Human Impacts on Climate Change: What will happen and what can we do about it? - Teacher Guide

Setting the Stage

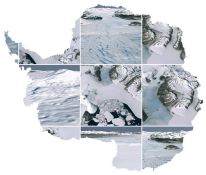
After learning about ice in Antarctica, how penguins are affected by their environment and vice versa, and what is causing melt in Antarctica, this lesson explores possible impacts that human activities will continue to have on Antarctic ice in the future, ending with a discussion of how humans cause climate change and what humans can do to stop/reverse these effects.

An iceberg floating in Antarctica's McMurdo Sound. (Credit: NASA)

Lesson Overview

- *Part 1 – Future Impacts (25 minutes) Understanding models for future climate change*
  Students will learn about the importance of Antarctic ice shelves as the climate warms and study two models/scenarios of human activities and fossil fuel emissions.
- *Part 2 Human Influence (35 minutes) How can we change our current behaviors to have a more positive impact on the future of the Earth's climate?*
  Ending on a comprehensive but also empowering note, this section explores how humans cause climate change and what humans can do to stop/reverse these effects.

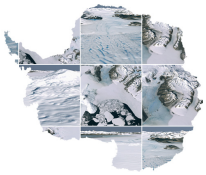
These materials were developed by Meghan Mosher, Penny Rodrick-Williams, Allen Pope, Anna Ruth Halberstadt, Luke Trusel, and Mahsa Moussavi in collaboration with CIRES Education & Outreach at CU Boulder. Funded by NSF OPP Award #1643715.



Instructional Overview	
Grade Level	High School
Instructional Time	60 minutes
Standards Alignment	**NGSS:** ● **ESS2.D: Weather and Climate:** Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. ● **Constructing Explanations and Designing Solutions** ● **Stability and Change**
Anchoring Phenomenon	● Climate change and environmental feedback loops are causing Antarctic ice to melt, which is causing dramatic local and global impacts.
Driving Questions	● What do models tell us about the future of human impact on the Earth's climate? ● How can we change our current behaviors to have a more positive impact on the future of the Earth's climate?

Learning Goals	● Students will be able to:
	  ● Understand the models/scenarios of human activities and their potential impact on climate change (through ice melt)
	  ● Recognize their own activities that increase greenhouse emissions and contribute to global warming
	  ● Develop a list of efforts that students could make in different parts of their lives to help reduce their greenhouse gas emissions

Materials	❏ Laptop with internet access ❏ Student handout
Material Preparations	❏ Print out student handouts (1 per student)
Instructional Strategies	● Collaborative learning, 5E



	Web Links for Lesson Resources
Part 1	• Article: "Ice Melt Could Get Worse, But Humans Can Slow It Down" https://www.huffpost.com/entry/antarctic-ice-sheet-study_n_561c3600e4b028dd7ea4e125?guccounter=1
Part 2	• Project Drawdown table of solutions https://www.drawdown.org/solutions/table-of-solutions

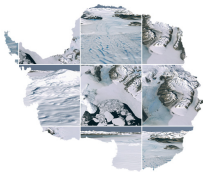
Part 1 Future Impacts *(25 minutes)*
Understanding models for future climate change
Driving Question: What do models tell us about the future of human impact on the Earth's climate?

Students will begin this section by reading a popular article that discusses climate change as seen in the melting of Antarctic ice. With human generated greenhouse gas emissions being the driving force behind climate change, the article discusses two models of human activity: one 'middle of the road scenario' where strong efforts are taken to curb greenhouse gas emissions, and another high-end warming scenario where nothing is done to curb emissions. Students also view a graphic from the article: How to save Antarctica (and the rest of Earth too) http://www.imperial.ac.uk/news/186668/how-save-antarctica-rest-earth/

You can either ask students to answer the following questions individually or use them to facilitate a whole-class or small-group discussion:

1. What is the fate of the ice shelves under the scenario where we continue or increase our fossil fuel use and emissions?
2. What is the fate of the ice shelves under the scenario where we reduce our fossil fuel use and emissions?
3. What are some results of melting ice?
4. Thinking beyond physical changes in the Antarctic environment, what are some of the effects on biological functioning in Antarctica?
5. What impact does ocean warming have on the melting of ice shelves?
6. How is this information both bad news AND good news?

Some additional resources that may be useful in part 1, especially for groups that want to dig more deeply into the science that is discussed in the news articles and student guide:



- The Nature Geoscience study on future Antarctic ice shelf melting by Trusel et al: https://www.nature.com/articles/ngeo2563
- A later Nature paper that is referenced in the student guide, which predicted up to 3 meters of sea level rise from Antarctica alone by 2100: https://www.nature.com/articles/nature17145
- And the Nature perspective article on choosing the future for Antarctica, where the figure comparing low emissions and high emissions was originally published: https://www.nature.com/articles/s41586-018-0173-4

Part 2 Human Influence *(35 minutes)*

Driving Question: How can we change our current behaviors to have a more positive impact on the future of the Earth's climate?

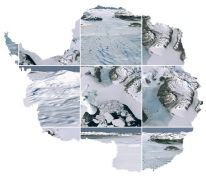
In this section, students will begin to think about how their own activities can have an impact on future global temperatures. The following instructions are also listed on the Student Handout.

1. Begin by asking students to list the 5 activities that they think contribute the most to greenhouse gas emissions and climate change on their student handouts. If you like, you can ask students to share what they listed and create a class list on the board.

2. Direct students to Project Drawdown's website showing a 'Table of Solutions,' which lists individual actions to combat climate change and their potential impacts on reducing global CO_2 emissions: https://www.drawdown.org/solutions/table-of-solutions On this page, the students can sort the solutions based on two scenarios. Scenario 1 stops climate change with a 2 ℃ (3.6°F) increase. Scenario 2 stops climate change with a 1.5 ℃ (2.7°F) increase. These temperature increases are relative to a 'pre-industrial' baseline (the average worldwide temperatures in the years 1850-1900). For reference, an IPCC report released in late 2018 found that temperatures have already warmed about 1°C.

3. Instruct students to choose one of the first 10 solutions and brainstorm ways that they could work on that solution at various levels of their lives. You may choose to discuss their ideas once they are complete, or wait until after the next task. Be sure to remind students that they should start by focusing on scenario 1 by clicking on the arrows until the highest numbers of gigatons are at the top.

4. Next, instruct students to re-sort the list of solutions to focus on scenario 2 by clicking on the arrows until the highest numbers of gigatons are at the top. They should observe that



the list of top solutions has changed. Once again, they should choose one of the top 10 solutions and brainstorm ways that they could work on that solution at various levels of their lives. You may have the students discuss their ideas.

5. After having looked at solutions for both scenarios, students should think about the top 10 solutions for each and answer the following questions:

- What is different about the top individual solutions in each?
- Is one based more on individual action, and one reliant upon both individual and structural (i.e., energy sources, conservation efforts, etc) change?
- What does this tell you about the necessary steps needed to limit warming?

In a discussion, students should recognize that, in order to make greater impacts on the future climate, the solutions involve more structural changes, such as using renewable energy sources or conservation and regeneration of rainforests. They should recognize that they can begin with their individual actions, but both encourage and participate in community actions in order to make progress with these solutions.