

# PEOPLE AND CLIMATE CHANGE: THE DATA IS IN



People  
and the  
Planet

Lessons for a Sustainable Future

## INTRODUCTION

There is scientific consensus that our climate is changing and it's happening at an alarming rate. Concentrations of atmospheric **carbon dioxide** are at the highest levels seen in centuries and are steadily climbing, average annual temperatures continue to soar, and all of Earth's environmental systems are suffering as a result. The root cause of all this sudden change is people. Around the dawn of the Industrial Age, human population began growing exponentially. The burning of **fossil fuels** powered a new modern life and led to a sharp increase in the amount of **greenhouse gases** in the atmosphere. This growing abundance of greenhouse gases (largely carbon dioxide) has had a ripple effect around the world, causing temperatures to increase, ice to melt, and, ultimately, seas to rise.

Scientists continuously collect **data** to monitor the many impacts of **climate change** and to make predictions about the future. By analyzing climate-related graphs, visual images, and news articles, people can begin to understand the many cause and effect relationships that are shaping our changing world.

## MATERIALS

- Butcher paper
- Glue sticks or tape
- Markers
- Data Bank Items\* (provided)
- 2 computers/tablets with internet access

\*To access the two Data Bank articles, you will need to sign up for a free Newsela account (<https://newsela.com>)

## PROCEDURE

1. Before class, sign-up for a free Newsela account (<https://newsela.com>) and print the two articles, "Earth is getting hotter, scientists say, pointing to 2014's record warmth" and "Greenland has lost vast amount of ice,

### CONCEPT

The Earth's climate is changing rapidly due to the rise in greenhouse gas emissions from human activity. Climate change impacts all of Earth's systems and these changes are evident in graphic, written, and visual data.

### OBJECTIVES

Students will be able to:

- Interpret information of various formats (graphic, written, and visual) and draw meaningful conclusions.
- Consider the benefits and drawbacks of certain types of data representation.
- Hypothesize cause and effect relationships between human population growth, increasing greenhouse gas emissions, temperature rise, ice melt, and sea level rise.

### SUBJECTS

Science (Earth and environmental Science), social studies (geography), math, English language arts

### SKILLS

Analyzing visual and numeric data, reading comprehension, summarizing, drawing correlations among data, identifying trends and patterns

### METHOD

Students interpret various forms of data (graphic, written, and visual) and identify relationships between population growth, greenhouse gas emissions, temperature rise, ice melt, and sea level rise.

and it's melting faster, study finds." Make copies of each article and the additional items from the Data Bank – you will need to make one copy for each pair of students. For example, a class of 20 would need 10 copies of each Data Bank item.

2. Place stacks of each data piece at the front of the classroom at random (don't have all the information related to temperature rise in the same area).
3. Divide the class into pairs.
4. Ask students to discuss three things they already know about climate change with their partner. (This lesson will work best if students already have a working knowledge of the basic causes and impacts of climate change.)
5. Point out the Data Bank at the front of the classroom and explain that students will be analyzing pieces of data related to climate change, but that the data isn't just numbers – it's graphs, images, articles, and more.

Data Bank Items:

Theme	Data	Form
Population Growth and Greenhouse Gasses	J-curve of human population growth (1 C.E. – 2050)	Line graph
	Carbon emissions and population growth (1751 – 2010)	Online data visualization
	CO2 levels over the past 400,000 years	Line graph
	Greenhouse gas emissions by type	Pie chart
Temperature Rise	Greenhouse effect	Visual diagram
	Global temperature maps (1884 – 2015)	Time series maps
	Climate change: Global Temperature (1880 – 2020)	Bar graph
	Article: "Earth is getting hotter, scientists say, pointing to 2014's record warmth"	Non-fiction article (adapted by Newsela)
Ice Melt*	Muir Glacier before (1941) and after (2004)	Photo image
	Antarctica ice shelf time lapse	Online data visualization
	Article: "Greenland has lost vast amount of ice, and it's melting faster, study finds"	Nonfiction article (adapted by Newsela)
Sea Level Rise	US Sea level change (1960 – 2014)	Map
	Flooding in Bangladesh	Photo image
	Past and projected changes in global sea level rise (1800 – 2100)	Line graph

\* The ice melt examined in this activity refers to land ice melt like glaciers and ice sheets that, when melted, contribute to sea level rise.

6. To begin, one person from each pair comes to the front of the room and picks a piece of data from the Bank. Don't give the students any guidance on what to pick first; the data should be chosen at random.

7. Each pair will work to complete the instructions and/or questions on their piece of data before going back to the Data Bank for another piece. Students should rotate who gets the data and keep all the pieces they've already analyzed at their desk.

**Note:** For more monitoring, students could be required to bring each completed piece of evidence to the teacher for a quick check on understanding and completion before getting another piece.

8. Tell students that as they collect and analyze data, they should think about two things:

- a. Is this information *communicating the same point* as any other data I've already seen?
- b. Is this information *related* to any of the other information – either as a direct cause or direct effect?

**Note:** All the information in the Data Bank can be grouped into four general themes, as indicated in the Data Bank Chart: 1. population growth and the rise of greenhouse gas emissions, 2. temperature rise, 3. land ice melt, and 4. sea level rise. There are several pieces of data for each theme – all of which represent the same general point, but through different methods (graph, data visualization, written article, image, etc.). Students might put the J-Curve graph of human population growth in its own group, and that's okay.

9. Tell students that information representing the same idea should be grouped. Next, they should attach each piece of data (still in groups) to the butcher paper and connect correlative relationships between groups of data with arrows.

