

ScienceNews

EDUCATOR GUIDE



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Earth Cannot Avoid A Warmer Future



About this Guide

In this Guide, based on the online *Science News* article "[The new UN climate change report shows there's no time for denial or delay](#)," students will learn about a United Nations assessment that concludes human-caused climate change is behind extreme weather events. Then, students will discuss and compare climate scenarios and visualize some of the data.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "[The new UN climate change report shows there's no time for denial or delay](#)," which describes a massive scientific assessment that concludes human-caused climate change is behind extreme weather events. A version of the story, "Earth cannot avoid a warmer future," appears in the September 11, 2021 issue of *Science News*. Related standards include NGSS-DCI: HS-ESS3.

Student Comprehension Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will learn about climate scenarios, analyze a chart of climate change impacts under four scenarios and create a data visualization for one climate change impact. Related standards include NGSS-DCI: HS-ESS3.

Student Discussion Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Article-based Comprehension, Q&A

Directions for teachers: Ask students to read the online *Science News* article "[The new UN climate change report shows there's no time for denial or delay](#)," which describes a massive scientific assessment that concludes human-caused climate change is behind extreme weather events. A version of the story, "Earth cannot avoid a warmer future," appears in the September 11, 2021 issue of *Science News*.

1. What is the IPCC? What does the IPCC do and who is involved?

The IPCC is the United Nations' Intergovernmental Panel on Climate Change. The panel is made up of hundreds of scientists from around the world that come together to analyze thousands of studies. Based on the scientists' analysis, the panel forms a consensus of how Earth's climate is changing and what role humans play in those changes.

2. What did the IPCC report recently about human impact on Earth's climate?

Humans are driving major shifts in Earth's climate, and the effects are now found in every region around the world and are intensifying at a fast pace.

3. What extreme events that are already happening does the IPCC's report link to climate change? Give some examples.

Drought and wildfires in the western United States, heat waves in Europe and flooding in Asia.

4. What are climate scenarios? Why are there multiple scenarios in the IPCC report?

The scenarios cover different levels of warming over preindustrial times based on different levels of greenhouse gas emissions, as well as what the effects of that warming might be. Multiple scenarios are included because the amount of future warming depends on a mix of social, economic and technological developments. If humans curb greenhouse gas emissions immediately, for example, future warming will look much different than if emissions continue as they are now.

5. Define net-zero carbon emissions.

Net-zero carbon emissions is when the amount of carbon emitted is negated by carbon removal from the atmosphere.

6. How might achieving net-zero by 2050 affect Earth's climate?

If the world gets to net-zero carbon emissions by 2050, temperatures would decrease in the following decades, though they would not come down to preindustrial levels.

7. What is a near-future climate change effect that is irreversible, according to the report? How

could reducing greenhouse gas emissions now help?

Sea level will rise until about 2300 as Greenland's ice sheet continues to melt. Even though rising sea level is inevitable, reducing emissions sharply and quickly will slow how much sea level rises by 2100.

8. How many reports has the IPCC released? How has climate science changed since the first report was released, and what was a major finding of the fifth report?

The IPCC has released six reports since 1990. Over the last 30 years, technological advances have improved scientists' understanding of climate change. The fifth report was the first to state that human activity is driving climate change.

9. What is the Paris Agreement? What special report did the IPCC undertake due to the agreement, and what did the report find?

The Paris Agreement was an agreement made by 195 nations to reduce emissions to limit warming by 2 degrees C over preindustrial levels. Some nations didn't think 2 degrees C was a strict enough limit, so the IPCC analyzed a scenario in which the world limited warming to 1.5 degrees C. The report showed that just a half degree of extra warming could make a big difference, from higher sea level to an increased likelihood of heat waves.

10. What impact do IPCC scientists hope the new report will have?

IPCC scientists hope the new report will encourage heads of state to act more strongly to limit climate change.

Student Comprehension Worksheet

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Cross-curricular Discussion, Q&A

Directions for teachers:

Have students read the online *Science News* article "[The new UN Climate change report shows there's no time for denial or delay](#)" and answer the related comprehension questions for homework, or have students read the article as a quick warm-up at the beginning of class. A version of the article, "Earth cannot avoid a warmer future," appears in the September 11, 2021 issue of *Science News*.

As a class, discuss the first set of questions below. Then have students answer the second set of questions with a partner. Finally, assign each pair an impact from the "Feeling the heat" chart in the *Science News* article to analyze. The students will use the third set of questions to create a data visualization for their assigned impact. If time permits, consider having students share their visualizations with the class.

Want to make it a virtual lesson? Post the online *Science News* article to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

So many scenarios

1. What are climate scenarios?

Climate scenarios forecast how much the world could warm relative to preindustrial times due to greenhouse gas emissions and what the effects of that warming might be. The scenarios are based on data and climate models.

