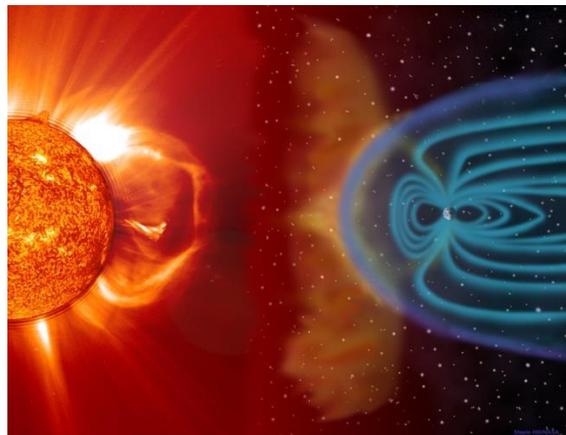




Oklahoma Alliance for Geographic Education

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Can You C-ME?



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Can You C-ME

Grade Level: 6 or 7

Purpose/Overview:

This lesson asks students to investigate a scientific phenomenon, coronal mass ejections (CME), that could have major impacts on our infrastructure, society, and the world. However, strong coronal mass ejections are not well understood by scientists and the public is mostly unaware that this threat even exists. A Carrington Class CME could strike at any time, and depending on its strength and our response, the event could be so catastrophic that modern civilization is forever changed. Using a CME investigation as the backbone, teachers can take this lesson down a variety of paths that relate to human systems, environment, and society.

National Geography Standards from *Geography for Life*

Geographic Elements & Standards:

Geography Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information.

2. The acquisition and organization of geospatial data to construct geographic representations.

Geography Standard 15: How physical systems affect human systems.

2. Environmental Hazards: The types, causes, and characteristics of environmental hazards occur at a variety of scales from local to global.

Oklahoma Academic Standards for the Social Studies:

Grade 6, Content Standard 1.2 Integrate visual information, draw conclusions, and make predictions from geographic data and analyze spatial distribution and patterns by interpreting that data as displayed on globes, graphs, charts, satellite and other forms of visual imagery including data from bar and line graphs, pie charts, thematic maps, population pyramids, climographs, cartograms, contour/relief maps, GIS, and diagrams.

Grade 6, Content Standard 1.5 Conduct short research projects by investigating contemporary events and issues from political, economic, social, and geographic perspectives.

Grade 6, Literacy Skills Standard C.7 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

Grade 7, Literacy Skills Standard 2.B.6 Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

Grade 7, Content Standard 1.3 The student will analyze data from a geographic perspective using the skills and tools of geography. Apply the concepts of scale, distance, direction, relative location, absolute location, and latitude and longitude.

Grade 7, Content Standard 3.2 Analyze from multiple perspectives the impact of natural disasters on human populations resulting in forced migration, scarcity of consumer goods, and loss of employment.

Geographic Themes: Location and Human-Environmental Interaction.

Objectives:

1. After the lesson, students will be able to describe the characteristics of a coronal mass ejection (CME) and how a strong CME could affect global stability.
2. Students will conduct research and describe how society could be affected by a CME.
3. Students will construct a map showing areas of the United States with high population densities that are vulnerable to a CME.
4. Students will identify measures to mitigate the catastrophic impacts of a strong CME.
5. Students will build a map within given parameters, emulating basic practices of GIS to make a product that contains graphical layers conveying information.

Materials:

All materials for this lesson can be found digitally here: <https://tinyurl.com/WGACME>

EAS alert mp3

Engage CME Strike Out handouts

Computer with projector and speakers

NASA CME video on YouTube: <https://www.youtube.com/watch?v=7ukQhycKOFw>

CME research websites

CME Presentation Rubric

Extend handout

National Geographic Map Maker website <http://mapmaker.nationalgeographic.org/#/>

Census Website: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml#

Time Frame: 4-5 class periods

PROCEDURES:

ENGAGE

1. Start class by playing the mock EAS alert telling citizens to get ready for a strong coronal mass ejection.

Teacher's note: Students may think this is real, and you may even let them believe it is actually happening at first, but you should not allow them to believe this for too long because they may be scared.

2. Pass out the first engage handout. Students will write down the top three things they will do to get ready within 12 hours.
3. With a partner (using whatever grouping method you desire), students will compare what they wrote down.
4. Students will look at the top three things their partner wrote, then mark out the one they feel is least important from the other's list.
5. Then, using engage handout 2, students should combine what is remaining on their lists into four items.

