Your Goal: is to investigate how a magnet changes the space surrounding it. Your investigation will consist of two parts. In Part 1, you will construct a 2-dimensional map of the space surrounding a magnet. In Part 2, you will explore how the magnetic forces interact between magnets and magnetized objects.

Part 1: Mapping the force surrounding a magnet

Things you will need for Part 1:

- Bar magnet
- Small see-through compasses
- Large paper (11 x 17 in or table tablet)
- Wooden pencils

In groups of two or three, work together from different sides of the magnet.

1. Lay a bar magnet in the middle of a large sheet of paper. Draw a pencil line to outline the perimeter of the magnet. Label the poles, N and S and then place the magnet back in position on the paper.

2. Place a small compass near one corner of the magnet. Place a pencil dot touching the outside of the compass at whichever end of the needle is further from the magnet (see diagram).

3. Slide the compass in the direction of the needle, so that the other end of the compass needle lies at the dot. Mark a second pencil dot next to the compass, where the needle points.

4. Continue in a similar fashion until you reach the edge of the paper, or cannot go any further.

5. Connect the dots with a smooth curve and place arrowheads at a few places along the line, indicating the direction of the compass needle.

6. Repeat this process 15 to 20 times, starting at different positions around the magnet. Each person in your group should write their initials next to each line they draw.

7. The pattern of the lines around the magnet is one way to construct a model to represent how forces are exerted in the space surrounding a magnet, represented by the density and direction of the lines. This represents a model of a magnetic field. Describe 5 different features about magnetic fields from the model you created.

a. 

b. 

c. 

d. 

e.
Investigation 2: Part 1
Don’t Cross My Path

Your Goal: in this part of the investigation will be to explore magnetic forces between magnets and other magnetic objects.

Part 2: Mapping magnetic fields between magnets

Things you will need:
- Bar magnet
- Iron filings in a salt shaker
- Adhesive tape
- Wooden pencil
- Small plastic weighing dish
- Manila folder

Now, you will use iron filings (shavings) to try to provide evidence for the kinds of forces that occur between magnetic fields and the interactions that result from them.

1. Place a single bar magnet on the lab table. Open a manila folder and place one side of the folder on top of the magnet, so that the magnet is under the middle of one side of the folder.
   a. Slowly sprinkle a small amount of iron filings from the shaker on top of the folder, over the area where the magnet is.
   b. Sketch the pattern formed by the filings in the space below.
   c. Carefully dump the filings into a plastic dish; your teacher will collect them later.
2. Repeat this process, placing two bar magnets on the table, about 2 cm (two finger widths) apart with the N and S ends facing each other. Again, place one side (half) of a file folder over the magnets, so that the magnets are under the middle of the page.
   a. Slowly sprinkle filings over the half of the folder covering the magnets until you see an obvious pattern emerge.
   b. Sketch the pattern formed by the filings in the space below.
   c. Carefully place the filings into the plastic dish, like before.

3. Now repeat the above process, this time with two N ends of magnets facing each other. Sketch the pattern formed by the filings. When finished, dump the filings into the dish.

4. Write a complete sentence to describe the differences in the patterns of the filings between the N-S pole combination and the N-N combination.
5. What do you think causes the differences in the patterns of the iron filings between the two magnet interactions?

6. Next, you will perform a similar procedure, this time using one magnet and an iron nail instead of two magnets, this time uncovered on top of the folder.
   a. Tape the nail to the lab table to hold it in position so that the head of the nail is about 1 cm (a finger width) from the **N end of the magnet**.
   b. Sprinkle a small amount of iron filings directly between the magnet and the nail. Sketch the pattern formed by the filings.
   c. Now, wipe the filings off the magnet and nail into the dish and repeat the process. This time turn the magnet around and use the **S end of the magnet**, but the **same end of the nail** as before. Sketch the pattern formed by the filings. Then wipe off the filings into the plastic dish.
d. Write a couple of sentences to compare the patterns formed by the iron filings between letter b (the nail and the N end of the magnet) and letter c (the nail and the S end of the magnet).

e. Do you think the nail has to actually touch the magnet in order to become magnetized? Explain why.

f. Do you think the magnet is interacting with the nail, the nail is interacting with the magnet, or both? Explain the basis of your decision. What evidence do you have to support what you think?

g. Based on what you have learned so far about magnetism, what do you think happens that causes a nail to be attracted to a magnet?

h. Return the shakers and dishes of filings to your teacher.

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