



# Exploring Magnetic Fields

<p><b>THE BASICS</b></p>	<p><b>THE TOOLBOX</b></p>	<p><b>EDUCATION STANDARDS</b></p>	<p><b>Physical Science Content Standard:</b> Reinforcing the concept that magnets attract and repel items and exert a magnetic field that can vary in strength.</p>
<p> Grade Level: K-6</p>	<ul style="list-style-type: none"> <li>• 2 bar, doughnut, or horseshoe magnets</li> <li>• Ziploc plastic bag</li> <li>• 3 x 5-inch index card</li> </ul>	<p><b>SAFETY CONCERNS</b></p>	<p>Be sure that students do not put iron filings in their mouths!</p>
<p> Estimated Time: 45 min.</p>	<ul style="list-style-type: none"> <li>• 1 teaspoon iron filings</li> <li>• Paper clip</li> <li>• Pen or pencil</li> </ul>	<p><b>FOR KIDS WITH DISABILITIES</b></p>	<p>For visually-impaired students, you may want to build a model of the magnetic field on paper using sprinkled sand glued along the lines of the magnetic field.</p>



**Educational Objective:**

To demonstrate the magnetic field that is formed by a small magnet and to compare it to the large magnetic field formed by the earth.

**What to Do:**

- Gather the materials for both parts of the activity and perform the experiments yourself before you do them with the students.
- If you are using loose filings, clean them up very carefully. To pick up the filings easily, slip your magnet inside a plastic bag. Run it over the loose filings and it will pick them up easily. To remove them from the magnet, simply remove the bag.
- Store iron filings separately from the magnets so they won't become magnetized.

**Questions to Ask Students As They Do This Activity:**

- Can you see magnetism? How? What does it look like?
- Are the patterns and shapes formed by the iron filings the same no matter how many times you do the experiment?
- What happens in part 2 when you use the other pole of the magnet?
- What happens in part 2 when you use two magnets?

### Why It Happens:

The area in space around a magnet where it attracts materials made of iron, steel, nickel, or cobalt is called its magnetic field. You can see the effect of the lines of force in this field when you do this activity. The lines that appear in the iron filings follow the invisible paths over which the magnetic force from the magnet acts. The iron filings line up with these lines of force.

Although the thin layer of iron filings we are using in this activity only shows the magnetic field in two dimensions, it really is three-dimensional. The lines of force in the field extend upward and downward as well as from side to side. In fact, you can see some of these lines near the pole of the magnet where some of the filings seem to stand up straight in the air. If we had a way to see it, these lines would curve upward and then back down toward the other pole of the magnet, just as those we can see in the filings do. The Earth's magnetic field looks very much the same, although it is much larger.

## WEB SITES

- **What Makes Earth a Magnetic Force?**  
[http://www.sciencenetlinks.com/sci\\_update.cfm?DocID=30](http://www.sciencenetlinks.com/sci_update.cfm?DocID=30)  
(Grades 6-12)
- **Build a Compass**  
[http://www.looklearnanddo.com/documents/projects\\_compass.html](http://www.looklearnanddo.com/documents/projects_compass.html) (Grades K-5)

## SOFTWARE

- **STV: Electricity and Simple Machines**  
National Geographic Society, 1995.  
(Grades 4-7)
- **Ozzie's Science**  
Digital Impact, 1996.  
(Grades K-4)

## READING ROOM

- Ardley, Neil. **The Science Book of Magnets.** Gulliver Green, 1991.  
(Grades 1-6)
- Fowler, Allan. **What Magnets Can Do.** Children's Press, 1995. (Grades 1-2)
- Gardner, Robert. **Science Projects About Electricity and Magnets.** Enslow, 1994. (Grades 5-12)

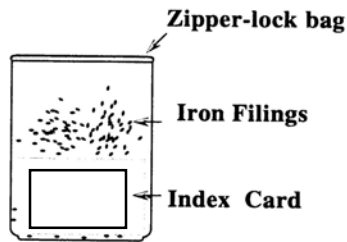
## Career Connections

Compasses work because the compass needle always points to the strong north and south magnetic poles. The magnetic poles are very important to geoscientists who study how the Earth works.

## EXPLORING MAGNETIC FIELDS ACTIVITY SHEET — PART 1

Around every magnet there is an invisible field called a **magnetic field**. This field is what attracts items such as paper clips and nails to the magnet. Although it is invisible, if we use some very small pieces of iron called **filings**, we can see the effects of this invisible field. In this activity you will work with a partner to explore magnetic fields.

1. Take a Ziploc bag and place a 3 x 5-inch index card inside. Add about a teaspoon of iron filings. Be careful to keep your magnet away from the filings. They will stick to it and are hard to get off!



2. Close the Ziploc bag and lay it on the table. Shake it gently so that most of the filings are in a smooth layer on top of the card. Carefully lift the bag and set it on a paper clip. Do the filings move around?
3. Now lift up the bag carefully. Place a magnet on the table and set the bag down on top of the magnet. What happens? Do the filings move around? Do they seem to form a pattern? Draw what you see on the back of this paper or on another sheet of paper.

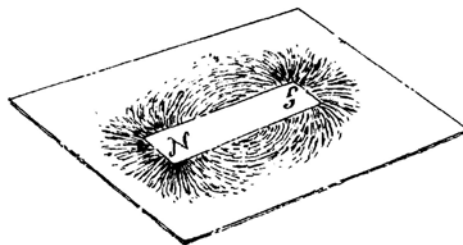
The pattern you see is the outline of the magnetic field around the magnet. Although the magnetic field is invisible, the iron filings show us where it is because they line up with the field. This is like the wind outside. We cannot see the wind, but we can see how it moves the leaves on the trees or paper in the street.