6. Students will participate in the instructional strategy, [Strike Out](#) with the class.
7. On your command, students will pass the list to another group and the group will mark out the least important item among the choices left. Repeat this three times so that the group lists that once had 4 items on it is only left with one thing that is not struck out.
8. Student groups get their original list back with all but one item marked out.
9. The groups look at what their peers deemed unimportant, but get to reclaim ONE thing that has been struck out. They can indicate which thing they reclaim by putting a star next to it.
10. Share with the class and discuss.

Teacher's note: Collect their ideas in some way, either on the board, or you may have them do it digitally using something like [mentimeter.com](#) or [Google Docs](#).

EXPLORE

Teacher's note: This phase will work best if you have all the resources for students to use in a folder shared with them via your classroom webpage, [Google Docs](#), [Google Classroom](#) or emailed directly to them.

To start this phase of the lesson, show the whole class this video:

<https://www.youtube.com/watch?v=7ukQhycKOFw>

1. Alone, with a partner, or in groups, students should make a presentation using [Google Slides](#), [Power Point](#), [Haiku Deck](#), [Prezi](#), etc. Students can also make a poster if access to technology is limited.
2. Students need to include all the important details surrounding CMEs, such as what it is, how it may affect people, what it can do to electricity providers and electronics, how they are detected, how to mitigate its impact, etc.
3. ***Give students the attached rubric to guide their research and presentation.***
4. Tell students they can find all the information needed in the links you provided, but they can also find their own links to use if they would like, as long as they are from a reputable source.
5. The teacher can use the rubric to assign grades to students.
6. Students will refer back to their research for the evaluate phase.

EXPLAIN

The teacher should have each group present, or pick the best one or two presentations and have those students present to the class. The teacher should talk about important points, but the students have used the rubric to put presentations full of information together.

EXTEND

Teacher's note: This phase will use map making software from [National Geographic](#) found here: <http://mapmaker.nationalgeographic.org/#/>. While it is easy to use, it would be best to tinker around with it beforehand to familiarize yourself with the basic functionality and how to add layers. Students will be using the latitude/longitude, lights at night, and population density layers to identify areas at risk. Students are also directed to use the [U.S. Census Bureau](#) website

to find population data:

https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml#

Additionally, students are given this address to help find county names, if needed:

<https://mapchart.net/usa-counties.html>

Now that students are experts about CMEs, they will assume the role of a Scientific Advisor to the Government. Individually or in groups, students need a computer and the extend handout. Students will follow directions on the handout and build a map using the National Geographic MapMaker software to determine areas of risk. They will then fill in the table with the city name, latitude/longitude coordinates, and the population. Students should hand in the table to the teacher when they are done.

EVALUATE

Teacher's note: Hand back their list of cities before you start this phase.

Students will choose one of the five cities they compiled in the EXTEND phase and write a one-minute radio Public Service Announcement. One minute on the radio is about 170-200 words, so their PSA should be no longer than 200 words. In the PSA, they need to include all the most important details from this lesson. Students need to:

- Tell the public that power will be shut off to try to save the power grid from catastrophic damage.
- How long they may be without power.
- Explain what a CME is in terms that are easy to understand.
- Why officials are worried about the CME.
- Why they should take this threat seriously.
- Steps they can take to prepare.

Students may record the PSA using the voice recorder on a smartphone or computer software.

Student will turn in the script or submit the PSA to the teacher.

Assessment Options:

1. The presentation in Explore has a rubric the teacher can use to assess students' work.
2. The list of cities students generated from the Extend phase can be collected.
3. The PSA the student made in Evaluate can be used as evidence of student learning.

Enrichment:

Two Voice Poem. Using the attached handout, teachers can ask students to take the perspective of a person who lived through the Carrington Class CME of 1859 as well as the perspective of a person living through an event of the same magnitude in 2017. Instructions for a Two Voice Poem are here: <https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f50611a8>