*Answer: In a basic sense, growing population → more greenhouse gases in the atmosphere → temperature rise → ice melt → sea level rise. However, depending on their climate background knowledge, students may be able to make more connections between these topics (e.g. ice melt leads to more greenhouse gas due to the release of methane).*

## ALTERNATE PROCEDURES

1. For younger students, or to save time, divide the class into groups of four or five. Give each group the data pieces from only one theme. After groups have had time to analyze all of their information, each group shares with the class one sentence that summarizes what their data conveyed, what format (graphic, visual, etc.) they thought best represented that information and why. Next, ask students to determine how their group's information relates to that of the other groups. Take time for each group to share and create a class web illustrating the connections that are discussed.
2. Eliminate some of the data. Including only one or two pieces of information from each category would cut down on time and make it easier for younger students to draw connections.

# DISCUSSION QUESTIONS

1. What piece of data did you find the most difficult to understand? Why do you think this is?
2. What form of information (visual, graphic, written) do you find the most effective? What are the benefits and drawbacks to each type of representation?

*Answers will vary. Students may feel that visual images are more powerful and interesting but lack in details, that data visualizations are easier to understand than line graphs, that line graphs best represent change over time, that articles have more information but take more time to process, etc. Some students may prefer to just look at numbers.*

3. Temperature change, land ice melt, and the resulting rise in our seas all stem from the increase of greenhouse gases in our Earth's atmosphere. How has population growth contributed to the rise in greenhouse gases?

*Fossil fuels power our lives. With more people, there are more cars on the road, more factories producing consumer goods, more food being processed, and more electricity being used. All of these human activities emit greenhouse gases and throw off Earth's natural cycles.*

4. Why do you think both population growth and CO<sub>2</sub> emissions drastically increased in the 19th century?

*Both population and carbon emissions grew after the dawn of the Industrial Revolution when advances in medicine, technology, and sanitation led to longer life expectancy as well as higher demand for energy. Also, advances during the Industrial era allowed us to harness energy from fossil fuels in massive quantities like never before. An ever-growing and ever-consuming population meant continued increases in carbon use.*

5. Are there any impacts of climate change that were not addressed in the Data Bank?

*Yes, there are many: coral bleaching, changes in weather patterns (more severe storms, extended droughts and shorter growing seasons), risks to wildlife health, changes in wildlife migration patterns, etc. All of these changes have far-reaching impacts on the well-being of both wildlife and humans.*

6. What could be done to halt or slow the advance of climate change? Hint: think about the driving causes.

*Stabilizing population growth would be a good place to start. But it's not only about our numbers – it's also about how we use resources. Decreasing our dependency on fossil fuels and using more renewable energy sources like solar and wind can make a big impact. Individuals can play a part by driving less, buying fewer material goods, eating local and eating less meat, and spreading the word to others. In addition to emitting less, we can protect and plant trees which absorb CO<sub>2</sub> from the atmosphere. Scientists and engineers are constantly brainstorming new technologies to help reverse Earth's rise in temperature.*

# ASSESSMENT

Students complete the following statements, as they relate to interactions between the four themes of data:

I learned that: \_\_\_\_\_

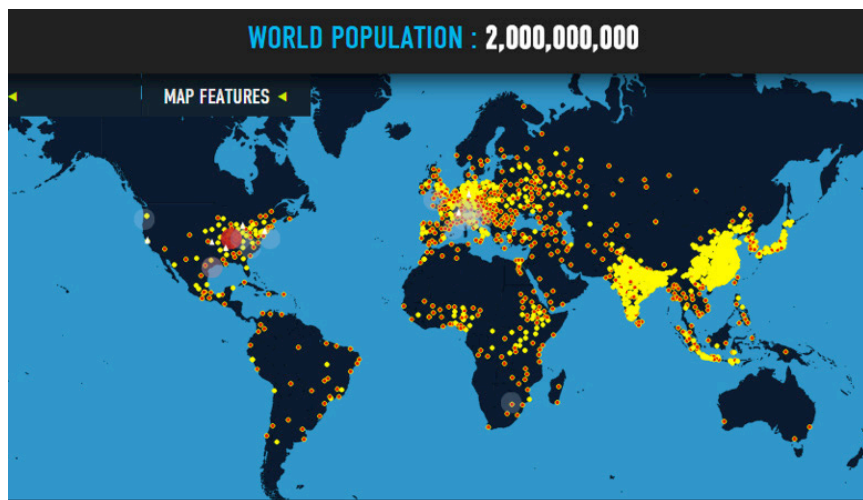
I was surprised about: \_\_\_\_\_

I felt: \_\_\_\_\_

# FOLLOW-UP ACTIVITIES

1. Ask students to write a persuasive essay that would help convince a climate change skeptic that climate change is happening and is a result of human activities. Students could pick data from the lesson, or find other evidence to support their argument.
2. Have students find and analyze data on impacts of climate change that were not addressed in this lesson (changes in weather patterns, changes in wildlife migrations, etc.).

# PEOPLE AND CLIMATE CHANGE: THE DATA IS IN DATA BANK



Go to [www.WorldPopulationHistory.org](http://www.WorldPopulationHistory.org). Click “Explore the Map” on the entrance screen. The yellow and red dots represent populations of 1 million.

Q1. How many dots are in South America? What was the population of South American in 1 C.E.?

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From the “Overlays” dropdown menu select “Fossil Fuel CO<sub>2</sub> emissions.”

