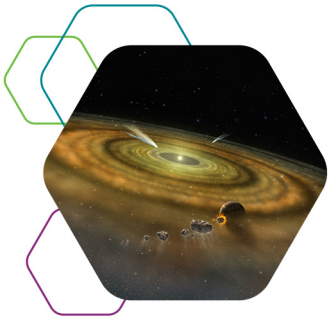

FACILITATOR GUIDE

Magnetic Fields

Learning objectives

- Scientists have observed active magnetic fields throughout the solar system.
- Earth has a strong, protective magnetic field.
- The Sun's magnetic field extends out into space and sends powerful bursts of magnetic energy into the solar system.

Materials

- Simple magnetometer pencil tool
- Earth model with magnetic core
- Sun model with sunspots
- Small steel pieces and container (paperclips)
- Tray for Earth model
- Tray for Sun model
- Activity and facilitator guides
- Information sheets
- *Tips for Leading Hands-on Activities*

The Explore Science toolkit comes complete with all necessary materials for this activity. The Sun model materials provided in the physical toolkit were custom made. You can substitute by carefully embedding pairs of neodymium magnets, about 2 inches apart into a 12 inch Styrofoam hemisphere available from crafting stores. The Earth globes were purchased for the kit from PlanetDog.com. Graphic files can be downloaded from www.nisenet.org.

Safety

This activity should be monitored. It includes very small pieces of metal and magnets. Although they are not a choking hazard, the metal pieces should not be swallowed. If they come loose, the neodymium magnets do pose a serious choking hazard to children. Take precaution and conduct periodic safety checks to be sure the magnets are secured within the Sun model.

Notes to the presenter

When first beginning the activity, set aside the cup of metal pieces and the Sun model. This will help the participants focus on finding Earth's invisible magnetic field using the pencil tool. Then try adding the metal pieces and invite visitors to try and connect the metal pieces between the north and south

poles of the Earth model. This is a nice visual depicting the magnetic field lines covering the entire Earth.

The second part of the activity focuses on the magnetic fields of the Sun. These are always changing and are very different from the more stable fields on Earth. The locations of the sunspots and magnetic activity in this demonstration illustrate just a moment in time.

Encourage participants to remove the metal pieces from the Earth and Sun models so the materials are reset for the next group of participants.

With young children, approach this activity as a demonstration rather than a hands-on activity, since the small parts can present a choking hazard. Young children are often intrigued by magnets, so if you are expecting many young visitors, consider offering another activity involving larger magnets adjacent to this one.

Difficult concepts

Magnetic fields and gravity are both examples of invisible forces. But, these are different phenomena and magnetic fields are *not* created by gravitational forces. Magnets can attract or repel. Gravity is always an attractive force.

Some participants may find it difficult to understand what causes gravity and magnetism and may suggest or think that in space there is no gravity or magnetism. You might try saying something like, "Yes, it's true that there is no air in outer space, but there are still forces like magnetism and gravity."

Gravity, not magnetism, is what keeps us and everything else grounded to Earth. Gravity also keeps Earth and all the other planets, moons, and other bodies in orbit around the Sun. Ask questions and help participants understand that Earth orbits the Sun because of gravity not magnetism.

Staff training resources

Refer to the *Tips for Leading Hands-on Activities* sheet in your activity materials.

- An activity training video is available at vimeo.com/245834753
- A content training video is available at vimeo.com/245835255
- The NISE Network has a curated list of programs, media, and professional development resources in the NASA Wavelength Digital Library that directly relate to the toolkit. These resources can be viewed and downloaded from nasawavelength.org/users/nisenet.

Credits and rights

This activity was adapted from an exploration of magnetic fields activity, developed by the University of California, Berkeley Space Sciences Laboratory's Multiverse project.

Illustration of Earth's magnetic fields courtesy Prof. Yohsuke Kamide/K. Endo/NCEI/ NOAA.

Image of aurora on Jupiter courtesy NASA's Goddard Space Flight Center.

Image of aurora on Saturn courtesy NASA/JPL-Caltech.

Image of solar flare courtesy NASA's Goddard Space Flight Center and Solar Dynamics Observatory.

Image of aurora on Earth and the ISS and composite image of Earth at night courtesy NASA's Earth Observatory.

Image of solar loop courtesy European Space Agency.

This material is based upon work supported by NASA under cooperative agreement award number NNX16AC67A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Aeronautics and Space Administration (NASA).