RAFT IDEAS

Topics: Magnetism, Magnetic Fields, Properties of Metals

Materials List

- ✓ Lots of tiny, rare earth magnets
- ✓ Optional: a variety of objects and materials to experiment with (i.e. – paper clips, metal cookie sheet, paper, craft sticks)

This activity can be used to teach:
Next Generation Science Standards

- Properties of materials (Grade 2, Physical Science 1-1, 1-2; Grade 5, Physical Science 1-3)
- Electric or magnetic interactions between objects not in contact with each other (Grade 3, Physical Science 2-3, Middle School, Physical Science 2-5)
- Magnets (Grade 3, Physical Science 2-4; Middle School, Physical Science 2-3)

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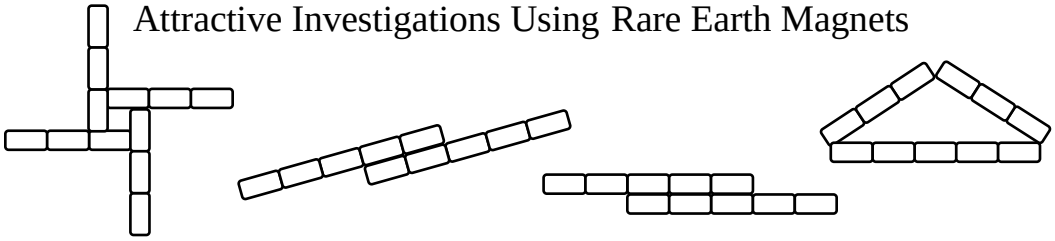
Tiny, Mighty Magnets

Attractive Investigations Using Rare Earth Magnets



Wow! These little magnets are great! While very strong they are safer to use than the larger rare earth magnets. The best way to understand the properties of magnets is to play and experiment with them, making observation after observation. These magnets are particularly well suited to hands-on, inquiry-based science investigations.

To Do and Notice

1. Handle and investigate the magnets for a couple of minutes, sharing observations with fellow explorers as you discover them. Observations might include:
   - Magnets can attract and repel other magnets.
   - Attraction and repulsion depends on orientation (like poles repel, opposite poles attract).
   - The force of attraction or repulsion decreases with increased distance.
   - Magnet strength varies at different locations on the magnet.
   - Magnets strongly attract some metals, such as iron and nickel.
2. After some initial observations, try more detailed investigations. What did you learn? Share your findings with friends and classmates!

NOTE: **Keep magnets away from** credit cards, computer floppy discs, video and audiotapes, and color TV screens as they can erase information or distort the image.

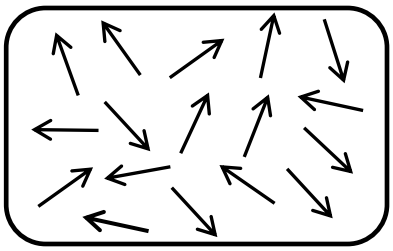
The Science Behind the Activity

Scientists can predict quite well what magnets can do, but why magnetism exists in the first place is complicated… and there is always more to learn. How do magnets work? The answers lie at the sub-atomic level.

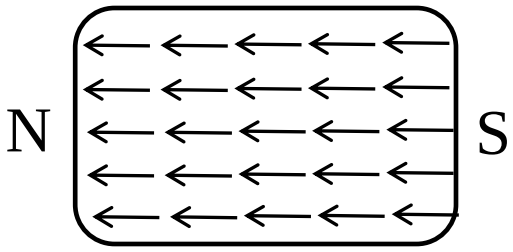
Everything has tiny parts (electrons, protons, etc.) that have an electrical charge; when charged parts move they create magnetic fields. In most cases, these fields cancel out at the sub-atomic level. In magnetic materials, like iron, these fields do not cancel out (due to the structure of the atoms themselves). In these materials, atoms or groups of atoms can be thought of as tiny bar magnets, which are usually oriented in different directions, canceling any net magnetic field. When most of the atoms align magnetically in the same direction, the magnetic fields combine, "pushing and pulling the same way", into a strong enough force for us to see its amazing effects!

Rare earth magnets, also called Neodymium magnets, contain an alloy (mixture) of neodymium, iron, and boron (NIB). Rare earth magnets can have field strengths that are easily 10X stronger than the strongest ferrite (iron) magnets. Rare earth magnets are relatively new having been developed in the 1980's by the General Motors Research Laboratory. (Measurement Note: Magnetic field strength is measured in Gauss (G) and Tesla (T): 10,000 G = 1 T)

Written by RAFT Education Department



Not a Magnet
(Fields Cancel)



Magnet
(Fields Combine)

Taking it Further
These strong magnets can be used for a variety of magnet investigations! Here are a few possibilities:

- ✓ Insert a mini magnet into a coffee-stirrer size straw to create a mini magnet wand. Use this wand to test materials to see if they are attracted to magnets (i.e. – paper clips, craft sticks, aluminum foil, plastic caps, anything you happen to have lying around.)

- ✓ Make a compass (floating or suspended) using the mini magnet as the magnet "needle."

- ✓ Map the invisible magnetic field lines of other magnets from pole to pole using a mini magnet in a straw section. The short straw section should be as long as the magnet with a thin string or thread tied to it.

- ✓ The ink in new US currency bills contains iron! This is one of the many anti-counterfeit measures used by the Treasury Department. Use the mini-magnets to attract an edge of a bill. There is not enough iron for the magnet to pick up the bill but the rare earth magnet can bend the bill toward it if it is brought close enough.

- ✓ Use the mini magnets as a medium to form letters and numbers. What letters and numbers can be formed lying down or upright on a metal juice lid, etc.?

- ✓ How many stable shapes can you make using 3 magnets, 4 magnets, 5 magnets, etc.? How stable is the shape? Can the shape stand up by itself? Will it stand up on a steel (alloy of iron) surface like a juice can lid? What happens to the shape when it is dropped on a table?

- ✓ Create a 3-d sculpture using the magnets.

- ✓ Use a red permanent marker to label the north magnetic poles. (Note: The **south end of a compass needle points to the north pole of a magnet** and a magnet that is free to pivot will turn until its north pole points north). Create a shape or array of magnets, and then have students explain why the shape holds its form by labeling the locations of the north and south poles.

Web Resources (Visit www.raft.net/raft-idea?isid=440 for more resources!)

- Physicist Paul Doherty shares the history of magnetism at: http://www.exo.net/~pauld/technorama/technoramaforum.html

- For detailed information about magnetism and how magnets are used, visit the following web-sites: http://my.execpc.com/~rhoadley/magwhy.htm http://www.dansdata.com/magnets.htm