



Planet Magnet

Unit: Sun-Earth
Lesson: 2

Materials & Preparation

Time:

- Preparation: 15 min
- Teaching: 30 min

Materials for the Teacher:

- Overhead projector or LCD and computer
- Overhead or digital images of depictions of the Earth's magnetosphere (see Advanced Preparation, p.2)
- Bowl to collect metal chips/ filings during clean-up.

Materials for Student Teams:

- Shallow box or cafeteria tray
- Bar magnet
- Plastic bag
- Tape
- White paper
- Magnetic chips (or iron filings) in a salt shaker
- A round piece of construction paper (see p.2)
- Compass
- Student Page

National Science Standards

- Science as Inquiry: Content Standard A
- Physical Science (Forces): Content Standard B
- Earth and Space Science: Content Standard D

Colorado Science Standards

- Science: 1, 2.1, 2.3, 4.1, 4.4

Learning Goals

Students will

- Make and record observations
- Communicate scientific work and observations to peers
- Identify magnetic field lines around a dipole magnet
- Develop an understanding of Earth's magnetic field

What Students Do in this Lesson

Middle school students use iron filings to explore the magnetic field around a magnet and record their observations. Next, students apply their experience with the magnet to understand the magnetic field around Earth. Following their investigation, students summarize their findings. This activity can be easily adapted for upper elementary students as well.

Key Concepts

- Dipole magnets have predictable and similar fields.
- Magnetic particles (like chips and filings) are attracted to magnets and will orient to follow the magnetic field.
- The magnetic field lines extend far beyond the magnet itself.
- The Earth acts as a dipole magnet.



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Advanced Preparation

- Note: Iron fillings are traditionally used in this classic classroom activity, however they can be messy in a classroom setting. Using magnetic chips instead is less messy and their elongate shape makes it easier for students to see the field lines. Magnetic chips can be obtained from Arbor Scientific (see Additional Resources, p.3).
- Cut circles out of colored construction paper with a diameter that is about the same length as the bar magnets. (Alternatively, instruct students to do this during the activity.)
- Copy Student Page for each student.
- Prepare to show images of Earth's magnetic field via overhead or LCD projector. Images can be obtained from *Windows to the Universe*:
 - http://www.windows.ucar.edu/tour/link=/earth/images/earth_magneto_image.html
 - <http://www.windows.ucar.edu/tour/link=/earth/Magnetosphere/overview.html>
 - http://www.windows.ucar.edu/tour/link=/physical_science/magnetism/planetary_magnetism.html

Facilitating the Lesson

1. Assign students to small groups. Explain that students will make and record observations of magnetic fields. Model the directions on the Student Page in front of the class to illustrate how to do the activity.
2. Provide each group with supplies and allow students at least 15 minutes to make and record observations.
3. During the first part of the activity (steps 1-4 on the Student Page), students generate understanding of how the chips or fillings interact with a magnet. Understanding that the chips are magnetic is essential for understanding results of the second part of the experiment. Consider pausing after students have reached this stage and reviewing the result.
4. During the second part of the activity (steps 5-6 on the Student Page) students should come to an understanding that the magnetic chips/fillings align themselves to a magnetic field. Students should be able to see the shape of the field and describe this with a picture on their Student Page. (Note: Students may use too many or too few chips/fillings to see the shape of the field. You may recommend that students repeat this part of the activity multiple times to ensure that the shape of the field they find is consistent each time. In science this is called having multiple replicates or trials. Scientists do this to ensure validity of experimental results.)
5. Show pictures of Earth's magnetic field (see web links above) and discuss how Earth behaves like a magnet. Ask students if the magnetic field they made looks like the field in the pictures. Have students place the planet shape at the center of their field and add the shape to the drawing on their Student Page.
6. Ask students if they can tell the north end from the south end of their magnet. They will not be able to figure this out using only the fillings/chips. Have students use a compass to deduce the polarity of the magnet and label their drawings. If students are not familiar with how a compass works, provide a brief introduction to how to use it and how it reacts to Earth's magnetic field.
7. Clean up: Instruct student groups to move the magnet filled bag around their tray to collect the chips/fillings (which will stick to the outside of the bag). Have students place their bag over a bowl and then open the bag and remove the magnet. The chips/fillings should fall into bowl.

Summarizing and Reflecting

- Time permitting, have student groups summarize their experiment by making a poster. Students should include information on their poster about (1) what they did/methods, (2) what happened/results, including a



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drawing of what the chips looked like when oriented over the magnet, (3) what they think it means/interpretation. Hang posters around the classroom and compare results of different groups.

