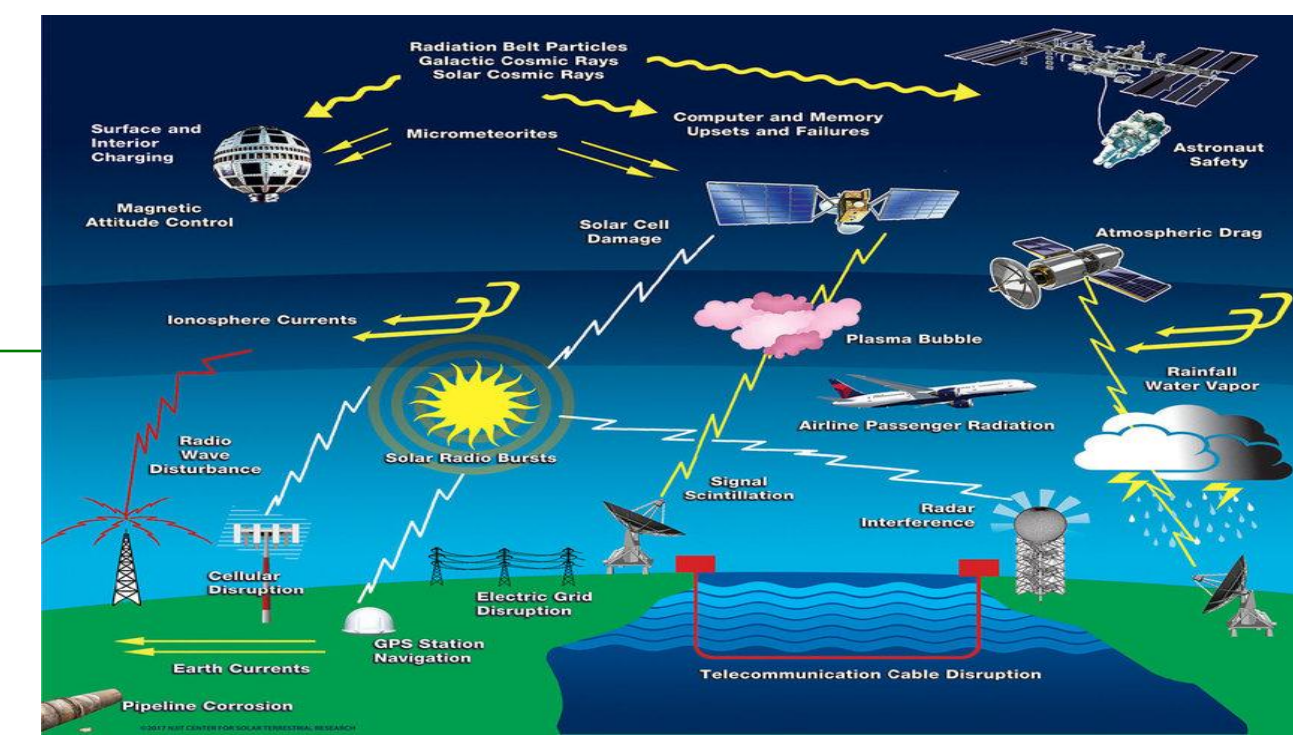




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OBJECTIVES

High School Earth Science/Astronomy

- Students will be able to explain the interactions between the earth's magnetic field and the solar wind.
- Students will be able to explain various impacts of geomagnetic storms to the nation's power grid.
- Students will be able to articulate, in words and in writing, ways citizens, power companies, local public services, state and federal governments can prepare and mitigate impacts to the electrical power grid during an extreme solar storm.

OVERVIEW

Geomagnetic Storms and the Electrical Power Grid

Guiding question:

What If the Biggest Solar Storm on Record Happened Today?

Challenge: Student "expert" teams of students are tasked with preparing for an impending large scale geomagnetic storm.