Q2. Next to the title, Fossil Fuel CO<sub>2</sub> Emissions, is a date, 1751 – 2010. What do you think this means?

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Look at the “year” box at the top right of the screen. It should now show the year 1751.

Click the triangle play button on the bottom right of the screen to see how population and CO<sub>2</sub> emissions change between 1751 and 2010.

Q4. What happens to population between 1751 and 2010?

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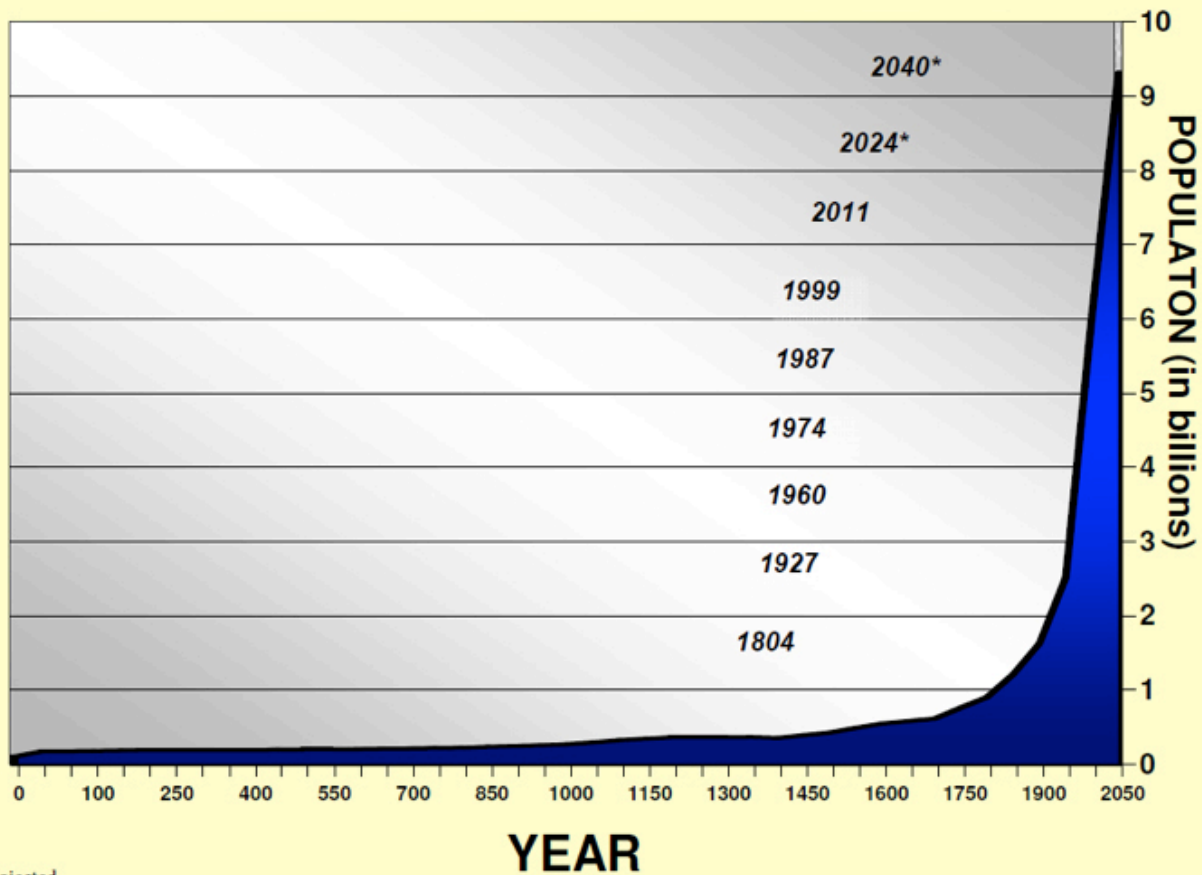
Q5. What happens to CO<sub>2</sub> emissions between 1751 and 2010? How do you know?

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Q6. How are population and CO<sub>2</sub> emissions related? Why do you think this is true?

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## Human Population 1 CE - 2050 CE



\*Projected

Q1. The graph starts in the year 1 C.E. How many years did it take for population to reach 1 billion people?

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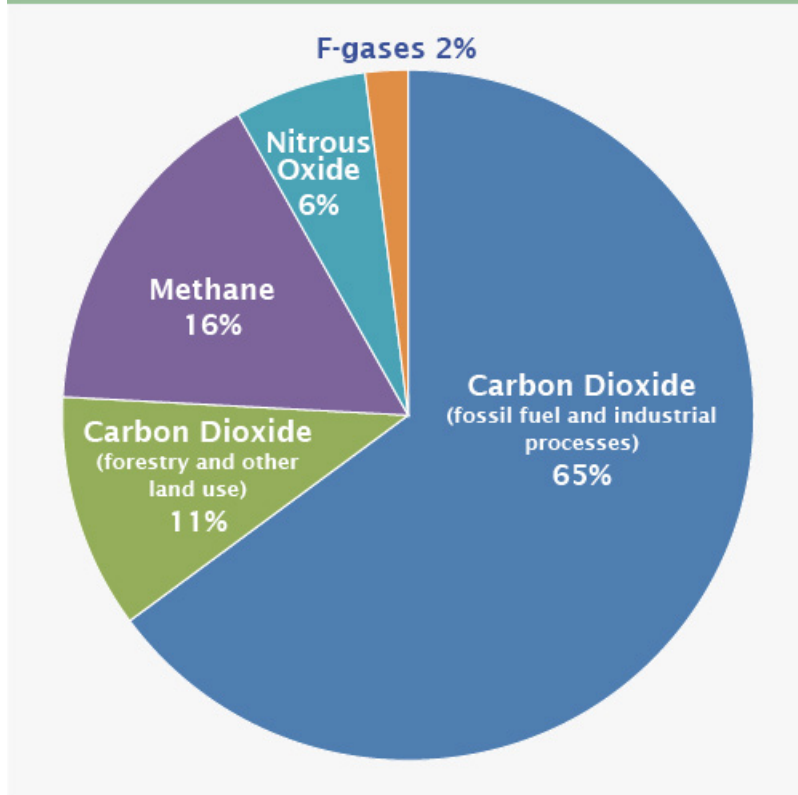
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Q2. It took 123 years to grow from 1 billion to 2 billion people. How long did it take to get from 6 billion to 7 billion people? What does this mean about the rate of population growth?