Resources:

https://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather
<http://solarscience.msfc.nasa.gov/SunspotCycle.shtml>
<http://solarscience.msfc.nasa.gov/CMEs.shtml>
<http://www.swpc.noaa.gov/phenomena/coronal-mass-ejections>
https://en.wikipedia.org/wiki/Coronal_mass_ejection
<http://www.foxnews.com/science/2015/07/29/uk-govt-earth-will-only-have-12-hour-warning-to-deal-with-next-massive-sun/>
<http://www.abc.net.au/news/2014-09-12/how-solar-storms-affect-earth/5740454>
<http://www.ready.gov/>
<https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/interdependency.jpg>
<https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/transformermap.jpg>
https://science.nasa.gov/science-news/science-at-nasa/2010/26oct_solarshield
<http://www.washingtonpost.com/blogs/capital-weather-gang/wp/2014/07/23/how-a-solar-storm-nearly-destroyed-life-as-we-know-it-two-years-ago/>
<http://video.foxnews.com/v/1978082983001/solar-tsunami-seen-in-nasa-video/?#sp=show-clips>
<http://www.telegraph.co.uk/news/science/space/9841852/Coronal-mass-ejection-sends-Sun-particles-to-Earth.html>
<https://www.youtube.com/watch?v=TWjtYSRIOUI>
www.mentimeter.com
<https://www.youtube.com/watch?v=7ukQhycKOFw>

Instructional Strategies

Appointment Clocks (for grouping help):

<https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505c91e>

Strike Out (to refine main ideas):

<https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5062cdf>

Two-Voice Poems (comparing and synthesizing two different ideas, events, etc.)

<https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f50611a8>

Name: _____

You get home, turn on the TV, and the news people are urging the public to prepare for a “Carrington Class” solar flare. Although the newscasters aren’t explaining the space weather very well, the threat is very clear: The entire northern hemisphere may be without ALL electronics AND power for up to a year. You have 12 hours to get ready for 1800s style living. You frantically start preparing.

Three things I do to get ready within 12 hours are:

1. _____

2. _____

3. _____

Name: _____

You get home, turn on the TV, and the news people are urging the public to prepare for a “Carrington Class” solar flare. Although the newscasters aren’t explaining the space weather very well, the threat is very clear: The entire northern hemisphere may be without ALL electronics AND power for up to a year. You have 12 hours to get ready for 1800s style living. You frantically start preparing.

Three things I do to get ready within 12 hours are:

1. _____

2. _____

3. _____

Group members' names:

1. _____

2. _____

- With your partner, compare your lists of the top 3 things you will do.
- **Do not look at other groups' lists!**
- Eliminate one item from your partner's list you feel is least important.
- After you've eliminated one item from your partner's list and they've eliminated one from yours, combine your two lists into one list of 4 items you feel are most important to prepare for the upcoming solar bombardment.

1. _____

2. _____

3. _____

4. _____

Websites with information about CMEs

GENERIC CME INFORMATION:

https://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather

<http://solarscience.msfc.nasa.gov/SunspotCycle.shtml>

<http://solarscience.msfc.nasa.gov/CMEs.shtml>

<http://www.swpc.noaa.gov/phenomena/coronal-mass-ejections>

https://en.wikipedia.org/wiki/Coronal_mass_ejection

<http://www.foxnews.com/science/2015/07/29/uk-govt-earth-will-only-have-12-hour-warning-to-deal-with-next-massive-sun/>

<http://www.abc.net.au/news/2014-09-12/how-solar-storms-affect-earth/5740454>

<http://www.ready.gov/>

<https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/interdependency.jpg>

<https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/transformermap.jpg>

https://science.nasa.gov/science-news/science-at-nasa/2010/26oct_solarshield

VIDEOS

<http://www.washingtonpost.com/blogs/capital-weather-gang/wp/2014/07/23/how-a-solar-storm-nearly-destroyed-life-as-we-know-it-two-years-ago/>

<http://video.foxnews.com/v/1978082983001/solar-tsunami-seen-in-nasa-video/?#sp=show-clips>

<http://www.telegraph.co.uk/news/science/space/9841852/Coronal-mass-ejection-sends-Sun-particles-to-Earth.html>

