



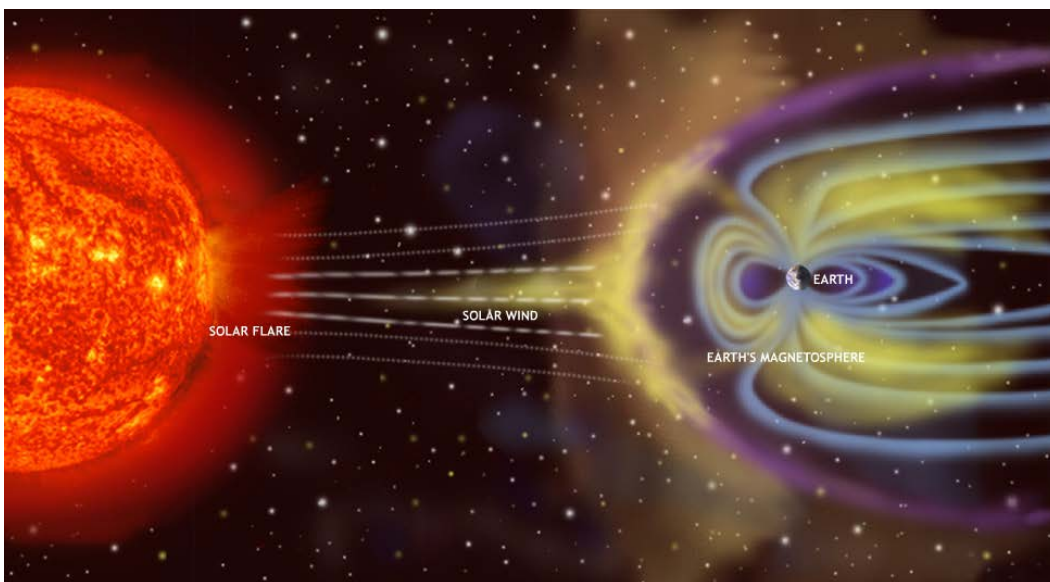
## Module 3: How does the Sun affect the Earth?

### Activity C: Solar Research in Action! - Make a Magnetometer

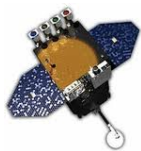
#### Overview

The solar wind is a constant stream of particles (mainly electrons and protons) that travel from the Sun, past Earth, to the edge of the solar system at incredible speeds ranging from 18000 km/h (over 11,000 miles/h) to more than 3,000,000 km/h (over 2,000,000 miles/h)! Solar wind is caused by the expansion of the Sun's extremely hot corona, which is made of plasma. The solar wind contains solar storms, also called magnetic storms, which are caused by solar activity. One method scientists use to measure the strength of solar storms is to monitor changes in the Earth's magnetic fields using a magnetometer. A magnetometer operates like a sensitive compass that reads slight changes in the magnetic field at Earth's surface. These changes in the magnetic field are signs of space weather that have impacted our planet.

Image: NASA



The Earth has a magnetic field with north and south poles. Earth's invisible magnetic field reaches 36,000 miles into space, in a region called the magnetosphere. The magnetosphere has a stronger magnetic field than the Sun's solar wind. The magnetosphere protects the Earth from most of the solar wind's particles hitting the Earth. If solar storms are strong enough, some particles from the solar wind can enter the magnetosphere. The beautiful auroras, seen most often in Polar Regions, are natural signs of solar storms passing by Earth. Some negative effects of space weather include communication and navigation disruptions, electrical current surges in power lines, increased rates of corrosion in oil pipelines, changes in satellite orbits, and radiation hazards to orbiting astronauts and spacecraft.



## Team Goal

Your goal is to make and use a magnetometer to measure changes in Earth's magnetic field caused by solar storms from the Sun for 7-10 days.

