

# Global Precipitation Measurement Mission

## Climate Change Online Lab – Earth’s Vital Signs Teacher Guide

**Lesson Overview:** Students will use NASA’s Global Climate Change website to research five of the key indicators (vital signs) of Earth’s climate health. They will use this information, shared in their expert groups, to create an informative poster about their assigned key indicator. The poster will be used by other groups to learn about all six of the key indicators and how Earth scientists use these indicators to analyze changes in Earth’s climate.

### National Standards:

**ESS2.D Human activities, such as the release of carbon dioxide from burning fossil fuels, are major factors in global warming.** Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

**MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

### Background Information:

“The Earth’s climate has changed throughout history. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 7,000 years ago marking the beginning of the modern climate era — and of human civilization. Most of these climate changes are attributed to very small variations in Earth’s orbit that change the amount of solar energy our planet receives.

“The current warming trend is of particular significance because most of it is very likely human-induced and proceeding at a rate that is unprecedented in the past 1,300 years. Earth-orbiting satellites and other technological advances have enabled scientists to see the big picture by collecting many different types of information about our planet and its climate on a global scale. Studying these climate data collected over many years reveals the signals of a changing climate.”<sup>1</sup>

More background information may be found at: [http://climate.nasa.gov/key\\_websites](http://climate.nasa.gov/key_websites).

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<sup>1</sup> Climate change: How do we know? <http://climate.nasa.gov/evidence>

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## Materials:

- 1 copy per student of the [pre and post assessments](#)
- [student capture sheets](#)
- computers for individual students or groups of students
- 1 copy per student of [“The Global Precipitation Measurement Mission” article](#)
- poster paper, 1 per expert group
- 1 copy per group of the list of research links (page four of this document)

## Engage:

- Administer the [pre-assessment](#).
- Use the activator question, [\[slide 2\]](#) “What is a vital sign?” on the [student capture sheet](#) to get the students to think about the Key Indicators that climate scientists use measure change in our climate, as simile to a vital sign that doctors use to measure our health. *“Similar to a doctor who checks a patient's vital signs-pulse, heartbeat, temperature, and so on-scientists regularly check Earth's vital signs, which informs us about the health of our planet: global temperature, atmospheric CO2, Arctic sea ice, land ice, and sea level.”*<sup>2</sup>

## Explore:

- Students think-pair-share the explore question, [\[slide 3\]](#) “What is a vital sign for Earth’s climate health?” After discussion, have students write the answer on their capture sheets.

## Explain:

- [\[slide 4\]](#) Divide the class into groups of four.
- Assign each of the groups one of the key indicators or a climate mission to research. If you have only six groups, do not assign the NASA missions as the key concepts here are the climate indicators.

Key Indicators	NASA Climate Missions
<ul style="list-style-type: none"> <li>• CO<sub>2</sub> concentrations</li> <li>• Global Temperature (surface)</li> <li>• Arctic Sea Ice</li> <li>• Land Ice</li> <li>• Sea Level</li> <li>• Forest Cover</li> </ul>	<ul style="list-style-type: none"> <li>• Aqua: <a href="http://aqua.nasa.gov/">http://aqua.nasa.gov/</a></li> <li>• Aura: <a href="http://aura.gsfc.nasa.gov/index.html">http://aura.gsfc.nasa.gov/index.html</a></li> <li>• TRMM &amp; GPM: <a href="http://pmm.nasa.gov/">http://pmm.nasa.gov/</a></li> <li>• OCO-2: <a href="http://oco.jpl.nasa.gov/">http://oco.jpl.nasa.gov/</a></li> </ul>

- Students go through the links on their capture sheets to answer questions and gather information about their groups’ assigned key indicator or climate mission.

<sup>2</sup> NASA’s Climate Change Web Page, Introduction to Earth’s Dynamically Changing Climate; [http://climate.nasa.gov/education/pbs\\_modules/lesson1Engage](http://climate.nasa.gov/education/pbs_modules/lesson1Engage)

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## Evaluate:

- [slide 5 & 6] Students use the information gathered during their research to create a poster/presentation. The poster should include information from page 2 of their capture sheet. (There is an optional rubric at the end of this guide.)
- Students complete a “gallery walk” by moving from one poster to another and taking notes on their capture sheets, OR students present their finding in front of the class as the other students fill in their capture sheets.
- Administer the [post assessment](#).

