

Sun-Earth Day

Celebrate the Connection!

www.sunearthday.nasa.gov

Public Outreach: Make and Take Activities

What You'll Need

- Polystyrene spheres: 4" diameter for the Sun 1" for Earth

For source, Google "polystyrene foam sphere". Otherwise, unpainted plain white spheres are just fine.

- 8 neodymium "rare earth" magnets, or other very strong magnets

You can purchase neodymium magnets online at: <http://www.kjmagnetics.com>

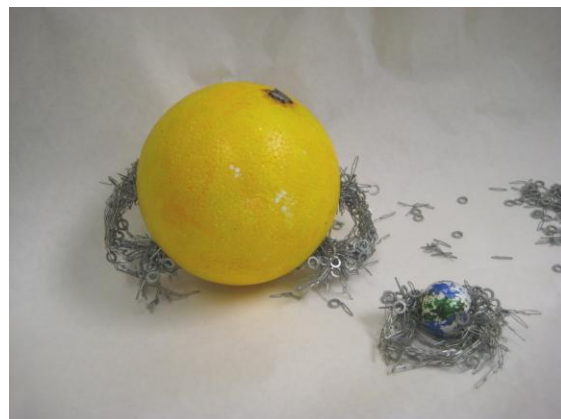
- Two-part epoxy adhesive, or other very strong adhesive
- Closed staples or very small washers (nothing bigger than #6) in container with lid
- Plastic tray or plate to hold everything and catch stray "field bits"
- #2 Pencil with eraser
- Paper Clip

Solar System Magnetism

About this Activity

In this activity, polystyrene spheres and strong magnets are used to represent the Sun and Earth and their distinct magnetic fields. Participants construct and use a "field detector" to predict where the magnetic fields are, and "field bits" to form loops and trace the invisible magnetic fields of the Sun and Earth.

Adapted from the planetarium show "Our Very Own Star" from "Planetarium Activities for Student Success" produced by the Lawrence Hall of Science, University of California, Berkeley. Copyright 2007 by the Regents of the University of California.



Preparation

You can make the closed staple "field bits" beforehand by using a stapler without paper. You can also clip the paper clips into the short 2-3cm lengths before starting this activity.

To Do and Notice

- Prepare the Sun sphere. Use 6 neodymium magnets arranged in pairs in 3 separate areas of the Sun (preferably near the seam [equator] of the 4" polystyrene sphere). There should be about two to three centimeters spacing between the edges of the magnets in each pair (see Fig.1). Drill or gouge holes into the polystyrene so that the magnets will fit in the holes and be approximately level with the surface of the sphere. *Two-part epoxy adhesive is strongly recommended for attaching the magnets to the polystyrene.* Glue each pair of magnets into their holes so that they create a dipole (i.e. the sides of the magnets facing outwards are attracted to each other).

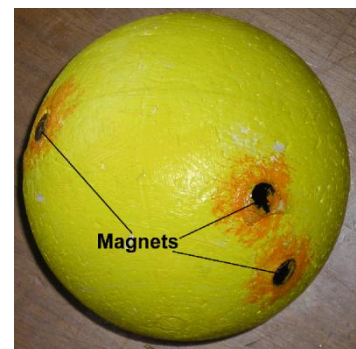


Fig. 1. Sun with magnets embedded and looking like sunspot pairs (one pair to the right and half of another pair on the left). If painted, you can embellish the sunspot clusters a bit)

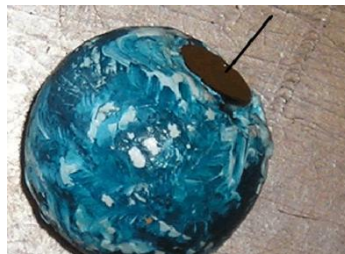


Fig. 2. Painted Earth showing one (of 2) magnets embedded at the poles.

- Prepare the Earth spheres. Use 2 neodymium magnets, gluing a magnet at each pole of the 1" sphere. Make sure they are oriented so that, together, they act as a dipole (Fig. 2). Follow the same instructions as the Sun ball for gluing on the magnets.

