Minds•On Physics Activity

FF•5

# Exploring the Magnetic Interaction

## Purpose and Expected Outcome

In this activity you will explore some properties of the magnetic interaction and record your observations. These findings will form the basis of a model for magnetic interactions that will be presented and examined in more detail in the next activity.

## Prior Experience / Knowledge Needed

No prior knowledge or experience is required. It is beneficial, however, to compare the actions and observations occurring in this activity to corresponding ones in the previous activities exploring the electrical interaction.

**WARNING: YOU ARE ENCOURAGED TO USE MAGNETS TO RE-CREATE THE PHENOMENA TO BE OBSERVED. IF THERE ARE ANY TELEVISION SCREENS, COMPUTER MONITORS, OR FLOPPY DISKS NEARBY, YOU MUST BE VERY CAREFUL TO KEEP STRONG MAGNETS FAR AWAY FROM THESE OBJECTS, AS THEY CAN BE PERMANENTLY DAMAGED BY MAGNETIC FIELDS.**

## Explanation of Activity

There are two parts in this activity. In the first part, you will record some observations about how magnets interact with each other. In the second part, you will explore some magnetic phenomena involving non-magnets.

### PART A: Exploring Magnetic Interactions

Record your views and observations regarding the interaction between magnets and assorted materials. Whenever possible test out what you think is true as you go along.

**A1.** Under what circumstances do magnets repel each other? For instance, does the repulsion depend in any way on the orientation of the two magnets? How? Does it depend on whether or not there is any material, such as paper or cardboard, between the two magnets? Does it depend on the separation of the two magnets? What other features of the situation are relevant?

**A2.** Under what circumstances do magnets attract each other?

**A3.** Do all magnets behave the same way? If not, explain any differences.

**A4.** Make a list of some materials that appear to interact with magnets.

**A5.** Make a list of some materials that appear to not interact with magnets.

**A6.** How do magnets interact with charged objects, such as a charged balloon or a charged STYROFOAM sheet? Is it possible to charge a magnet?

## Reflection (for part A)

**R1.** In what ways are magnetic interactions similar to electric interactions?

**R2.** In what ways are magnetic interactions different from electric interactions?

**R3.** Can you show that magnetic interactions are not the result of electric interactions? Explain.

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### MAGNETIC INTERACTIONS

Magnets do not appear to interact with most materials, and non-magnetized materials do not appear to interact magnetically with each other. The table on the next page summarizes the interactions of different groups of materials. Group 1 materials are sometimes referred to as *permanent magnets*. Group 2 materials are called *magnetic* because they interact with magnets, even when they are not magnetized. Group 3 materials are called *non-magnetic*, because they do not seem to interact magnetically.

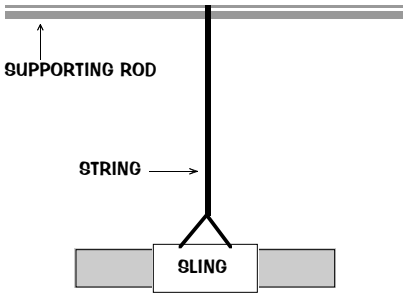
| | | Group 1<br>Permanent Magnets | Group 2<br>Iron, Steel, Nickel | Group 3<br>Wood, Aluminum, Copper |
|---|---|---|---|---|
| Group 3 | Wood<br>Aluminum<br>Copper | X | X | X |
| Group 2 | Iron<br>Steel<br>Nickel | A† | X | X |
| Group 1 | Permanent Magnets | A,R* | A† | X |

* The direction of the magnetic force depends on which parts of the magnets are closest together.

† Group 2 materials are attracted to both ends of a permanent magnet.

## PART B: Forming a Model of Magnetic Interactions

For each situation below, you will construct a similar set-up. You will hang an object from a long piece of string, and attach the combination to a moveable supporting rod. We recommended that you construct a sling, so that the objects you are studying may be put in place more easily. Record your observations carefully, so that you can share them with your classmates and so that you can begin to model magnetic interactions.




**B1.** Hang a permanent magnet (Group 1) from a string. Note the orientation of the magnet. Change the orientation of supporting rod. What happens to the orientation of the magnet? Repeat with one or two other magnets. Compare your results with your classmates. Which direction is North? How does "North" compare to the orientation of your magnets? Label your magnets according to which end appears to be attracted to the geographic North pole of the Earth.

**B2.** Hang a *magnetic* object (Group 2) from a string. Note the orientation of the object. Change the orientation of supporting rod. What happens to the orientation of the object? Compare your results with your classmates. How does "North" compare to the orientation of the objects?

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**B3.** Hang a *non-magnetic* object (Group 3) from a string. Note the orientation of the object. Change the orientation of the supporting rod. What happens to the orientation of the object? Compare your observations with your classmates.

**B4.** (Use labeled magnets from B1.) Hang a permanent magnet from a string. Slowly bring in a second magnet along the axis of the magnet (i.e., from the North or South). Repeat with different orientations of the second magnet. What happens to the hanging magnet? Slowly bring in the second magnet from the side (East or West). Repeat with different orientations of the second magnet. What happens to the hanging magnet? Are the effects the same when one or both of the magnets is covered with tape?

**B5.** Tape together two (labeled) magnets with like poles touching. Repeat B4. Comment on the results.

**B6.** Hold two (labeled) magnets together, or secure them together using tape, with opposite poles touching. Repeat B4. Comment on the results.

## Postscript

By convention, we label as "North" or "N" the part of a magnet that is attracted to the geographic North Pole of the Earth. This is called the North *pole* of the magnet. The other end (or side) is called the "South" pole of the magnet. It is often labeled simply "S".

## Reflection (continued)

**R4.** Do you suppose there is magnetic charge, like electric charge, that can be passed from one object to another? Explain why or why not.

**R5.** Do you suppose the geographic South Pole of the Earth is also a magnetic South pole or is it a magnetic North pole? Explain why you think so.