Torrents, Droughts, and Twisters Oh My!

From the Center for Science Education

<https://scied.ucar.edu/activity/torrents-droughts-and-twisters-oh-my-0>

Grade Level: Middle School and High School

* Time: Class time: Approximately three class periods plus ample research time during class or for homework over 2-3 days

Students review current scientific understandings of the relationship between extreme weather events and climate change.

## Learning Objectives

* Students will research the nature of science and the process of scientific research to obtain evidence to support or refute ideas.
* Students will investigate the scientific process that requires a review of scientific research and/or theoretical models, and the explanations proposed by other scientists' research to advance our knowledge of the natural world.
* Students will investigate the current state of knowledge about severe weather and the impact of increasing global temperatures on severe weather.
* Students will discuss and present their research to classmates and demonstrate their knowledge about the state of current scientific evidence.

## Materials

[Torrents, Droughts, and Twisters Student Sheet A](https://scied.ucar.edu/sites/default/files/documents/Torrents-Droughts-Twisters_Student-Sheet-A.pdf) (See downloadable material)

[Torrents, Droughts, and Twisters Student Background](https://scied.ucar.edu/sites/default/files/documents/Torrents-Droughts-Twisters_Student-Background.pdf) (See downloadable material)

[Torrents, Droughts, and Twisters Student Note-taking Sheet (Student Sheet B)](https://scied.ucar.edu/sites/default/files/documents/Torrents-Droughts-Twisters_Student-Sheet-B.pdf) (See downloadable material)

[Presentation Rubric for Torrents, Droughts, Twisters, Oh My!](https://scied.ucar.edu/sites/default/files/documents/Torrents-Droughts-Twisters-oh-my_presentation-rubric.pdf) (See downloadable material)

You will need to make 2 copies/student for pre-and post-ranking of Student Sheet A (for students to rank phenomena's relationship to climate change)

## Directions

1. As a pre-assessment exercise, ask students to rank which weather and/or climate phenomena scientists feel are most influenced by or influence Earth’s increasing heat-trapping gases using **Student Sheet A**provided.
2. Following the pre-assessment, ask students to read and discuss the student content titled, ***Torrents and Droughts and Twisters – Student Background.*** Students should record what they learn about the scientific consensus, if any, regarding each extreme event and its connection to climate change. A note-taking sheet is provided in the materials. For more in-depth research, have students look for scientific evidence in science journals and/or news reports between one of the extreme events and its connection to climate change. Students could also review the **2014 Fifth Assessment Report (AR5)** from the Intergovernmental Policy on Climate Change (IPCC) and/or the **2014 National Climate Assessmen**t. Have each student serve as an “expert” for the phenomenon they have researched, ideally writing notes pertaining to content within the report they find relevant to their phenomenon and increasing greenhouse gases.
3. Have “experts” gather in small groups to discuss what they’ve learned about their phenomenon by reviewing reputable source documents. Their research should help to determine the degree of confidence regarding their phenomenon’s connection to climate change. Each group should report their research to the class using a presentation or multimedia software of their choosing.
4. Bring the class together as a whole and have each group of experts present their phenomenon and any of their findings linking it to Earth’s increasing climate change.
5. Following the class discussion, have students review their initial rankings on Student Student Sheet A and rank again the degree of confidence found within peer-reviewed science regarding relationships between various natural phenomena and heat-trapping gases.
6. Compare the class rankings to the actual order of phenomena that scientists know are most closely linked to Earth’s increasing greenhouse gases and those that are less certain at this point in time.
7. During a final review of the activity, remind students that believing that there is a relationship between severe weather and increasing global temperatures does not make it so. Evidence must exist to support all scientific conclusions and our knowledge changes and advances over time.

## Assessment

Each group should report their research to the class using a presentation or multimedia software of their choosing. A [rubric](https://scied.ucar.edu/sites/default/files/media/documents/Presentation%20Rubric.pdf) (See downloadable material) to assess each presentation is attached.

## Background

[Torrents, Droughts, Twisters Oh My! article](https://scied.ucar.edu/sites/default/files/media/documents/TorrentsDroughtsTwistersBackgrounder.Notes_.pdf) by Bob Henson, UCAR Office for Science Education (See downloadable material)

## Extensions

To build and reinforce an understanding of the nature of science, ask students how they feel about the knowledge and confidence that scientists have currently regarding extreme events and their relationship to climate change. Ask them to explicitly state how science works to establish relationships and how it differs from other ways of learning and knowing. What type of data do scientists need to prove or disprove an idea? If the students were scientists, what data would they seek to obtain to help them prove or disprove correlations and causations? What is the difference between correlation and causation, and why is the distinction important to know? What questions do students have about the connections between extreme weather and climate change? What would they need to know and do to answer these questions? Allow students to attempt to answer these questions if they remain interested and motivated to seek such answers. If possible, connect with a climate scientist who is working in this area via Skype or other distance learning platform to learn more about their research and that of the larger climate science community.

## Related Resources

* [National Climate Assessment (2014)](https://nca2014.globalchange.gov/)
* Intergovernmental Panel on Climate Change Fifth Assessment Report (2013/2014)
	+ [The Physical Science Basis Summary for Policy Makers](https://www.ipcc.ch/report/ar5/wg1/) - Working Group I
		- https://www.ipcc.ch/report/ar5/wg1/
	+ [Impacts, Adaption, and Vulnerability Summary for Policy Makers](https://www.ipcc.ch/site/assets/uploads/2018/03/ar5_wgII_spm_en-1.pdf) - Working Group II
		- See downloadable material
	+ [Mitigation of Climate Change Summary for Policy Makers](https://ecotality.com/climate-change-report-how-advantages-of-solar-energy-help/) - Working Group III
		- https://ecotality.com/climate-change-report-how-advantages-of-solar-energy-help/
* [EPA Climate Change Indicators in the United States](https://www.epa.gov/climate-indicators)
	+ https://www.epa.gov/climate-indicators