- Optional: paint the Sun with yellow acrylic paint, and the Earth in blue and green acrylic paint splotches after attaching the magnets and the epoxy has hardened.

- Push Pin
- Needle-nose pliers
- Wire Clippers
- (optional) Acrylic paints in yellow, green and blue.

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- 3) Make the “field detector” by bending the paper clip into the shape shown, and attach it loosely to the eraser head of a pencil with a push pin so that the paper clip can swivel freely. You will need small long-nose pliers to shape the paper clip, and a diagonal or wire clippers to cut the paper clip short, so that the finished paper clip part is only about 2–3 cm long.
- 4) Explore the Sun and Earth spheres using the “field detector”. Observe carefully the interaction between the pairs of magnets on the Sun and the Earth. You can make predictions on what you think the magnetic field loops will look like.
- 5) Free play with the “field bits” and the Sun and Earth spheres. Notice what shapes they make and how far they extend. You can also use the “field detector” to see where the magnetic field extends beyond the loops formed by the “field bits”.

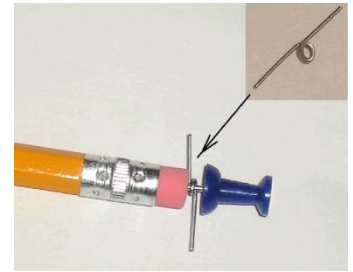


Fig. 3. Field detector is made of a paper clip, pencil, and pushpin

Activity Notes

Please remind everyone to keep their cell phones, electronic devices, and credit cards away from the magnets.

This activity covers the following:

Big Idea – The Sun and Earth have differing magnetic properties.

Key Concepts – Sunspots are related to magnetism on the Sun. The Earth has a strong simple magnetic field with two poles.

Supplementary Concepts – Magnetic fields around the Sun and Earth come from charged matter moving around (electrical currents) in the interior. Earth’s strong magnetic field shields our atmosphere from the solar wind.

The interactions between Earth’s magnetic field and charged particles coming from the Sun is often referred to as “space weather”, which can cause phenomena such as the aurora, satellite failures, blackouts on the ground, disruption of radio transmissions, and more...

Sunspots are found where magnetic fields emerge from the surface of the Sun. They often come in pairs, with one north magnetic pole and one south magnetic pole.

The Sun’s magnetic field is created by the movement of plasma in its interior. It is very complex and changes significantly over time. Plasma on the surface of the Sun is attracted to the magnetic field lines, creating *prominences*.

Earth’s spinning core creates our magnetic field, which extends far out into space – between 5 to 25 times the diameter of the Earth.

The magnetic forces between the Sun and Earth are negligible compared to gravity, and do not noticeably push or pull the Earth towards or away from the Sun.

Related Websites

PASS “Planetarium Activities for Student Success:
<http://www.lawrencehallofscience.org/pass>

Space Weather: the latest updates and images
<http://www.spaceweather.com>

Satellite images of the Sun:
<http://sohowww.nascom.nasa.gov/>
<http://sdo.gsfc.nasa.gov/>

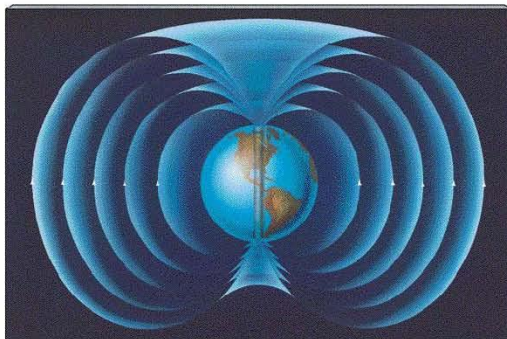
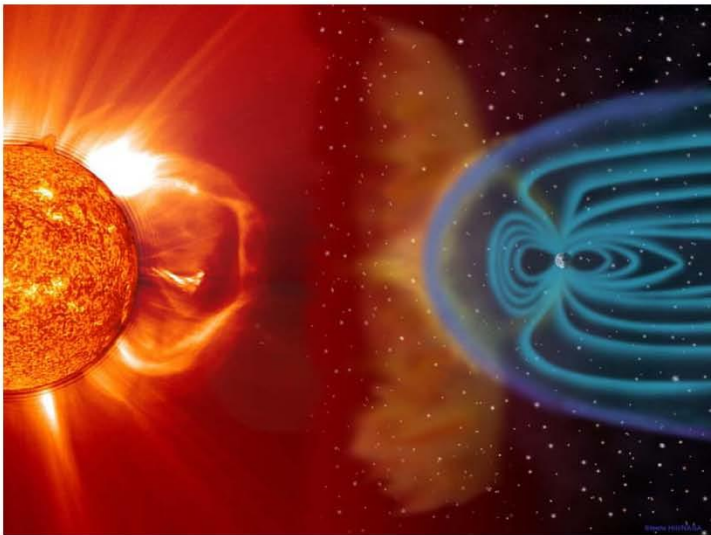