The electric power grid is our most critical piece of infrastructure. This key resource provides the energy required for all other infrastructures to function. In modern times, electricity has become necessary to sustain life. The power grid in the U.S. is vulnerable to naturally occurring events, such as earthquakes, solar storms, etc.

Solar storms are naturally occurring events that have the potential to create large-scale blackouts that could potentially affect a significant portion of the U.S. population for an extended period of time. Understanding space weather and its effects on our (students and their families) daily lives becomes more critical as we depend more and more on electronic devices for communication, navigation, location, etc.

ENGINEERING CONNECTIONS

- Empathize** with citizens, government agencies, state and local governments
- Define** the potential crisis and who will be affected.
- Ideate** ways to address/prepare for geomagnetic storms.
- Prototype** a conceptual model or plan of action (POA)
- Test** a computer simulation or execute a POA.

MATERIALS

- Computer with internet access
- PlayPosit video with probing questions (Auroras)
- Geomagnetic Storm Web Resources
- US Dept of Labor career summaries/link for each "expert" group
- 6 Whiteboards/large paper and markers for ideation/prototyping
- Time: 2 long classes or 3 shorter

REFERENCES

Electric Power Transmission. (NOAA). Retrieved on June 20, 2018 from <https://www.swpc.noaa.gov/phenomena/electric-power-transmission>.

Geomagnetic Storms. (NOAA). Retrieved on June 20, 2018 from <https://www.swpc.noaa.gov/phenomena/geomagnetic-storms>.

Lovett, Richard A., (March 4, 2011). What if the biggest solar storm on record happened today? Retrieved on June 20, 2018 from <https://news.nationalgeographic.com/news/2011/03/110302-solar-flares-sun-storms-earth-danger-carrington-event-science/>.

Russell, Randy, (March 29, 2010). "[Geomagnetic Storms](#)". *Windows to the Universe*. National Earth Science Teachers Association. Retrieved June 20, 2018.

USGS Geomagnetism Program. (USGS). Retrieved on June 20, 2018 from <https://geomag.usgs.gov/>

PROCEDURES

Students will be given a near future geomagnetic storm scenario (based on past solar storms/blackouts) in which to create a plan to protect life, property and mitigate electronics/power outages.

Six (6) groups of 4-5 students each will be given an "expert" stakeholder role to play ([Emergency Management Director](#), [Power Company Engineer](#), [Local City Government/Mayor](#), [Police/Fire/EMT Chiefs](#), [Water Utilities](#), [Earth/Space Scientist](#)) in preparing for a massive geomagnetic storm. (20 mins).

Each of the groups will begin as one of the 6 stakeholders and research the responsibilities/concerns of each. These students will become "experts" in their respective job duties either through internet research or via a short description that explains those duties, or both. (20 mins).

Once each "expert" group explains what their responsibilities are to the rest of the class, they will be put into 6 jigsaw groups made up of one stakeholder from each "expert" group. (5-10mins)

These "jigsaw" groups will be assigned either a northern (e.g. Cleveland, OH) or southern city (e.g. Knoxville, TN) and told to prepare a Plan of Action (POA) for the city to prepare for the impending solar storm. (90 mins)

The POA will need to be prepared quickly in order to inform the public of the plan. Possible presentation ideas could be:

- Mock press conference where the members of the group are "on stage" fielding questions from the media (class).
- A public service announcement (PSA) in the form of a video, radio spot and/or slide presentation.
- Written plan of action detailing specific steps to be taken and what each stakeholder will be responsible and how it achieves the projects goals.

LESSON OUTCOMES

Once POAs are completed, each group presents their plan to prepare and deal with the solar storm to the class. (45-60 mins).

- Students review and discuss innovative approaches and unexpected results of the POA.
- Students reflection on whether or not the proposed POA/PSA will be potentially successful.
- Whole class discussion of connections between potential earth vs. space weather events, similarities and differences.
- Whole class discussion of possible new technologies as electrical event impact mitigation.