



*Teacher's Guide to*

# **“Solar Superstorms”**

## **OBJECTIVES:**

- To demonstrate how the Sun can generate phenomena like solar flares and coronal mass ejections.
- To explain how activity on the Sun can affect the Earth
- To show the importance of magnetism in the space environment
- To show how real data can be transformed into a scientific visualization

This show conforms to the following NGSS: HS.ESS1.1

## **BRIEF SHOW DESCRIPTION:**

A fury is building on the surface of the Sun - high velocity jets, fiery tsunami waves reaching 100,000 km high, and rising loops of electrified gas. What is driving these strange phenomena and will they affect Earth? Find out in this new production, featuring scientific visualizations from the National Center for Supercomputing Applications (NCSA) on the UIUC campus. Peer into the Sun using the latest scientific data. Narrated by Benedict Cumberbatch. Sponsored by SuperValu.

## **PRE-VISIT ACTIVITIES/TOPICS FOR DISCUSSION:**

- Discuss with the class how they think the Sun can affect the Earth. The Sun heats the Earth's surface and drives our weather systems, but are there other ways?
- Place a sheet of blank paper over a bar magnet and pour some iron filings (purchased from a chemical supply company) over the magnet. Note how the filings line up with the magnetic field of the bar magnet. The Earth's field has roughly the same structure though, during a solar storm, it is compressed on the sunward side and drawn out into a tail on the opposite side.
- Take a nail and try to pick up a paperclip with it. (It shouldn't work). Repeat the experiment but wrap insulated wire around the nail and connect it to a 9-volt battery. (It should pick up the paperclip this time). This shows moving charges create magnetism. We think the same thing is happening inside the Earth's core.

## **POST-VISIT ACTIVITIES/TOPICS FOR DISCUSSION:**

- Research the Carrington Event of 1859, mentioned at the beginning of the show. Use the internet resources below.
- Could a Carrington Event happen again? Given the technology we have today, what would be the effect of such an event? Check out:  
<https://news.nationalgeographic.com/news/2011/03/110302-solar-flares-sun-storms-earth-danger-carrington-event-science/>
- For a planet to generate a magnetic field, you need a molten, conductive core and you need to spin the core. A large planet may have a conductive core but if it spins slowly, it may not have a magnetic field. Discuss this in relation to the other planets. Which planets would you expect to have a magnetic field? Check size and rotation rates. Which other planets sport aurorae?

**VOCABULARY LIST:**

Aurora	Nuclear Fusion
Carrington Event	Plasma
Charged particles	Prominence
Coronal Mass Ejection	Space Weather
Geomagnetic Storm	Solar flare
Magnetic Field	Solar Wind
Magnetosphere	Sunspots

**INTERNET RESOURCES:**

- The Carrington Event: [https://en.wikipedia.org/wiki/Solar\\_storm\\_of\\_1859](https://en.wikipedia.org/wiki/Solar_storm_of_1859)
- Current space weather: [www.spaceweather.com](http://www.spaceweather.com)
- The SOHO mission: <https://sohowww.nascom.nasa.gov/> or <https://www.spaceweatherlive.com/en/solar-activity/solar-images/soho>
- The Solar Dynamics Observatory satellite: <https://sdo.gsfc.nasa.gov/> (look under “data” for movies to project in the classroom).
- The Parker Solar probe: <https://www.nasa.gov/content/goddard/parker-solar-probe>
- The sunspot cycle: <https://scied.ucar.edu/sunspot-cycle>
- Solar facts and space weather: <http://www.thesuntoday.org/>
- NCSA page: [http://www.ncsa.illinois.edu/enabling/vis/cadens/documentary/solar\\_superstorms](http://www.ncsa.illinois.edu/enabling/vis/cadens/documentary/solar_superstorms)