Extensions

- This activity is a great way to introduce students to magnets and magnetic fields in a guided format and can be extended by allowing student groups to design their own experiments using magnets and/or magnetic chips in a true inquiry format. Have students develop a question about magnets, a related hypothesis, and experiment to test their hypothesis.
- Have students collect their own iron filings by dragging a magnet through sand or dirt. Students may do this with a box of sand or outside in places such as dunes, the seashore, or a desert.
- Model the 3-dimensional nature of the magnetic field with the Windows to the Universe Terrabagga activity (http://www.windows.ucar.edu/tour/link=/teacher_resources/magnetism/teach_terrabagga.html)
- Have students research how magnets are used in various technologies (such as MRI).

Background Information

Magnetism is one of the main forces of nature. Like the force of gravity, which causes objects to be attracted to each other, magnetism causes magnetized objects to be attracted to each other. Simple dipole magnets have two poles: a positively charged one and a negatively charged one. If two magnetically charged objects are brought together, the positively end of one will “stick” to the negative end of the other.

In this activity, the magnetic chips or fillings align themselves along the lines of magnetic force. These lines of force point from the positive pole to the negative pole of the magnet. When students sprinkle magnetic chips onto their magnet they first learn that the chips are magnetic (because they “stick” to the magnet). They then explore how magnetism forces the chips to line up in the direction the magnetic force points, allowing them to see the shape of the magnetic field.

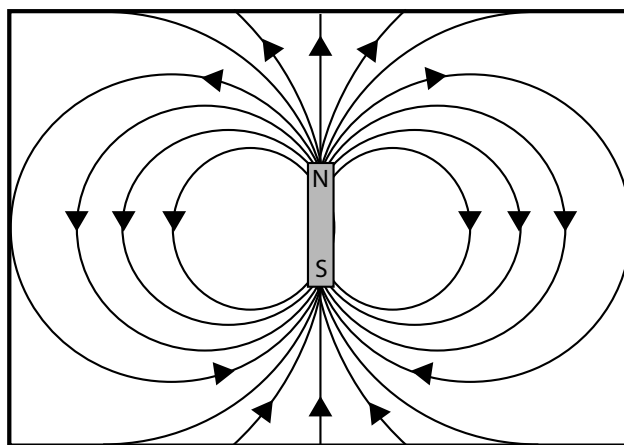


Fig 1. Magnetic lines of force. In this activity, the mag-

The Earth is an example of a dipole magnet, where the lines of force point in a direction out of the South (magnetic) Pole and into the North (magnetic) Pole. The magnetic field is made by currents of molten material which move around deep within our planet. On Earth, a simple compass can always be used to detect the presence of the magnetic field of the Earth, as well as any other nearby magnetic fields such as magnetic metals (refrigerator doors, for example). The needle of the compass acts like the magnetic chips or fillings used in this activity.

Additional Resources

- Windows to the Universe: Earth's Magnetosphere
<http://www.windows.ucar.edu/tour/link=/earth/Magnetosphere/overview.html>
- Windows to the Universe: Magnetism Classroom Activities
http://www.windows.ucar.edu/tour/link=/teacher_resources/activity.html
- Magnetic chips from Arbor Scientific (Product ID P8-1140) <http://www.arborsci.com>



Planet

Magnet

Name _____
Date _____ Class _____

Directions:

In this activity you will explore magnetism! The shape and size of this force is invisible, but through this experiment you will be able to see and describe it!

You will need:

- A shallow box or cafeteria tray
- A bar magnet in a plastic bag
- Tape
- White paper
- Metal chips or iron filings in a salt shaker
- A round piece of colored paper
- A compass

What you do:

1. Put the magnet in the bag flat in the bottom of your box or tray. Tape in in place.
2. Put the piece of white paper on top of the magnet and tape it to the tray on all corners.
3. Sprinkle just a few chips or filings onto the paper over the magnet.
4. Tip your box or tray a little and watch some of the filings slide downhill. *Answer this! Did all the filings slide down? Why did some of them stay put?*

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5. Sprinkle many filings onto paper. Try to sprinkle evenly over the whole paper. Make sure there are not so many that you can't see the paper.
 6. *In the space below draw a picture of the pattern that the filings make.* This pattern shows where the field of the bar magnet is located.

7. Place the piece of round colored paper into the magnetic field so that it is directly over the bar magnet. This represents a planet, like Earth, that has a magnetic field! *Draw the planet shape into your drawing above.*
8. Do you know where the poles are? *Draw the poles into your drawing above.* You will need to use a compass to figure out which is the north pole and which is the south.