2. What do the four scenarios outlined in the "Feeling the heat" chart in the *Science News* article represent?

The first scenario describes the climate impacts of today's level of warming — about 1.1 degrees Celsius warmer than preindustrial times. The next two scenarios forecast what the climate impacts could be if we cut greenhouse gas emissions enough to limit global warming to around 1.5 degrees C and 2 degrees C. The final scenario forecasts what the climate impacts could be if the average global temperature rises by 4 degrees C relative to preindustrial times.

3. Why do you think scientists look at more than one scenario in climate change studies? Think about what determines how much climate will change in the future.

Changes in human activity such as population size, fossil fuel consumption and land use affect greenhouse gas emissions, which contribute to global warming. Evaluating multiple scenarios allows scientists to look at the climate impacts for different amounts of emissions and thus different amounts of warming. Setting out these scenarios could help people make decisions about how to change and how much to change their activities going forward.

4. How might understanding different climate scenarios and their impacts benefit policy makers around the world?

Knowing how increases in global temperature will affect weather patterns and extremes, and thinking about how those changes may affect people, could inform policy makers' decisions about how to regulate carbon emissions.

5. Why do you think it is important for you to understand how scientists use climate change scenarios? Explain.

Answers will vary, but students might mention that knowing how scientists investigate the potential impacts of climate change could help students understand what they read about climate change in the news. For instance, if students read about how much snow cover extent might decrease over the next several decades, they will know that the forecast is based on some specific climate scenario. They may want to investigate what scenario was used for the forecast.

Data dive

1. Look at the chart titled “Feeling the heat” in the *Science News* article. In your own words, describe what the chart shows. Make sure to state any units of measurement used, and compare your answer with your partner’s answer.

The chart shows how much worse than preindustrial levels extreme weather events will be according to four climate scenarios. Global temperatures based on different levels of greenhouse gas emissions are given as a number of degrees over the average global temperature from preindustrial times. Today’s temperature is given as +1.1 degrees C relative to preindustrial times. The extreme weather events in the chart are related to temperature, drought, precipitation, snow and tropical cyclones.

2. Choose two data points off the chart for your partner and have them explain the meaning of the points to you. Make sure your chosen points are different than the points your partner chooses. Take time to think through your answers before taking turns explaining the data points to each other.

Student answers will vary. As an example, if students choose the point for drought and +2 degrees C, they should explain that if the average global temperature is 2 degrees C warmer than it was during preindustrial times, then a once-in-a-decade drought is 3.1 times as likely to occur.

3. Look at the climate impacts for the +1.5 degrees Celsius scenario and the +2 degrees C scenario. Based on the chart and the rest of the *Science News* article, how does half a degree of warming affect the severity of extreme events? Use one extreme event given in the chart as an example to help explain your reasoning. Think about differences in severity relative to preindustrial times and relative to now.

The effect that 2 degrees C of warming has on extreme conditions versus the effect that 1.5 degrees C of warming has is substantial, according to a special IPCC report. For instance, the likelihood of heat waves increases more under the +2 degrees C scenario than it does under the +1.5 degrees C scenario. According to the chart, that extra half degree of warming means that the hottest day in a decade could be 2.6 degrees C hotter relative to preindustrial times as opposed to 1.9 degrees C hotter. Relative to today, that's 1.4 degrees C hotter versus 0.7 degrees C hotter.

Diagram the data

1. Check in with your teacher to determine which extreme weather event you and your partner should explore. State which extreme event you are investigating. What geographic regions do you think will be most affected by changes in the severity of that event?

Student answer will vary.

2. Draw a diagram to represent the relative data for your assigned extreme event under each of the four climate scenarios in the "Feeling the heat" chart. Make sure that your data visualization correctly represents the relative changes in severity for the different scenarios.

Student diagrams will vary, but should accurately represent the data given for a particular extreme event.

3. Explain how you could determine the rate of change in severity of your extreme event.

Student answers will vary. Students could graph the severity data relative to the projected temperature increases to determine the rate of change.

Student Discussion Worksheet

Directions: After reading the online *Science News* article "[The new UN Climate change report shows there's no time for denial or delay](#)," discuss the first set of questions with your class. Then, discuss and answer the second set of questions with a partner. Your teacher will assign you an extreme condition to focus on when completing the third set of questions. A version of the article, "Earth cannot avoid a warmer future," appears in the September 11, 2021 issue of *Science News*.

So many scenarios

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2. What do the four scenarios outlined in the "Feeling the heat" chart in the *Science News* article represent?
3. Why do you think scientists look at more than one scenario in climate change studies? Think about what determines how much climate will change in the future.
4. How might understanding different climate scenarios and their impacts benefit policy makers around the world?
5. Why do you think it is important for you to understand how scientists use climate change scenarios? Explain.

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