnet attracts a plain iron nail.

The forces between a magnet and magnetic objects or other magnets can be explained in terms of a magnetic field. Iron filings provide a convenient way to show the magnetic field pattern around a magnet. Magnetic induction makes the filings temporary magnets that align themselves with the field of the magnet that caused the induction. The long, thin filings act like a compass needle, pointing along the magnetic field lines.

A compass is a small magnet that is free to pivot in a horizontal plane about an axis. The end of the magnet that points to geographic north is called the north (N) pole. The opposite end of the magnet is the south (S) pole. Stated another way, a magnet's N pole is really the geographic north-seeking pole. By definition, magnetic field lines exit the N pole of a magnet and enter the S pole.

Problem

How can you determine the polarity of a magnet and map its magnetic field?

Hypothesis

Formulate a hypothesis about using a compass to find the polarity of a magnet and to map magnetic field lines.

Possible Materials

- 2 bar magnets
- sheet of paper or thin cardboard
- magnetic compass
- iron filings
- iron nail

Plan the Experiment

1. Decide on a procedure that uses the suggested materials (or others of your choosing) to determine the polarity of a bar magnet and the shape and direction of the field about the magnet. Make sure you investigate fields around pairs of like and unlike poles.
2. Decide what kind of data to collect and how to analyze it. You can record your data on the drawings on the next page.
3. Write your procedure on another sheet of paper or in your notebook.
4. **Check the Plan** Have your teacher approve your plan before you proceed with your experiment.

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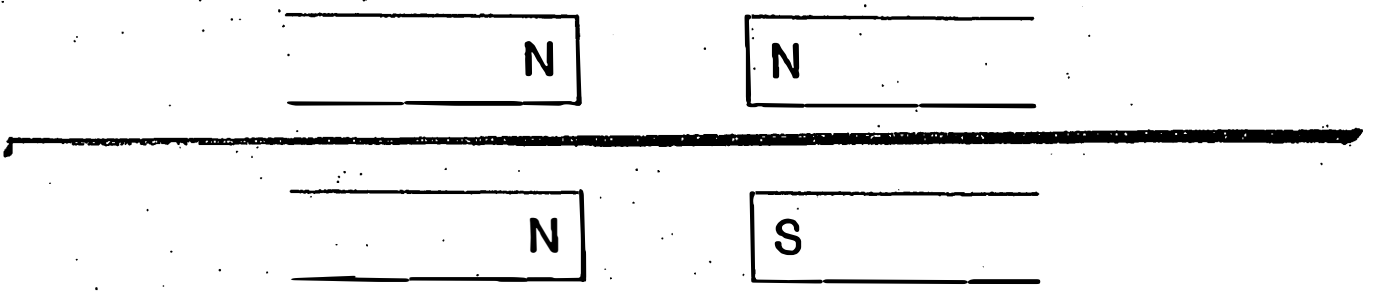
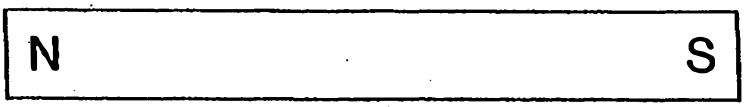
Data and Observations

Magnetic field lines between poles



Direction and shape of magnetic field lines



Analyze and Conclude

1. **Analyzing Results** Where are the magnetic field lines around a magnet most concentrated? Describe the patterns formed by the magnetic field lines between like poles and unlike poles.

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2. **Checking Your Hypothesis** How does the orientation of a compass needle change relative to the magnetic field of a bar magnet?

3. **Checking Your Hypothesis** When a compass points to the south pole of a magnet, what do the magnetic field lines around the compass and magnet look like?

4. **Predicting** A magnet is attached to one end of an iron nail. Predict the polarity of the induced magnetism at the free end of the nail compared to the magnet. Use a compass to test your prediction.

Apply

1. Draw a figure that represents Earth. Label the north and south Poles. The interior of Earth can be thought of as a bar magnet with one pole at the magnetic north Pole and one pole at the magnetic south Pole. Add to your sketch a bar magnet showing the correct polarity for Earth, and sketch the magnetic field lines around Earth.