## Materials

- "Make a Magnetometer" lab sheets
- One quart size jar OR one 2-liter plastic soda bottle with cap
- About ½ pound (500g) of sand
- Thread (50cm)
- 1 Bar magnet (200mm x 7mm)
- One 3"x5" index card
- 1 small craft mirror or large sequin
- 1 Laser Pointer OR adjustable gooseneck desk lamp with clear bulb
- Scissors
- Meter stick
- Super Glue
- Clear packing tape
- Plastic soda straw,
- Large sheet of white paper
- Ruler
- Pencil
- Nail & hammer

## Engage & Explore!

### 1. BUILD Knowledge:

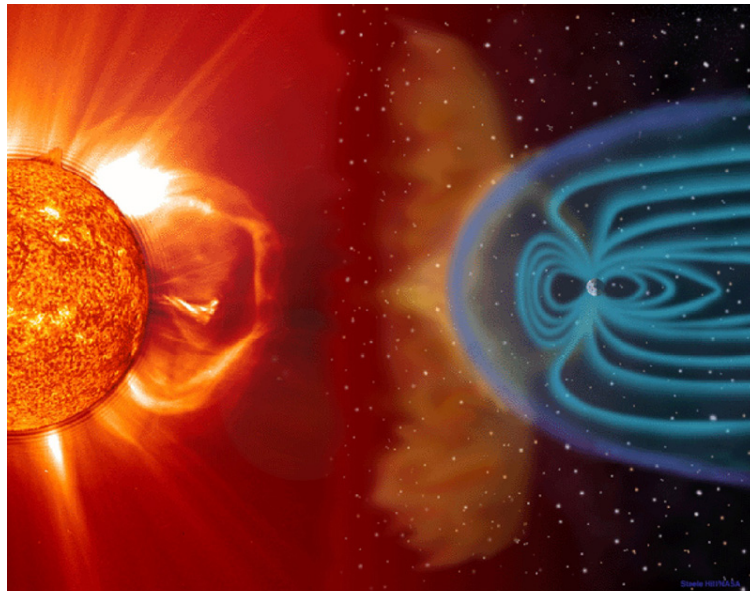
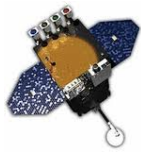
#### Earth's Magnetosphere

Learn about the magnetic field that surrounds Earth, the magnetosphere, which protects our planet from the Sun's solar winds and activity that cause space weather. Click on the NOVA Sun Lab and NASA video links to learn more:

[Earth's Magnetic Shield Video](#)

[NASA Space Weather Media Viewer: Videos "Magnetosphere #1-6"](#)

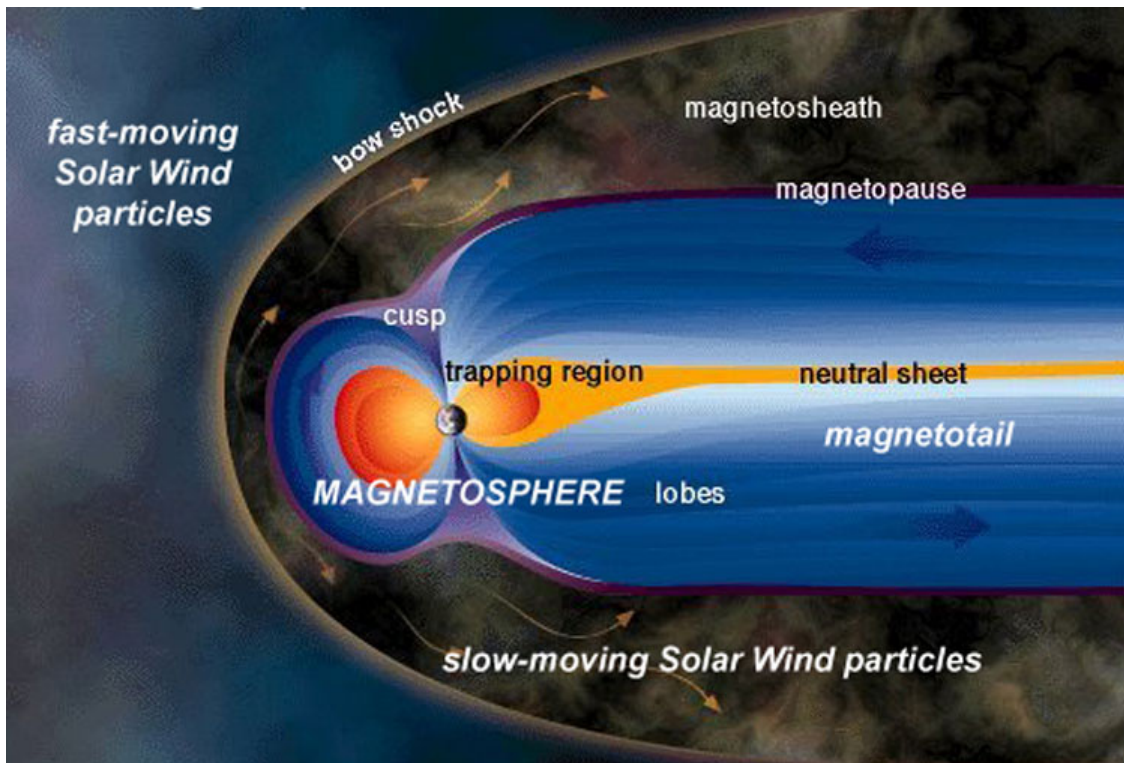
[NASA Space Weather Media Viewer: Illustrations "The Magnetosphere"](#)