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## Global Greenhouse Gas Emissions by Gas



Source: EPA

Circle the title of the graph.

Q1. What type of greenhouse gas is the most prevalent worldwide?

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Q2. What human activities contribute CO<sub>2</sub> to the atmosphere (hint: look at the graph for clues)?

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Q3. Is a pie graph a good way to represent this data? Why or why not?

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Source: NASA

This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO<sub>2</sub> has increased since the Industrial Revolution. (Credit: Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO<sub>2</sub> record.)

Q1. Which greenhouse gas is being graphed?

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Q2. What time period is represented by this graph?

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Q3. What is the graph's main take-away?

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Q4. Is this a compelling piece of information? Why or why not?

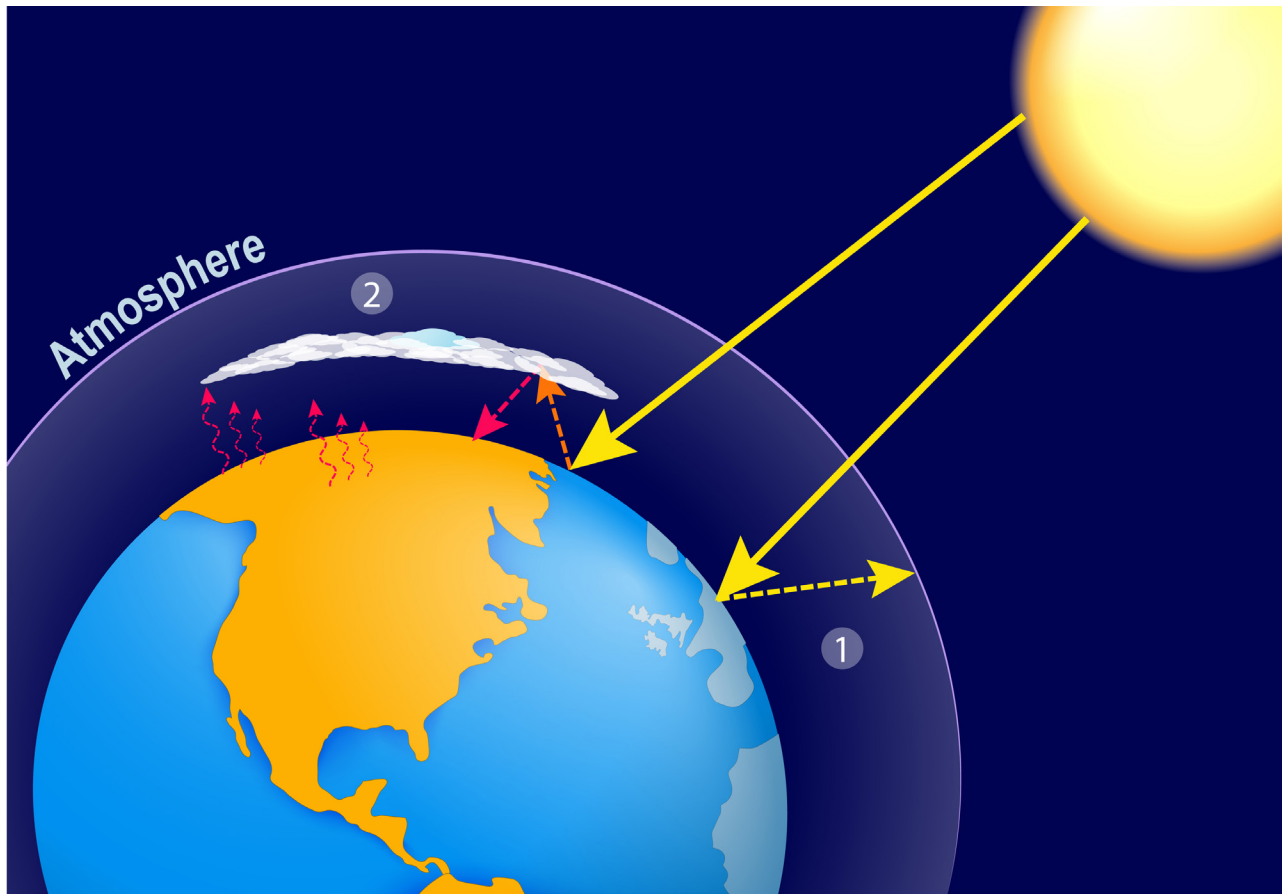
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Q5. Give this graph a title.

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The greenhouse effect is thrown out of balance by too much man-made carbon dioxide. (1) Some sunlight that hits the Earth is reflected. Some becomes heat. (2) CO<sub>2</sub> and other greenhouse gases in the atmosphere trap heat, keeping the Earth warm.