## Extend:

- Brief Constructed Response: “Applying What You’ve Learned: How the GPM mission will be useful to climate scientists.”
- Students can test their understanding of climate change by taking one or more, interactive quizzes at [http://climate.nasa.gov/climate\\_resource\\_center/interactives/quizzes](http://climate.nasa.gov/climate_resource_center/interactives/quizzes). (This link is on the capture sheet.)

## Teacher Notes:

If you do not have access to enough computers, you can download and print the web pages and make copies for the groups. Students will lose interactivity found on some of the pages, but they can still complete the lesson accurately.

## Additional Resources:

- PBS/NASA Global Climate Change Modules  
[http://climate.nasa.gov/education/pbs\\_modules](http://climate.nasa.gov/education/pbs_modules)
- NASA Global Climate Change Education Modules  
<http://esseacourses.strategies.org/module.nasa.html>
- NOAA National Climate Data Center, State of the Climate; <http://www.ncdc.noaa.gov/sotc/>
- NOAA National Climate Data Center, Global Warming; <http://www.ncdc.noaa.gov/cmb-faq/globalwarming.php>
- IPCC Fourth Assessment Report, Summary for Policymakers  
[http://www.ipcc.ch/publications\\_and\\_data/ar4/syr/en/spm.html](http://www.ipcc.ch/publications_and_data/ar4/syr/en/spm.html)

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## Research links for further investigation

### Carbon Dioxide:

- *Carbon dioxide controls Earth's temperature* (article) - <http://climate.nasa.gov/news/423>
- *The Human Factor: Understanding the Sources of Rising Carbon Dioxide* (article) <http://www.jpl.nasa.gov/news/news.php?feature=2001>
- *Carbon Dioxide Concentration* (graphic) - [http://climate.nasa.gov/climate\\_resources/106/](http://climate.nasa.gov/climate_resources/106/)
- *Climate Time Machine* (interactive)- [http://climate.nasa.gov/interactives/climate\\_time\\_machine](http://climate.nasa.gov/interactives/climate_time_machine)  
→ Click on the 'Carbon Emissions' button at the bottom of the viewer

### Global Temperature

- *Piecing Together the Temperature Puzzle* (video)- [http://climate.nasa.gov/climate\\_resources/42/](http://climate.nasa.gov/climate_resources/42/)
- *2009: Second warmest year on record; end of warmest decade* (article) - <http://climate.nasa.gov/news/249>
- *Long-term global warming trend sustained in 2013* (article) - <http://climate.nasa.gov/news/1029/>
- *A Warming World* (interactive) - [http://climate.nasa.gov/interactives/warming\\_world](http://climate.nasa.gov/interactives/warming_world)
- *Rising temperatures: A month versus a decade* (article) - <http://climate.nasa.gov/news/2180/>
- *Climate Time Machine* (interactive)- [http://climate.nasa.gov/interactives/climate\\_time\\_machine](http://climate.nasa.gov/interactives/climate_time_machine)  
→ Click on the 'Average Global Temperature' button at the bottom of the viewer

### Arctic Sea Ice

- *Study sheds new light on Arctic sea ice volume losses* (article) - <http://climate.nasa.gov/news/863>
- *Arctic sea ice hits smallest extent in satellite era* (article) - <http://climate.nasa.gov/news/782>
- *Global Ice Viewer* (interactive) - [http://climate.nasa.gov/interactives/global\\_ice\\_viewer](http://climate.nasa.gov/interactives/global_ice_viewer)  
→ Click on the 'Arctic' button at the bottom of the viewer
- *Climate Time Machine* (interactive)- [http://climate.nasa.gov/interactives/climate\\_time\\_machine](http://climate.nasa.gov/interactives/climate_time_machine)  
→ Click on the 'Sea Ice' button at the bottom of the viewer.
- *Arctic Sea Ice 101* (article) - <http://nsidc.org/icelights/crash-course/arctic-sea-ice/>
- *Arctic Sea Ice 101* (video) - <http://youtu.be/m-M37vc-m0>
- *Q&A: What is happening with Antarctic sea ice?* (article) - <http://climate.nasa.gov/news/2167/>

### Land Ice

- *NASA mission takes stock of Earth's melting land ice* (article) - <http://climate.nasa.gov/news/676>
- *Is Antarctica melting?* (article) - <http://climate.nasa.gov/news/242>
- *Just 5 questions: Ice ice, baby* (article)- <http://climate.nasa.gov/news/299>
- *Global Ice Viewer* (interactive) - [http://climate.nasa.gov/interactives/global\\_ice\\_viewer](http://climate.nasa.gov/interactives/global_ice_viewer)
- *Greater Himalaya's vanishing glaciers* (article) - <http://climate.nasa.gov/news/2159/>