Earth's magnetic field, or magnetosphere, protects us from most effects of solar storms and the solar wind.

Credit: SOHO image composite by Steele Hill (NASA)

Images: NASA





## 2. CREATE Resources & CONNECT to the Real World:

### Make a Magnetometer

Following the “Make a Magnetometer” lab sheets, your team will make a magnetometer and record real-time changes in Earth’s protective magnetosphere. Your team will be able to identify the presence of passing solar magnetic storms from the Sun that are affecting Earth’s magnetic field. Your magnetometer, data table, and graph will serve as artifacts for your team’s SDO Module 4 SDO Exploration Museum 3-D Solar Exhibit.

[Make a Magnetometer Lab Sheet \(see attached file\)](#)

SDO Project Suite Student Guide

Names: \_\_\_\_\_ Date: \_\_\_\_\_

**Module 3C: Make a Magnetometer Lab Sheet**

**Overview**  
Solar activity can affect the Earth’s magnetic field causing small changes in its direction at Earth’s surface, which are called magnetic storms. A magnetometer operates like a sensitive compass and can sense slight changes in the magnetic field that surrounds our planet. Your team will build a simple magnetometer to measure changes in Earth’s magnetosphere (magnetic field) over a 7-10 day period of time by following the directions below.

This activity is adapted from: National Geographic Education Build a Magnetometer: <http://education.nationalgeographic.com/education/build-a-magnetometer/3c.pdf>

**IMPORTANT SAFETY TIP: DO NOT** point the laser pointer at other students or at your own eyes. Lasers can cause permanent damage to the retina of the eye.

**Materials:**

- Quart size jar OR 2L plastic bottle
- Sand (about ½ pound/500g)
- Index card (3"x5")
- Scissors
- Bar magnet (about 200mm x 7mm)
- Small craft mirror or large sequin
- Straw
- Low-melt glue or Super Glue
- Thread
- Clear packing tape
- Meter stick
- Metric ruler
- Laser pointer OR adjustable gooseneck desk lamp with clear bulb
- Nail & hammer
- Large sheet white paper
- Pencil

**Procedure:**

1. Refer to the magnetometer model and illustrated instructions when building your magnetometer.
2. Remove labels, clean, and dry a quart size jar or 2L plastic bottle. If using a 2L bottle, use scissors to carefully cut around the circumference of the bottle about ½ of the distance below the bend in the neck of the bottle.
3. Review Diagram A “Magnetometer” details. Fill the bottom of the jar or bottle with enough sand to cover and stabilize it.

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**A) Magnetometer:**

**B) Magnetometer Sensor Card Detail:**

**C) Magnetometer Station Set Up:**

CIRES Education and Outreach <http://cires.colorado.edu/education/outreach/>

***Marvelous, your team members are Magnetic Masters!***