Q1. Draw an arrow pointing to where greenhouse gases are located on the diagram.

Q2. Why is it called the Greenhouse Effect?

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Q3. How does CO<sub>2</sub> in the air contribute to Earth's warming? Use the diagram and the text below the diagram for reference.

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Q4. What human activities do you know of that contribute CO<sub>2</sub> to the atmosphere?

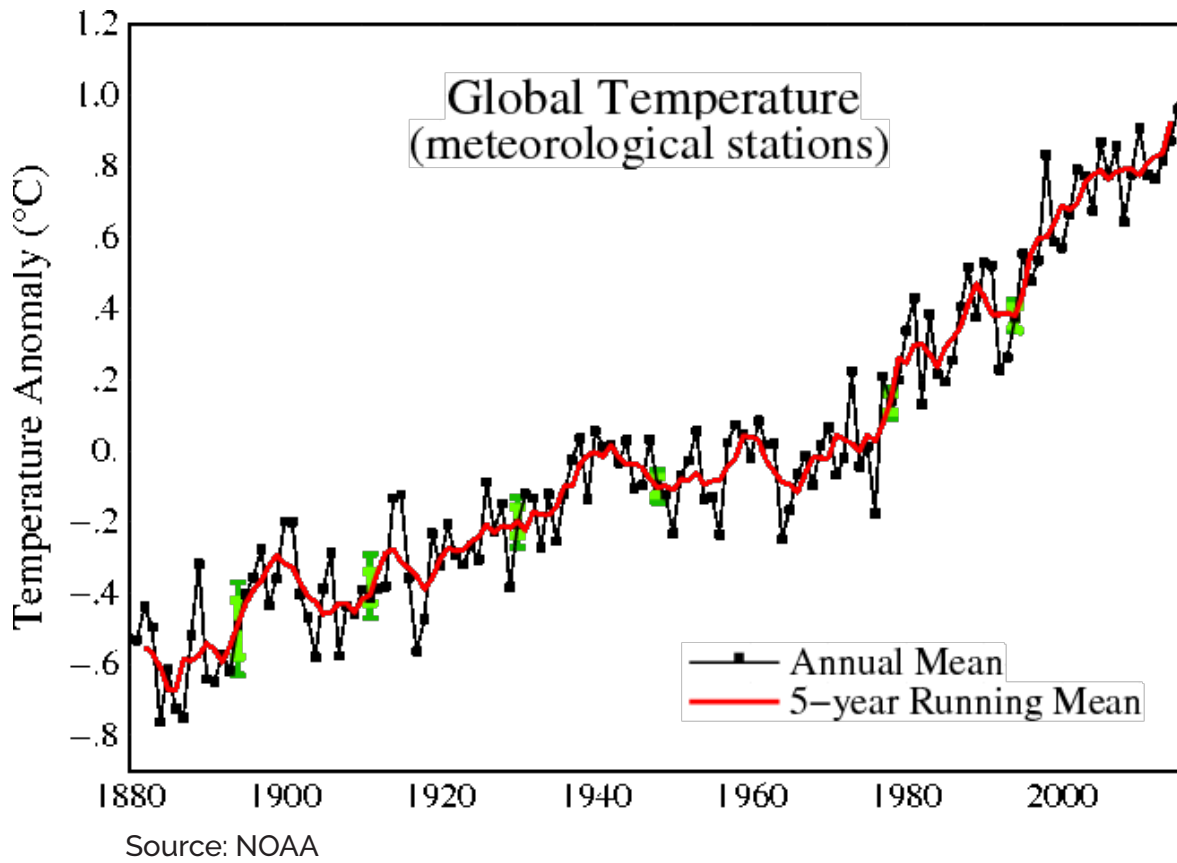
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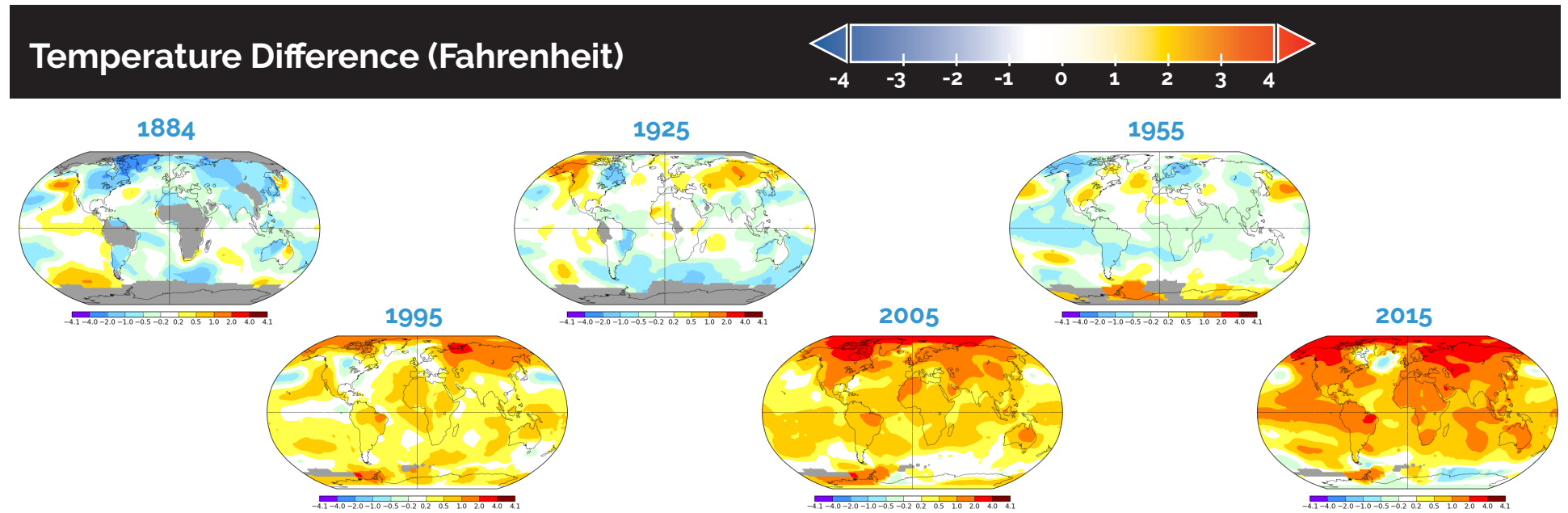
Q1. "Anomaly" means a departure from the long-term average. What do you think the 0 on the y-axis of the graph means?

