NATIONAL GEOGRAPHIC

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ACTIVITY : 55 MINS

Build a Magnetometer

Construct a simple magnetometer in order to monitor and measure changes in Earth's magnetic field.

GRADES

6 - 8

SUBJECTS

Astronomy, Mathematics

CONTENTS

1 Video, 2 Images, 2 PDFs, 1 Link

OVERVIEW

Construct a simple magnetometer in order to monitor and measure changes in Earth's magnetic field.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/build-a-magnetometer/

Program

WILDEST WEATHER IN THE SOLAR SYSTEM

DIRECTIONS

1. Prepare the magnetometer container.
As you work, refer to the step-by-step illustration "Magnetometer," which shows how to build a magnetometer. Make sure the glass jar is clean, dry, and free of labels. Use scissors to put a

small hole into the center of the jar top. It should be just large enough to allow you to pass string through. Fill 1/4 of the bottom of the jar with sand to keep it from tipping over. Note: If you choose to use a 2-liter plastic soda bottle instead of a glass jar, carefully cut around the bottle about 1/3 of the way down from the neck of the bottle. This will allow you access to assemble the magnetometer inside of the bottle. Before Step 7, use transparent tape to join the top and bottom of the bottle back together.

2. Prepare the index card.
Measure the diameter of the jar and subtract 4 centimeters to make sure the index card will not touch the sides. Then cut the index card so that it will fit inside the jar without touching the sides.

3. Glue the small craft mirror to the index card.
Place a ruler from the top right corner of the card to the bottom left corner so that the edge of the ruler is lined up with both corners. Draw a line along the edge of the ruler. Place the ruler from the top left corner to the bottom right corner. Draw a line along the edge of the ruler. The location of the center of the card is where the lines intersect. Glue the small craft mirror at the center of the card.

4. Glue the bar magnet to the index card.
Find the midpoint of the top of the index card by measuring the top edge of the card and dividing the measurement in half. Mark it with a pencil. Glue the small bar magnet to the card so that the center of the length of the magnet is at the center mark on the card. The bar magnet should line up with the top of the card and should not be touching the mirror. The placement of the magnet on the card is very important and should be level with the card top.

5. Glue the straw to the index card and magnet.
Measure and cut a 2.5-centimeter section of a plastic straw and glue the straw to the top of the card and magnet. The top of the card and the magnet should be lined up evenly so that the straw sits on top of the card and magnet. The straw should prevent you from seeing the card or the magnet in its location. The straw is your guide for the string to keep your magnet and mirror in a level position.

6. Hang the bar magnet/index card in the jar.
Run the thread through the straw and tie into a triangle with 5-centimeter sides. Run the other end of the thread through the top of the bottle and then the lid of the jar. Make sure the magnet/index card hangs freely and below the cut on the bottle. Tape the thread to the

lid.

7. Create a reference point.
If possible, set up the magnetometer in a place where it will not be disturbed. Place the bottle on a flat surface and point the laser pointer so that a reflected spot shows on a nearby wall about 2 meters (6 feet) away. Tape a piece of white paper on the wall. Use a pencil to mark the point where the light is reflected. This point will be your reference point. If you do not have a laser pointer, you can use a gooseneck lamp instead. Make sure to use a clear light bulb.

8. Use your magnetometer to collect data.
Check your magnetometer 15 times to gather data, recording all information on the worksheet Magnetometer Data Collection. Measure the changes from the reference spot position to the current position of the reflected light. Record this measurement on the data sheet. This is the Measured Change in Reflection (due to the reflection of the light). When magnetic storms occur, you will see the reflection point change by several degrees within a few hours, and then return to its normal orientation pointing towards the magnetic north pole. Your magnetometer is sensitive to changes in the magnetic field and the reflected spot will show the changes by slight changes in position. Those changes can be measured using a ruler. Measure the change in reflection in centimeters. Convert the measurement to Degrees of Deflection by multiplying the change in reflection by 0.25 degrees.

Quiz Yourself!

- How can changes in the magnetic field provide information about magnetic storms?

  Increased changes in the magnetic fields indicate probable magnetic storms.

What You'll Need

MATERIALS YOU PROVIDE

- 2-liter plastic soda bottles
- Clear packing tape
- Index cards
- Laser pointer or gooseneck lamp
- Low-melt glue or superglue
- Meter sticks
- Pencils
- Plastic straws

- Quart-sized glass jars with lids
- Rulers
- Sand
- Scissors
- Small bar magnets (not refrigerator magnets)
- Small craft mirrors
- String
- Thread
- White paper

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, Projector, Speakers
- Plug-Ins: Flash

RECOMMENDED PRIOR ACTIVITIES

- Magnetic Fields Lab
- Our Active Sun

BACKGROUND

Background Information

Scientists measure solar storms using a variety of tools. One of the measurements they use to determine the intensity of solar storms is changes in magnetic fields. Scientists use magnetometers to monitor the Earth's environment in space for signs of bad space weather caused by solar activity. Solar storms can affect the Earth's magnetic field causing small changes in its direction at the surface, which are called magnetic storms. A magnetometer operates like a sensitive compass and reads the slight changes.

Vocabulary

Term	Part of Speech	Definition
magnetic field	*noun*	area around and affected by a magnet or charged particle.

Term	Part of Speech	Definition
magnetic storm	*noun*	interaction between the Earth's atmosphere and charged particles from solar wind.
magnetometer	*noun*	scientific instrument used to measure the presence, strength, and direction of Earth's magnetic field.
magnetosphere	*noun*	teardrop-shaped area, with the flat area facing the sun, around the Earth controlled by the Earth's magnetic field.
nanotesla	*noun*	(nT) unit of measurement for magnetic flux density (magnetic field B), which is magnetic force on a moving charge.
solar flare	*noun*	explosion in the sun's atmosphere, which releases a burst of energy and charged particles into the solar system.
solar wind	*noun*	flow of charged particles, mainly protons and electrons, from the sun to the edge of the solar system.
space weather	*noun*	changes in the environment outside the Earth's atmosphere, usually influenced by the sun.

LEARN MORE

For Further Exploration

Websites

- Nat Geo Movies: Wildest Weather in the Solar System
- National Geographic Science: Space
- USGS: Geomagnetism—FAQ
- National Geographic News: Why Does Earth's Magnetic Field Flip?

FUNDER