<https://www.youtube.com/watch?v=TWjtYSRIQUI>

Rubric for Coronal Mass Ejection Presentation

	0	1	2	SCORE
Describe CMEs	Not addressed	An attempt to describe CMEs are made, but not detailed or accurate.	A detailed and accurate description of a CME is included on the presentation.	/2
How are CMEs measured	Not addressed	Indicates CMEs are measured, but not how.	Indicates CMEs are measured and explains how.	/2
When do they occur	Not addressed	Indicates CMEs are common, but makes no distinction between events.	Indicates CMEs are common and explains the differences between weak and strong ones.	/2
How catastrophic CMEs could affect humanity	Not addressed	Presentation indicates CMEs could cause issues on Earth, but with little or no explanation.	Detailed explanation of what could happen on Earth due to a strong CME.	/2
Preparedness	Not addressed	Presentation offers one or two ways to prepare for natural disasters.	Presentation offers three or more ways to prepare for natural disasters.	/2
History	Not addressed	Says CMEs have happened in the past, but gives no explanation.	Says CMEs have occurred in the past, and offers details about what happened.	/2
Mitigation	Not addressed	Mentions things can be done to limit impact, but offers no examples.	Says there are things we can do to limit impacts and offers an example.	/2
Presentation visually appealing	0-2 images or maps	Presentation contains 3 or less images or maps.	Presentation contains 4 or more images or maps.	/2
Grammar/Typos	5 or more errors	3-4 errors	0-2 errors	/2
References	No references	1-2 references listed on presentation.	3 or more references listed on presentation.	/2
SCORE				

/20

COMMENTS:

IDENTIFYING THREATENED LOCATIONS USING MAPS AND DATABASES

Scenario:

A large coronal mass ejection has just been detected by NASA. You are a member of a team of government scientists who has been asked by FEMA (The Federal Emergency Management Agency) to compile a list of cities in America that are most vulnerable to the event.

Details:

- NASA says the only way to save the electrical grid in the affected cities is to shut the power off for three days while the event passes.
- Cities under the greatest threat in the US are at latitudes 35° N and farther north.
- FEMA needs to know how many people may be affected in each city and the metro area.

Tasks:

1. Using National Geographic's MapMaker Interactive tool (<http://mapmaker.nationalgeographic.org/#/>), identify **five** cities north of 35° N that have large populations and use a lot of power.
 - a. In the left-hand column, click on the icon that looks like a grid.
 - b. Turn **on** latitude and longitude lines and show position. Line interval: 5.
 - c. Now the latitude and longitude should appear in the upper right-hand column when you move your cursor.
 - d. In the right-hand column, click "layers," then "add layer."
 - e. Choose "energy."
 - f. To see areas that use the most power, click on the green "+" next to "Lights at Night."
 - g. Click the blue x to close.
 - h. Adjust the transparency in the "Lights at Night" layer to see the city names.
 - i. You can also zoom in and out of the map.
 - j. Gather some ideas for places of interest.
 - k. In the right-hand column, click "layers," then "add layer."
 - l. Choose "Human Populations" and go to the second page of choices.
 - m. To see areas with the most people, click on the green "+" next to "Population Density."
2. Using census data here: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml#
Estimate the populations of each city you've chosen to focus on. You may need to look up the city's county to know how many people live in the city and surrounding areas—this could make a big difference. For example, Oklahoma City has fewer than 600,000 people living in the city limits, but the entire Oklahoma City metro area has over 1,300,000 people. This website may help you find county names nationwide: <https://mapchart.net/usa-counties.html>

Fill in the table on the next page with the results of your investigation.

Name: _____

City	Latitude/Longitude Coordinates	Population

Once you have filled in the table with your five cities, hand in this page to the FEMA Advisor (your teacher).

Poem for Two Voices

I am...

I am...



We are...

I believe...

I believe...

We believe...

I feel...

I feel...

We feel...

I fear...

I fear...

We fear...

TWO-VOICE POEMS

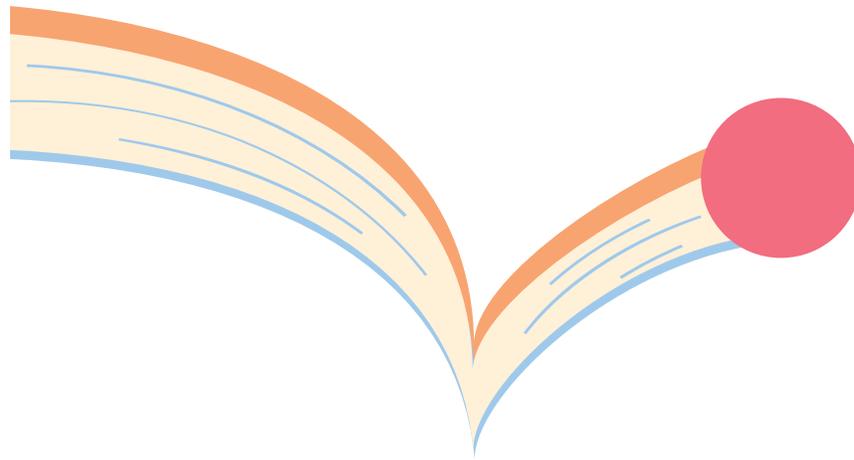
SUMMARY

Students identify similarities and differences between two people, concepts, or readings and then write a poem from the perspectives, contrasting their differences in the "verses" and showing their similarities in the "chorus."