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Q2. What is the trend in global temperatures? Draw an extension of the red line to represent what you think will happen in the year 2020.

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The time series below shows the five-year average variation of global surface temperatures from 1884 to 2015. Dark blue indicates areas cooler than average. Dark red indicates areas warmer than average.



Q1. What was the trend from 1884 – 1955?

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Q2. What is the trend in the last 20 years of data?

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Q3. What color do you think will be most represented on the map in 20 years?

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Q4. What benefits are there to viewing temperature data in this format? What are the drawbacks?

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Q5. How else could this data be portrayed?

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# Earth is getting hotter, scientists say, pointing to 2014's record warmth

By Los Angeles Times, adapted by Newlea staff

01.22.15



Members of the glaciology unit of Peru's national water authority on the Pastoruri glacier in Huaraz, Peru, Dec. 4, 2014. The glaciology unit was studying the measurement of ice thickness. Photo: AP Photo/Rodrigo Abd

**Please read the printed article that your teacher has provided.**

Q1. What point is the article's author making?

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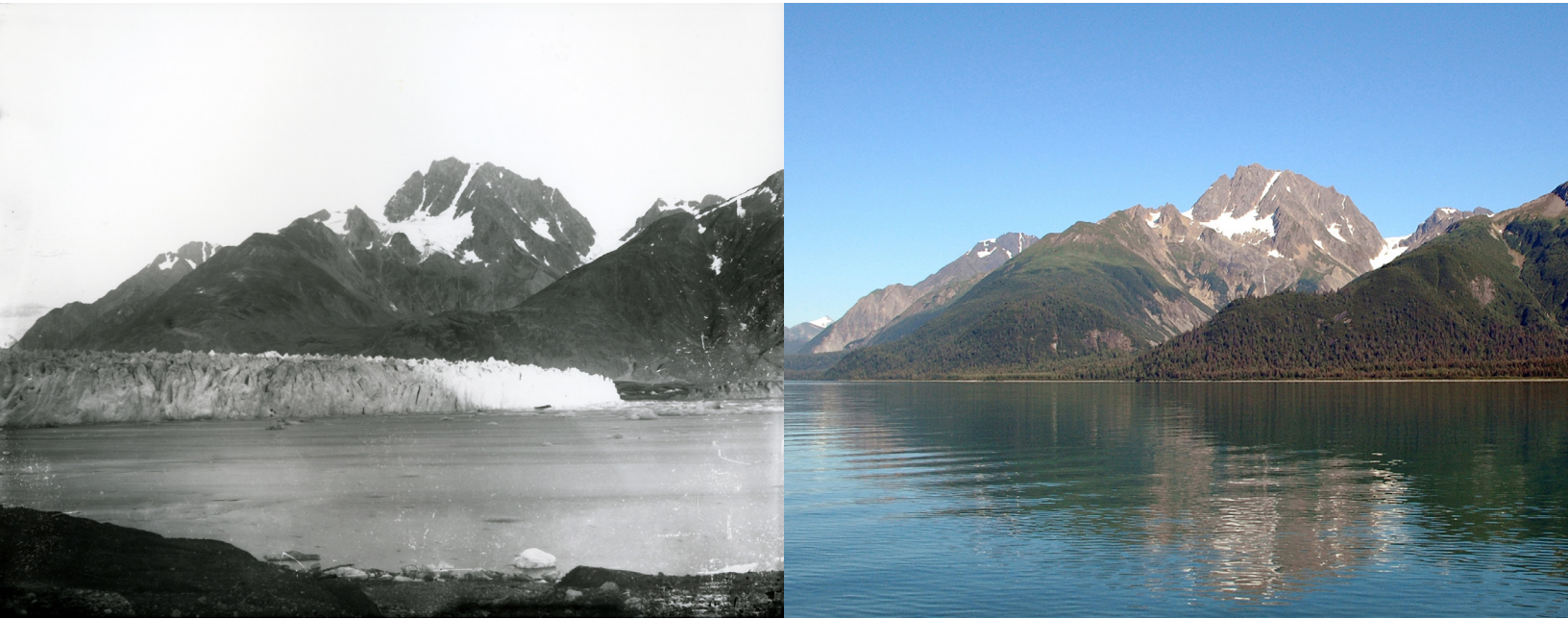
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Q2. Circle the paragraph that, in your opinion, is the most persuasive in expressing the author's point.