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Useful Information Sheets that can go along with the activity.

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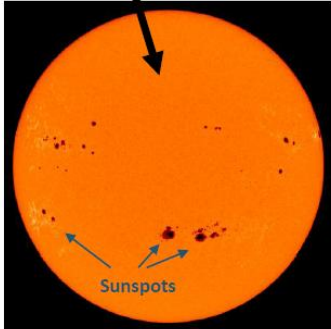


Magnetism on Earth and the Sun

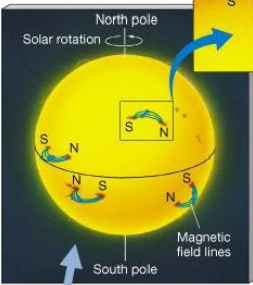
- Earth behaves like a simple bar magnet with one north magnetic pole and one south magnetic pole.
- Earth's spinning core creates our magnetic field, which extends tens of thousands of miles out into space and shields us from dangerous particles coming from the Sun.
- The Sun has a much more complicated magnetic field, created by the movement of plasma in the interior.
- *Sunspots* are places on the surface of the Sun where magnetic field lines emerge.
- *Sunspots* usually come in pairs, with one north magnetic pole and one south magnetic pole.
- Plasma on the surface of the Sun is attracted to the magnetic field lines, creating *prominences*.
- The magnetic forces between the Sun and Earth are negligible compared to gravity, and do not noticeably push or pull the Earth towards or away from the Sun.

THE MAGNETIC SUN

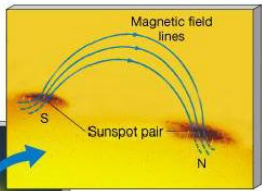
Real images of the Sun (taken with special filters)



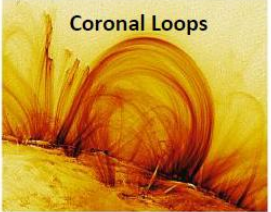
Sunspots



North pole
Solar rotation
South pole
Magnetic field lines

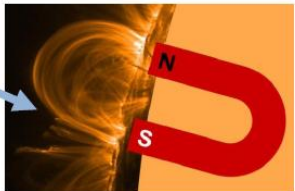
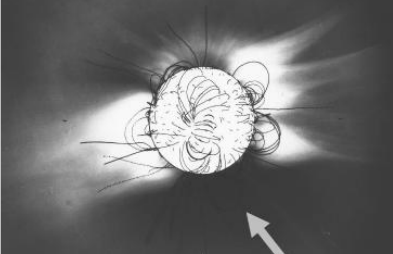


Magnetic field lines
Sunspot pair

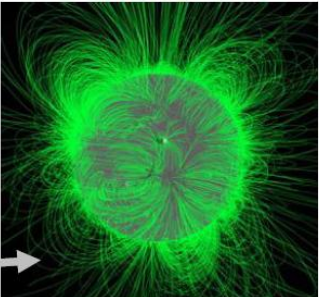



Coronal Loops

Animations of the connection between sunspots, prominences, and magnetic fields

Computer models of solar magnetic field lines

This image shows the true relative sizes of the Sun and the planets.

Earth is less than 1/100th the size (diameter) of the Sun.

(Note: the DISTANCES between the planets and the Sun ARE WAY OFF in this image)

