



Mission

The principal objective of the Solar TERrestrial Relations Observatory (STEREO) is to understand the origin and consequences of Coronal Mass Ejections (CME's). CME's are the most energetic eruptions on the Sun. They are responsible for essentially all of the largest geomagnetic storms. In order to understand and forecast CME's, especially those traveling toward and past Earth, we need 3-Dimensional images of them and of the ambient solar corona and heliosphere. Achieving this perspective will require moving away from our customary Earth-bound lookout point. To provide the images for a stereo reconstruction of solar eruptions, one spacecraft will lead Earth and one will be lagging in its orbit about the Sun.

Key science objectives for the STEREO mission are to understand the mechanism and sites of solar energetic particle acceleration as well as how CME's propagate through and interact with the steady solar wind. Vital to understanding these objectives is the In-situ Measurements of Particles and CME Transients (IMPACT) suite of seven instruments. The IMPACT instruments will sample the distribution of solar wind plasma electrons, the characteristics of the solar energetic particle (SEP) ions and electrons, and the local vector magnetic field in all directions from the STEREO spacecraft. IMPACT is one of the STEREO mission's four measurement packages.

STEREO will be launched in the spring of 2006.

*Above left: A long pole (boom) as it will be extended in space from the STEREO satellite. IMPACT instruments located on the boom are kept at a safe distance from the satellite.

Education & Public Outreach

A multifaceted education and public outreach program provides:



Grades 4-9 Education Products

- Lessons (print, web, CD-ROM)
- Teachers' guides
- Classroom testing



Professional Development Workshops

- Center for Science Education at UC Berkeley
- Regional and National Science Teacher Conferences



Underserved Audiences

- Solar Camp
- Society for the Advancement of Chicanos and Native Americans in Science (SACNAS)



Interactive Installations

- STEREO sonification project: turning solar data into music
- Web page resources and content information



Diverse Partnerships

- Science centers (Exploratorium)
- Educators
- Scientists
- Musicians



Visit our websites: IMPACT education and outreach [<http://cse.ssl.berkeley.edu/impact>]
 IMPACT science [<http://sprg.ssl.berkeley.edu/impact>] STEREO mission [<http://stereo.gsfc.nasa.gov>]

Mapping Magnetic Fields

An Activity for Grades 4 - 8

Activity Summary

Using bar magnets, classroom materials, and a compass, students will explore how bar magnets interact with one another and with other materials. Students will learn how to use a compass to find which direction is north. Students will use a compass, a bar magnet, paper, and a pencil to make visible the lines of magnetic force (magnetic field lines) around a bar magnet. Magnetic field lines are an important concept which STEREO scientists use to understand Coronal Mass Ejections.

Student Objectives

1. Students will know that bar magnets have two poles and that similar poles repel each other and differing poles attract each other.
2. Students will be able to detect and draw a magnetic field using compasses.
3. Students will know that magnets have an invisible force field known as a magnetic field and a bar magnet has a dipole field.

National Science Content Standards

- Unifying Concepts and Processes: Evidence, models, and explanation ; Change, constancy, and measurement
- Science as Inquiry: Abilities necessary to do scientific inquiry ; Understandings about scientific inquiry
- Physical Science: Properties and changes of properties in matter ; Motions and Forces

Materials (per group of two students)

1 compass per student; 2 Alnico bar magnets; 4 sheets of 8½" x 11" paper; paper clips; pencils; ruler; tape

Hints

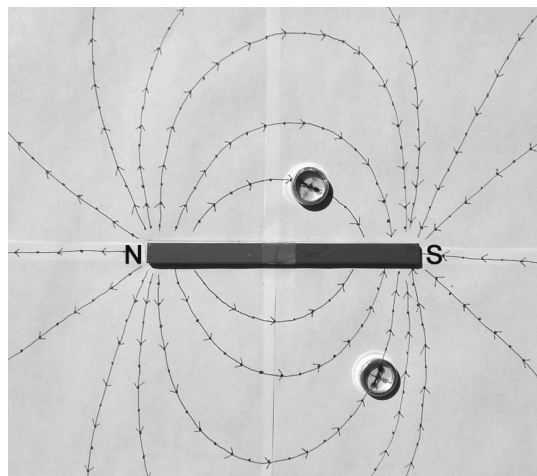
1. We recommend using Alnico or cow magnets rather than Chrome-Steel magnets since they hold their magnetism longer.
2. Compasses with transparent (glass or plastic) faces can be used on an overhead to demonstrate the mapping procedure.
3. Compasses can easily change polarity when a bar magnet is dragged across the compass needle without allowing the needle to move.

Activity Procedures

1. Ask your students about their experiences with magnetism and their knowledge and ideas about what it is and what causes it. Ask questions about whether or not Earth is magnetic, how they know if it is or not, and if there are any other astronomical bodies that are magnetic (like the Sun). You might also ask if they know what a magnetic compass is and what it does.
2. Allow students some time to freely experiment with the magnets and materials around them, such as paper clips, rulers, and pencils. You may make some suggestions about trying to get the magnets to attract or repel each other and attract or repel the other objects.
3. Discuss with the students what they know about compasses. Teach the students how a compass works by having each student hold the compass so the disc of the compass is horizontal and the N-S markings are facing up. Next have the students align the line marked "N" (for North) on the glass/plastic top with the arrow inside the compass. Talk about how compasses are used in the wilderness.
4. Have the students tape some white paper together and place the bar magnets on top and in the middle of the taped paper. Tell the students that they will now trace the magnetic force field shape around the bar magnet. Ask them to hypothesize what they think the magnetic force field will look like and to draw it.

To make the tracings, have the students do the following:

- a. Draw a dot somewhere near the magnet and place the center of a compass over the dot.
- b. Draw a dot at the location of the arrow head (or tail) of the compass needle.
- c. Move the compass center to this new dot, and again draw a dot at the location of the compass needle head (or tail).
- d. Remove the compass from the paper and draw lines connecting the dots with arrows indicating the direction that the compass points.
- e. Repeat steps c-d until the line meets the magnet or paper's edge.
- f. Pick another spot near the magnet and repeat the process (steps a-e).



Have the students continue until they have lines surrounding the magnet as shown in the picture: a **dipole** (two-pole) pattern of force field. Introduce the word **dipole magnetic field** and that these lines are called **magnetic field lines**.

5. If time permits, have the students place two magnets side by side and do the same magnetic field tracing procedure again. Be sure to ask the students to hypothesize what the field of force will look like before they create their map.