# MUIR GLACIER, ALASKA

September 2, 1892

August 11, 2005



Source: USGS

A pair of northeast looking photographs, both taken from the same location on the west shoreline of Muir Inlet, Glacier Bay National Park and Preserve, Alaska showing the changes that have occurred to Muir Glacier between September 2, 1892 and August 11, 2005.

Q1. How many years passed between the first and the second picture?

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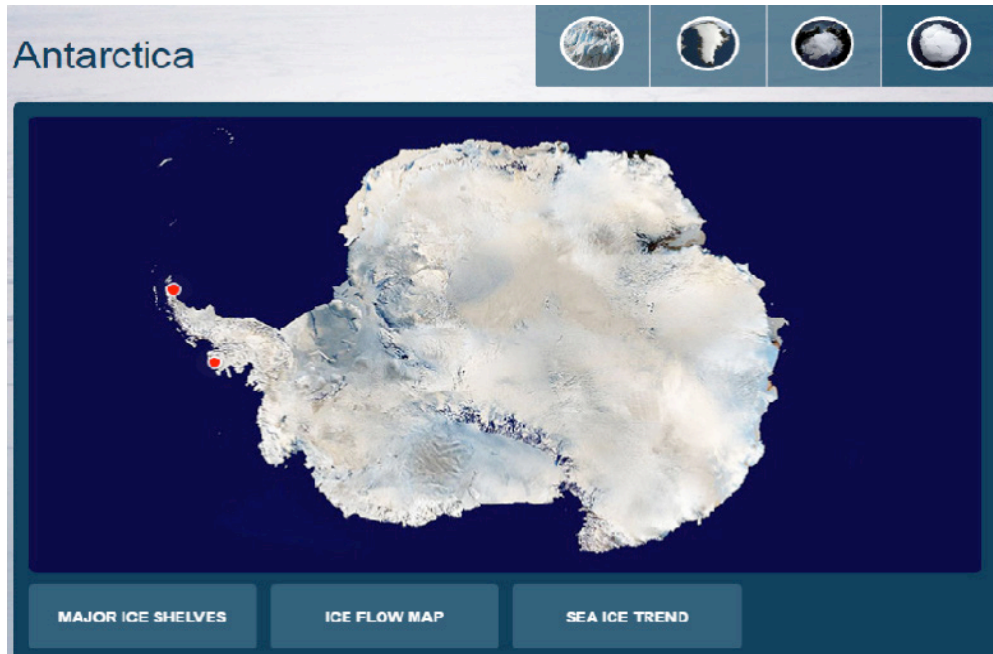
Q2. What do you think is causing the glacier to retreat so rapidly?

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Q3. Give this set of images a catchy title.

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Go to NASA's Global Ice Viewer: <http://climate.nasa.gov/interactives/global-ice-viewer/>

Click on "Antarctica."

Click the red dot representing the Larsen B ice shelf and click the play arrow to watch what happens to Larson B. Then click on the dot for the Wilkins ice shelf and click "play."

Q1. What do these visualizations show?

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Q2. What questions do you still have?

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# Greenland has lost vast amount of ice and it's melting faster, study find

By Washington Post, adapted by Newlea staff

01.05.16



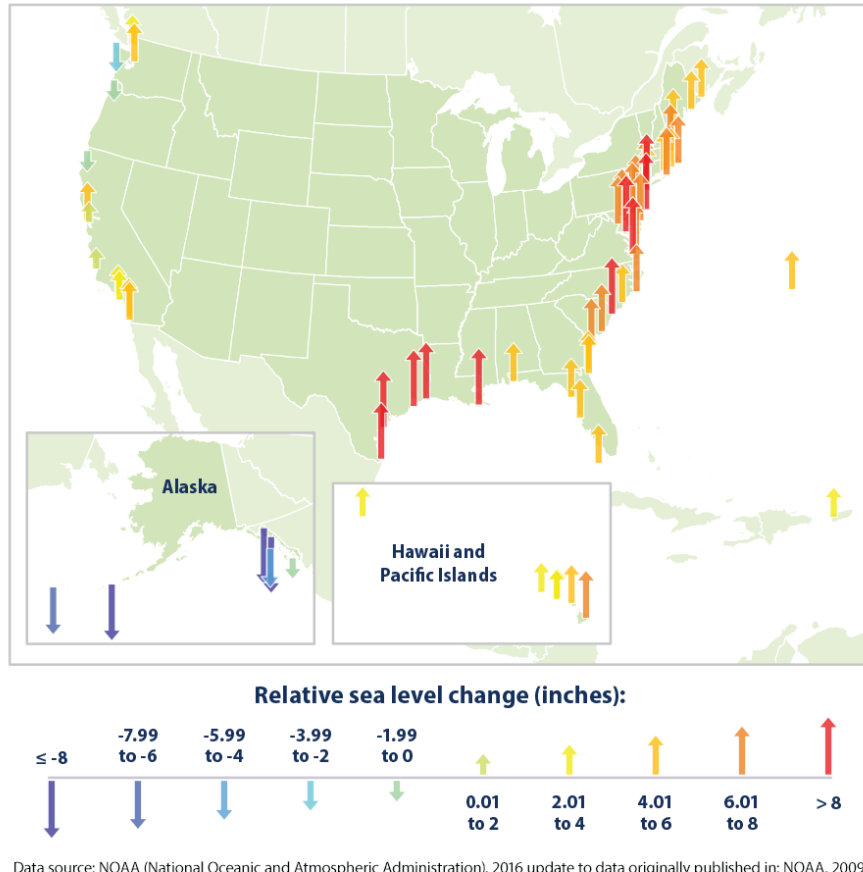
A melting iceberg floats along a fjord leading away from the edge of the Greenland ice sheet near Nuuk, Greenland, July 26 2011. Photo: AP/Brennan Linsley

**Please read the printed article that your teacher has provided.**

Q1. Circle the sentence that best summarizes the main point of the article.



