

Visualising the magnetic field of the Sun

Age: 7 +

Activity Time: 15 min.

Prep Time: 2 min

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Students will learn about the magnetic field of the Sun by exploring bar magnets. At its most basic level, the Sun's magnetic field is just like that of a bar magnet. Even though magnetic fields are invisible, they are detectable with a compass. By detecting and recording the magnetic field of a bar magnet, students will visualize magnetic field lines and get an intuitive sense of what the Sun's bulk magnetic field is like.

Credit: Activity created by SEGwayEd and adapted by NSO http://cse.ssl.berkeley.edu/SegwayEd/lessons/ exploring_magnetism/Exploring_Magnetism/s1.html#ws

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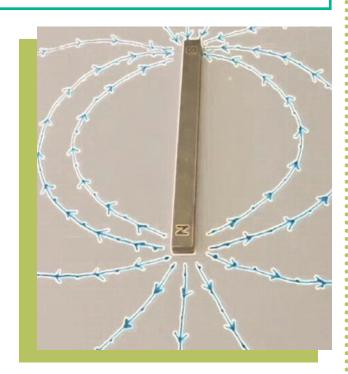
Materials

- Students will know that the Sun has a magnetic field.
- Students will know that magnets have two poles and that a compass will align itself with a large magnetic field.
- Students will be able to detect and draw the magnetic field of a bar magnet using compasses.
- Students will understand the overall shape of the Sun's magnetic field.

<u>Materials Needed</u> <u>per group of Students</u>

- 1 magnetic compass per student (ones with transparent faces work best)
- 1 long Alnico bar magnet
- 1 large sheet of white paper or several sheets of regular paper and scotch tape
- a pencil or marker





WARNING: Do not bring bar magnets near computers, computer monitors, audio tapes, or other magnetic devices. Strong magnets can destroy materials with magnetic properties.

SCIENCE BACKGROUND

The Sun has a magnetic field like the Earth, Jupiter and the magnets on your refrigerator. While there are many intricacies to the behavior of the Sun's magnetic field, its overall structure is just like that of any bar magnet you might have in your home. What causes an object to have a magnetic field? All magentism in the universe ultimately derives from the motion of charged particles. Permanent magnets like the ones on your fridge do this on a quantum mechanical level, but there are other types of magnetism that are easier to explain and all involve a moving charge (also known as a current). For example, junk yards can lift and move cars weighing several

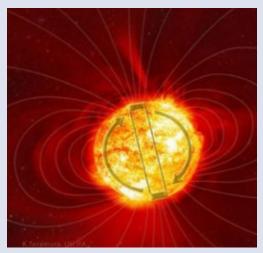


Credit: Stockbyte/Getty Images

tons using electromagnetic cranes. These devices run a very large electric current around in big circles, creating a magnetic field. Similarly, the rotation and convection of negatively charged electrons inside the Sun causes it to have a "magnetic dynamo," which is the name for a magnetic field created by a rotating astronomical body. How does this happen? The Sun rotates, electrons rotate with it, the flow of electrons is an electric current, electric currents

generate magnetic fields.

The Sun's magnetic field has a North and a South pole, just like a bar magnet. Magnetic field's are typically shown by drawing lines that represent the direction a positive charge would move if it were introduced into the magnetic field. These electrons flow from negative to positive and from North to South. The closer together the magnetic field lines are, the stronger the magnetic field is in that region. One of the mysterious things about the Sun's magnetic field, is that it switches orientation every 11 years. Solar scientists are currently trying to figure out the exact mechanisms behind this swap.



Credit: Karen Taramura, U. of Hawaii

NAMING CONVENTIONS WITH MAGNETIC POLES:

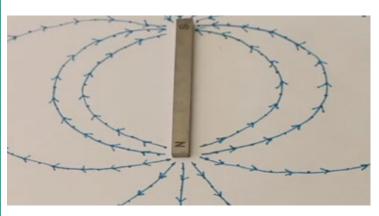
By convention in the United States today, the compass arrow points in approximately the direction of the North Geographic Pole. And by convention (unrelated to the first convention), the compass arrow is a magnetic north pole, which is points to the magnetic south pole of a bar magnet, often marked with an "S" or with blue color. Using the fact that opposite poles attract, the compass arrow must be attracted to a magnetic South pole in the Northern Hemisphere on Earth.