PROCEDURE

1. Students select writing topics or are assigned one by the teacher.
2. Once topics are selected, student pairs brainstorm similarities and differences found between the topics. One student researches one topic, and the other student researches the other one. Then together they compare and contrast the two to list similarities and differences.
3. Students complete the Two-Voice Poem by writing things specific to one topic on one side of the page and things specific to the other topic on the other side of the page. These list items become "verses." The best Two-Voice Poems allow each side to address the same topic one right after the other (meaning every two verses) so their differences will be obvious.
4. Those things that are common to both topics are written in the center every three or four verses or so. This is called a "chorus." These choruses can be repeated throughout the poem, if there are few similarities between the two, or they can change throughout if there are many similarities.
5. Pairs read their poems aloud, each student reading only those things specific to the topic they, personally, researched (each student reads every other line then both students read the chorus together).

INSTRUCTIONAL STRATEGIES



STRIKEOUT!

SUMMARY

Students review key content via small and large group discussions resulting in a master list of major ideas from the unit generated by the entire class. The master list can also serve as a prewriting tool or organizer.

DESCRIPTION

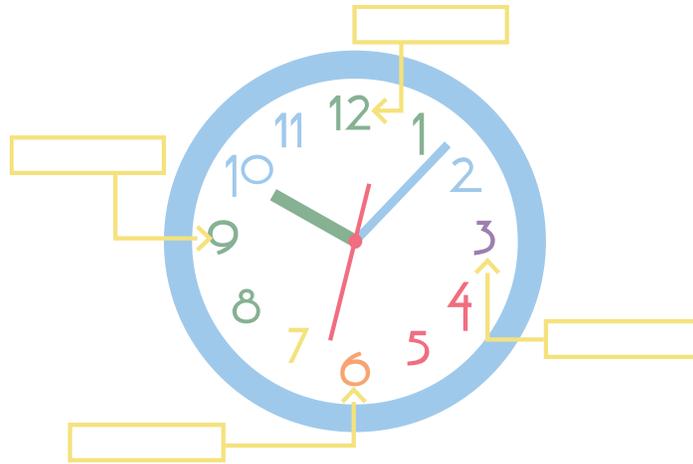
Working in groups, students generate key ideas or themes from a unit of study that can serve as a guide for further study or review.

PROCEDURE

- 1 Students work in small groups to write down as many key or main ideas from a unit of instruction they can remember without using notes or texts.
- 2 Groups pass their list to the next group and that group strikes the least important item from the list.
- 3 Groups repeat step two until the lists return to their original groups or until the teacher stops the activity.
- 4 If they would like, the original group now may reclaim one item that has been struck out. They may also edit their lists by grouping items into larger concepts if they wish.
- 5 Groups share the items that remain on their lists with the rest of the class. These answers are written on a master class list and should represent the facts that the class decided are the most important for the topic.
- 6 Have students evaluate their decisions in constructing the list—whether or not each item would be relevant to a test, whether something important is missing, etc.

LEARN. K20CENTER.OU.EDU/STRATEGIES

INSTRUCTIONAL STRATEGIES



APPOINTMENT CLOCKS

SUMMARY

Students partner up by setting up "appointment times" with their classmates. The activity below only uses four "appointment times," but it can be altered to have more or fewer. Another way to use the strategy is to have students store their clocks after the activity and use them to pair students up in the future.

DESCRIPTION

This strategy can get multiple participants thinking, collaborating, and discussing together in a short amount of time. It can also be used as a way to pair students that can be easily referenced for use in the future.

PROCEDURE

- 1 Pass out a handout featuring a simply drawn analog clock with no hands or have students draw one themselves.
- 2 Students then walk around the room and find four partners, scheduling each of them in one of the available "appointment times," either 12:00, 3:00, 6:00, or 9:00. Once scheduled, both partners write each other's names next to their agreed upon time.
- 3 Present students with a prompt (e.g., a question, task, or statement) then give students enough time to think about that prompt.
- 4 Call out a time to have students immediately move to meet with their corresponding "appointment" to discuss their thoughts on the prompt. Together, they should decide upon one response. While they do this, walk around and observe their conversations.
- 5 Repeat step four until students have met with all of their appointments (optional).
- 6 Ask partners to share out their agreed upon responses.

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