### Relative Sea Level Change Along U.S. Coasts, 1960–2015



Data source: NOAA (National Oceanic and Atmospheric Administration). 2016 update to data originally published in: NOAA. 2009. Sea level variations of the United States 1854–2006. NOAA Technical Report NOS CO-OPS 053. [www.tidesandcurrents.noaa.gov/publications/Tech\\_rpt\\_53.pdf](http://www.tidesandcurrents.noaa.gov/publications/Tech_rpt_53.pdf).

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators).

This map shows total changes in sea level from 1960 to 2014 at tide gauge stations along U.S. coasts. Relative sea level reflects changes in sea level as well as land elevation.

*NOTES: After a period of approximately 2,000 years of little change (not shown here), global average sea level rose throughout the 20<sup>th</sup> century, and the rate of change has accelerated in recent years. When averaged over all the world's oceans, absolute sea level increased at an average rate of 0.06 inches per year from 1880 to 2013. Since 1993, however, average sea level has risen at a rate of 0.11 to 0.14 inches per year—roughly twice as fast as the long-term trend. Source: EPA*

Q1. What is this map showing?

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Q2. What do you think relative sea level change means?

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Q3. Underline the sentence in the "NOTES" that most helps you understand this image.



A Bangladeshi woman walks to another village to find drinking water after the well in her village flooded. Bangladesh is low-lying and densely populated, making it one of the most vulnerable countries to sea level rise from climate change.

Q1. How does this image make you feel?

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Q2. What are benefits of getting information in this format? What are drawbacks?

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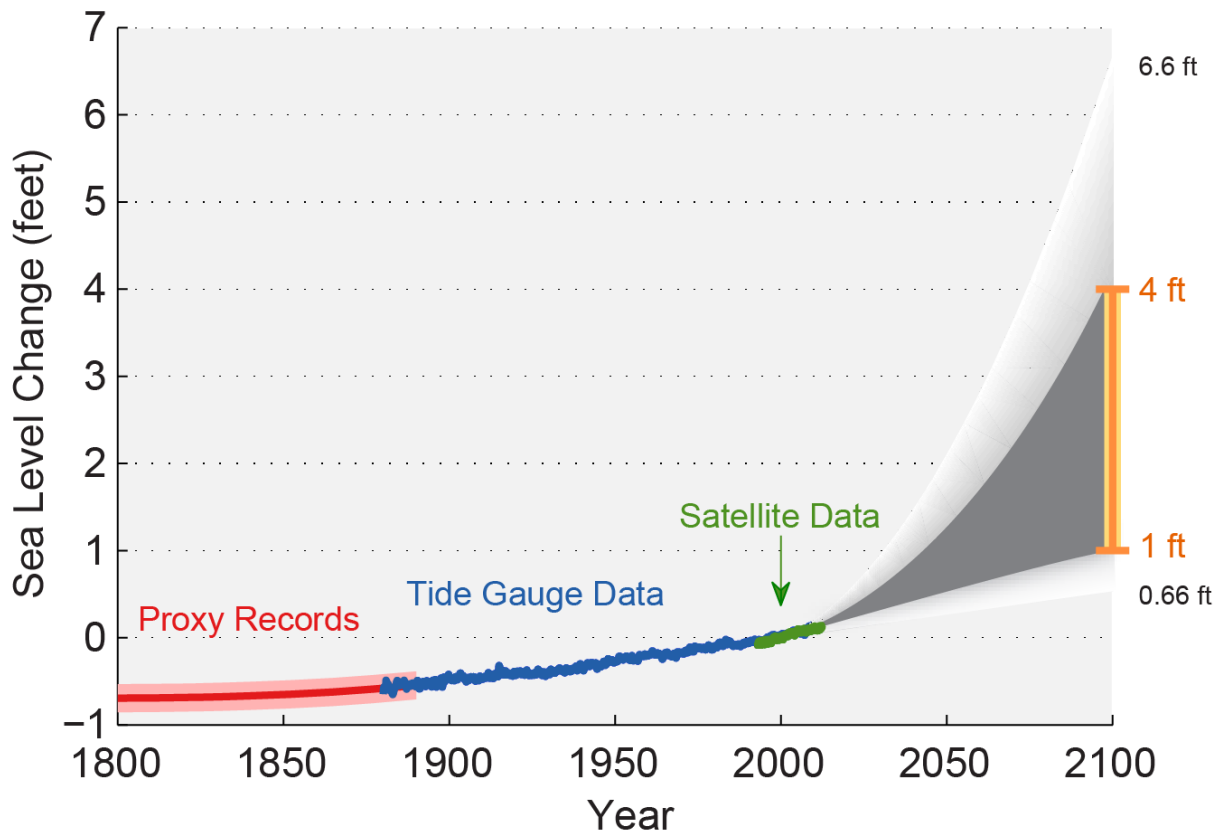
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Q3. Have you heard of other low-lying areas that will be impacted by sea level rise? Where?

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# Past and Projected Changes in Global Sea Level



Source: EPA

Q1. What unit of measurement is used for tracking sea level rise in this graph?

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Q2. Why do you think the orange bar shows such a wide range of potential sea level rise?

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