

Don't Cross My Path

Name _____ Per _____

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

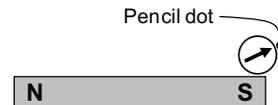
Small see-through compasses

Large paper (11 x 17 in or table tablet)

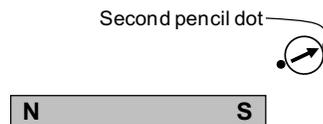
Wooden pencils

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 to 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.

Experiments in Magnetism Across Scale

Investigation 2: Part 1
Don't Cross My Path

Name _____ Per _____

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

Wooden pencil

Iron filings in a salt shaker

Small plastic weighing dish

Adhesive tape

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.

Experiments in Magnetism Across Scale

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.

Experiments in Magnetism Across Scale

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.

For more lessons and programs from Purdue Physics and Astronomy, check out **Saturday Morning Astrophysics at Purdue** on YouTube, <https://bit.ly/3dgBSG4>