4. If you have some other magnets, you can see what kind of pattern they create. Be sure to try placing the **two** magnets under the bag. What does the pattern look like when the magnets are placed so that they are **attracted** to each other? What does the pattern look like when the magnets are placed so that they **repel** one another? Does the shape of the magnetic field change? Try it!

## EXPLORING MAGNETIC FIELDS ACTIVITY SHEET — PART 2

Around every magnet there is an invisible field called a **magnetic field**. This field is what attracts items such as paper clips and nails to the magnet. Although it is invisible, if we use some very small pieces of iron called **filings**, we can see the effects of this invisible field.

1. Work with a partner. For this activity, you will need the following items:
  - 2 bar magnets
  - paper clip
  - pen or pencil for drawing pictures
  - Ziploc bag with a 3 x 5-inch index card and iron filings inside
2. Lay the bag on a table and shake it gently back and forth. Let your partner try it, too. With a little practice, you can get a thin layer of filings on top of the index card in your bag. The filings should not all be in a lump at one end.
3. Lay your paper clip on the other end of your desk. When you have a nice layer of filings on the index card in your bag, gently lift up the bag and hold it right over the paper clip. What happens? Do the filings move around?
4. Now, lay your magnet on the other end of your desk. Again shake your bag so that you have a thin layer of filings on the index card. Then gently lift up your bag and hold it right over the magnet. What happens? Do the filings move around? Do you see something like this?



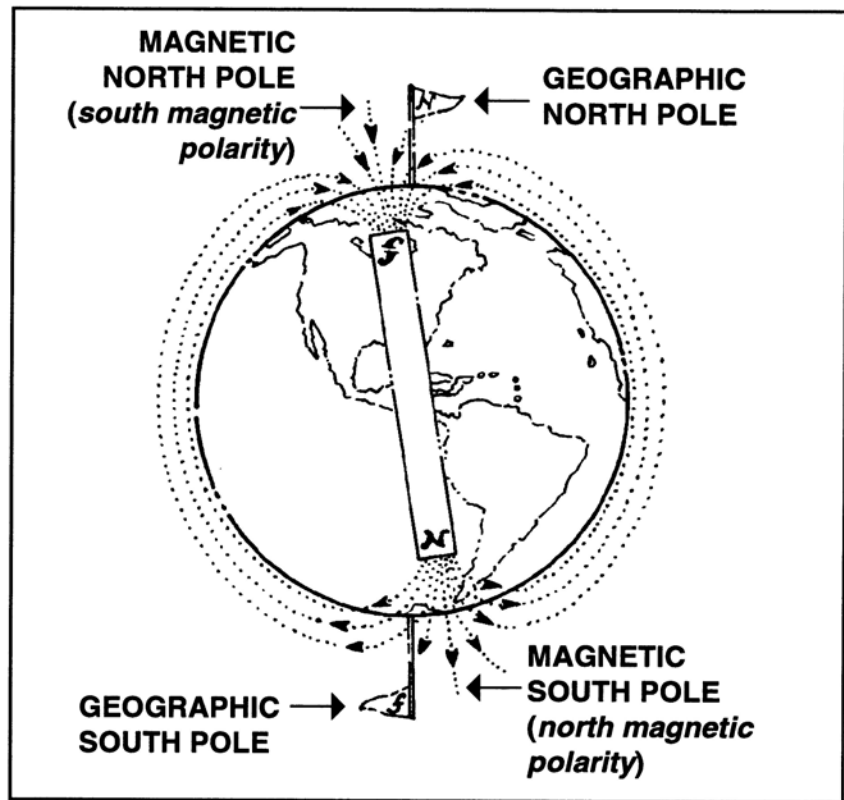
5. Try it a few times. You can hold the magnet flat in your hand and set the bag down on it there, too. Draw a picture of the magnetic field you see in your bag on your data sheet.

**Remember**—We cannot really see the magnetic field, but we can see how it moves the iron filings around. This is like the wind outside. We cannot see the wind, but we can see how it moves the leaves on the trees or paper in the street.

6. Now put your other bar magnet under the Ziploc bag. Does the magnetic field of this magnet look like the first one? Try some other bar magnets and compare with those of other teams of students.

7. Now, put your two bar magnets end-to-end so that they are **attracted** to each other and then put your Ziploc bag on top. What do the magnetic fields of the two magnets look like now? Draw a picture on your data sheet.
8. Next, put your two magnets end-to-end so that they **repel** each other. Set your Ziploc bag on top and see if the fields look different. Draw a picture on your data sheet of what you see. Look at your pictures. Can one magnetic field change the shape of another magnetic field when they get close to each other? What do your drawings show you about this?
9. Now ask your teacher for another magnet of a different shape. This magnet might be shaped like a doughnut or a horseshoe. Try to see what the magnetic field looks like around this magnet. Draw a picture of it on your data sheet. Do all magnetic fields look alike? Do they change shape with the shape of the magnet?
10. Why do you think the iron filings line up along the magnetic field as they do?

**Remember** that the Earth acts like a giant magnet. It also has a giant magnetic field! The Earth's magnetic field looks something like this diagram. When you hang a magnet from a string and let it dangle in the air, it always points toward the north and south poles. This is because it is lining up with the Earth's giant magnetic field just like the tiny pieces of iron filings line up along the magnetic field of your small magnet.



## Exploring Magnetic Fields Data Sheet

What does the magnetic field look like around your bar magnet? Draw a picture of what you see.

What does it look like when you have two magnets under the Ziploc bag that are attracted to each other? Draw a picture of what you see.

What does the magnetic field look like around a horseshoe or doughnut magnet? Draw a picture of what you see.

What does it look like when the two magnets are repelling each other? Draw a picture of what you see.