- 1. Discuss with students that Sun has a magnetic field and it acts almost like a bar magnet.
- 2. Have the students arrange their compasses around one of the bar magnets.

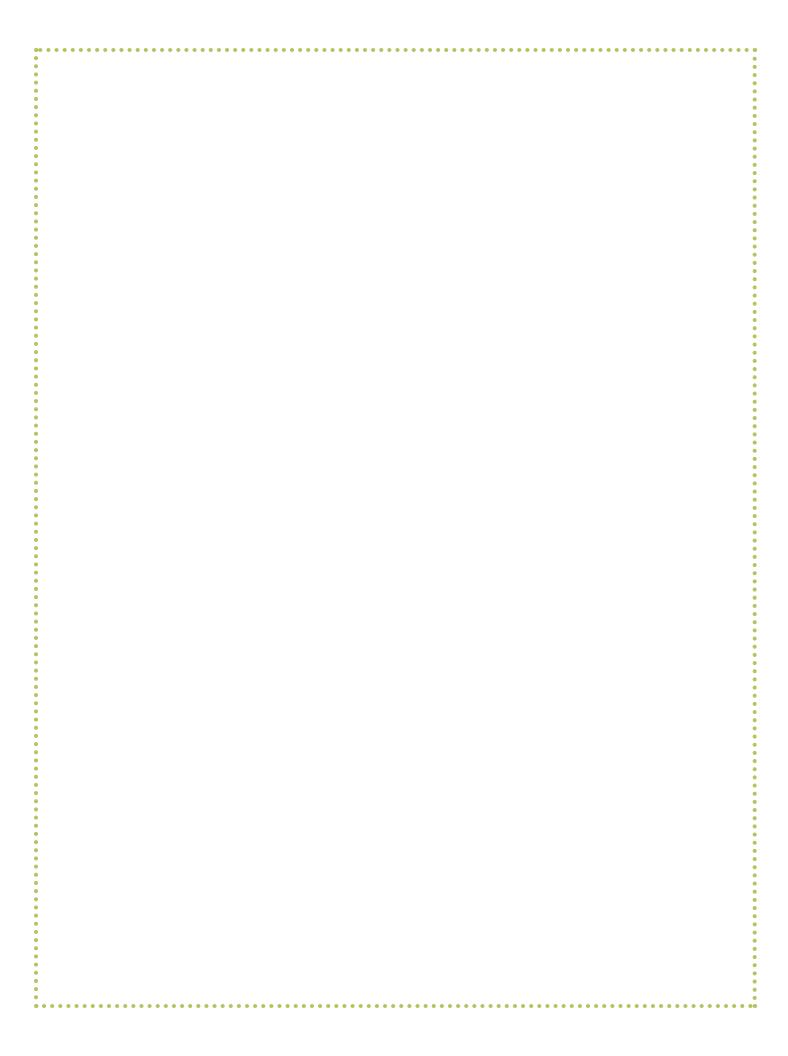
 Note how the heads of the compass needles point toward the magnetic south pole and away from the magnetic north pole of the bar magnet.
- 4. Use the large sheets of paper (or have the students tape together several sheets) and place the bar magnet on top and in the middle of the paper. Tell the students that they will now trace the magnetic field around the bar magnet. Ask them to hypothesize what they think the magnetic field will look like.
- 5. To make the tracings, draw a dot somewhere near the magnet and place the center of a compass over the dot.
- 6. Draw a dot at the location of the arrow head (or tail) of the compass needle.
- 7. Move the compass center to this new dot, and again draw a dot at the location of the compass needle head (or tail).



- 8. Remove the compass from the paper and draw lines connecting the dots with arrows indicating the direction that the compass points.
- 9. Continue making new dots until the line meets back up with the magnet or you reach the edge of the paper. Connect the dots with a line and draw in some arrow markers to show the direction of the magnetic field, from North to South.



10. Pick another spot near the magnet and repeat steps 5-9. Have the students continue until they have lines surrounding the magnet, making a dipole pattern of magnetic field.



Watch a video tutorial of this activity on YouTube: http://bit.ly/ExploringMagnetism

Find out more by watching our solar magnetism webcast:

http://bit.ly/Webcast2-TheLayersOfTheSun









The National Solar Observatory is sponsored by the National Science Foundation. Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.