### Sea Level Rise

- *Melting Ice, Rising Seas* (video) - <http://pmm.nasa.gov/education/videos/melting-ice-rising-seas>
- *Waves in the bathtub: Why sea level rise isn't level at all* (article) - <http://climate.nasa.gov/blog/239>
- *Quiz: Sea level rise* - [http://climate.nasa.gov/climate\\_resources/18/](http://climate.nasa.gov/climate_resources/18/)
- *Sea Level Viewer* (interactive) - [http://climate.nasa.gov/interactives/sea\\_level\\_viewer](http://climate.nasa.gov/interactives/sea_level_viewer)
- *Ice Shelf and Ice Sheet Simulation* (interactive) - [http://www.pbslearningmedia.org/asset/ipy07\\_int\\_icesimulate/](http://www.pbslearningmedia.org/asset/ipy07_int_icesimulate/)

### Forest Cover

- *Climate Impacts on Forests* (article) - <http://www.epa.gov/climatechange/impacts-adaptation/forests.html>
- *NASA-USGS Landsat Data of the Global Forest* (video & article) - <http://go.nasa.gov/1wfy6NA>
- *Global Forest Watch* (interactive map) - <http://www.globalforestwatch.org/map>
- *Landsat Satellite sees Florida Mangroves Migrate North* (article) - <http://go.nasa.gov/1wzfMGN>
- *Will Climate Change Lead to More Boreal Fires?* (article) - <http://go.nasa.gov/1wfybAS>
- *International Deforestation Patterns in Tropical Rainforests* (article & animation) <http://go.nasa.gov/1wFAFPE>

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Name: \_\_\_\_\_ Date: \_\_\_\_\_ Per.: \_\_\_\_\_

## Climate Change Project Rubric

	<b>Advanced (4)</b>	<b>Proficient (3)</b>	<b>Partially Proficient (2)</b>	<b>Basic (1)</b>
<b>Content</b>				
<i>What is happening?</i>	<ul style="list-style-type: none"> <li>Includes details about what is happening and who/what is affected.</li> <li>Explanations are clearly written and make sense.</li> <li>Evidence from the article is included.</li> </ul>	<ul style="list-style-type: none"> <li>Some details are included, but explanations may not be as clear or insufficient evidence is given.</li> </ul>	<ul style="list-style-type: none"> <li>Many details or evidence is lacking, or writing is very unclear, but the general picture comes across.</li> </ul>	<ul style="list-style-type: none"> <li>An attempt is made to answer the question, but very little effort is shown.</li> </ul>
<i>Why is it happening?</i>	<ul style="list-style-type: none"> <li>Explains the causes of what is happening and what we can do about it</li> <li>Explanations are clearly written and make sense.</li> <li>Evidence from the article is included.</li> </ul>	<ul style="list-style-type: none"> <li>Some details are included, but explanations may not be as clear or insufficient evidence is given.</li> </ul>	<ul style="list-style-type: none"> <li>Many details or evidence is lacking, or writing is very unclear, but the general picture comes across.</li> </ul>	<ul style="list-style-type: none"> <li>An attempt is made to answer the question, but very little effort is shown.</li> </ul>
<b>Presentation</b>				
<i>Visuals</i>	<ul style="list-style-type: none"> <li>Includes 2-3 pictures that clearly show what is happening and why.</li> <li>If images are printed (not hand-drawn), citations are included.</li> </ul>	<ul style="list-style-type: none"> <li>Includes 2-3 pictures, but may not be best ones to illustrate topic.</li> <li>If images are printed (not hand-drawn), citations are included.</li> </ul>	<ul style="list-style-type: none"> <li>Includes too few or completely irrelevant pictures, or citations are missing or incorrect.</li> </ul>	<ul style="list-style-type: none"> <li>No pictures included.</li> </ul>
<i>Neatness</i>	<ul style="list-style-type: none"> <li>Neatly drawn and written.</li> <li>Very few errors in grammar or spelling.</li> <li>Makes the viewer say "wow, that's great!"</li> </ul>	<ul style="list-style-type: none"> <li>Neatly drawn and written.</li> <li>Very few errors in grammar or spelling.</li> </ul>	<ul style="list-style-type: none"> <li>Shows a lack of effort to be neat, or many distracting errors in grammar or spelling</li> </ul>	<ul style="list-style-type: none"> <li>Shows poor effort at neatness and/or excessive errors in grammar or spelling.</li> </ul>