Solar Activity and Geomagnetic Storms

Directions: Read the following passage about solar storms and Earth's magnetosphere below. While reading, use the following close reading strategy:

- *Underline any new vocabulary words and define them in the margin*
- *Circle the main idea from this passage.*

In order to understand the Carrington solar storm event of 1859 we need to understand two things: Solar activity and how Earth's magnetic field responds to that solar activity. Our sun is composed of superheated gas, called plasma, that undergoes nuclear fusion continuously releasing an immense amount of energy and heat into space. This energy takes the form of electromagnetic radiation (the light spectrum that includes visible light and ultraviolet radiation) and also charged particles, called the solar wind. The plasma of the sun moves around and generates magnetic fields which twist and build energy. As a result, sometimes the sun experiences larger and faster-moving eruptions of energy and matter that we call solar storms. One type of solar storm is a solar flare. Flares are the sudden explosion of electromagnetic energy from the sun, mostly in the form of ultraviolet and x-ray radiation, but can sometimes release high-energy light photons which Carrington observed as a flash of white light. The sun also experiences solar storms called coronal mass ejections, or CMEs, that hurl plasma into space at more than a million miles per hour. Solar flares and CMEs are different and can happen separately, but the most powerful solar flares are usually accompanied by a CME. The solar flare is like an explosion and the CME is the debris, like rocks and particles, that hurtle away from an explosion.

When solar storms reach Earth, they interact with Earth's magnetic field first. The magnetic field acts as a shield to deflect charged particles around Earth, like water flowing around a rock in a stream. Unlike a rock however, the Earth's magnetic field constantly changes

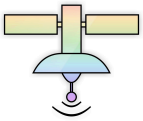
shape and intensity as the solar winds interact with it. Large solar events cause large disturbances we call geomagnetic storms. The geomagnetic storms can make it impossible to navigate accurately, something much of the world's economy relies on. When magnetic fields change, you induce electricity and this electricity can interfere with the electronics on satellites and communication towers. It was electricity from a geomagnetic storm that traveled along telegram wires and sparked fires during the Carrington event. Scientists want to study how solar storms cause changes in Earth's magnetic field in order to plan for large events like the Carrington event. By constantly measuring the magnetic field through satellites and land-based stations, scientists can observe how the field has changed over a period of years and during large solar storms. They can use this data to create models of how it may change during large events in the future.

Model Activity:

*Directions: Cut out the images and text along the dotted lines. Arrange the cards and add your own drawings to explain **how** events such as the Carrington event of 1859 occur on page 4.*

EARTH

SUN



SATELLITE

CELL TOWER

Geomagnetic storm: Major disturbance of Earth's magnetosphere

Aurora: Natural light display in the atmosphere, usually seen at the poles

Solar winds: The sun continually emits (releases) electromagnetic radiation and superheated, charged gas (plasma)

Solar Flare: sudden explosion of electromagnetic energy from the sun

CME: coronal mass ejections blast superheated gas (plasma) into space at more than a million miles per hour

Magnetosphere: Acts as a shield to protect Earth's atmosphere from solar winds

How do events like the Carrington event occur? Arrange and paste the cards into the box below. You will need to add your own drawings and text.

Model Share out:

Your Feedback for partners:

Name	Strength(s)	Missing information

Feedback For You:

Strengths of your model	Information missing from your model:
How would you modify your model?	

CrowdMag Activity:

Measure background geomagnetic field:

- Select the 'WMM' screen and then press the location symbol in the upper right to populate your location. Choose today's date and press calculate

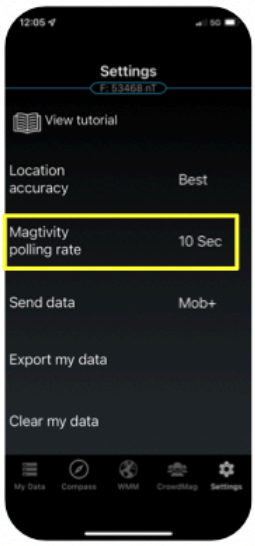
What is the predicted total magnetic field for your location?

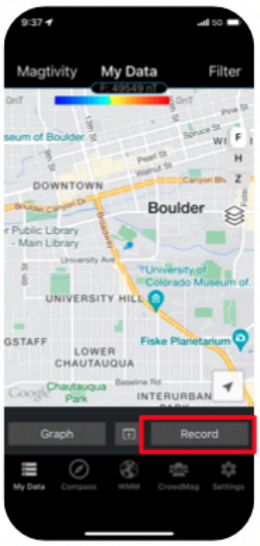
Data Collection:

- As a group, plan a route around campus to measure the intensity of the magnetic field at various locations.
- Collect data according to the instructions in the box below:

To Collect Data:

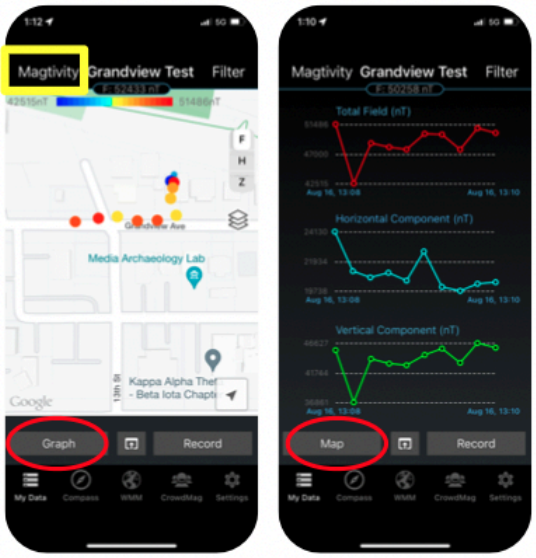
- In settings, set Magtivity polling rate at every 10 s
- Open "My Data"
- Press 'Record' to start collecting data
- Press pause to pause or complete your session





Final Data:

- Name your data so you can find it in the 'Magtivity' tab
- Data can be viewed in the app as a map or a graph



What was the highest magnetic intensity that you encountered on your walk and what object caused it?

What was the lowest reading and where was it?

Data Collection Protocol:

Location:

Device:

How:

Reflection:

Should we be concerned about large solar storms? Why or why not?