



RACING
EXTINCTION

The Warming
Planet
Too Hot to Handle?

Essential Questions

- What is climate change?
- How are anthropogenic changes to the atmosphere and oceans destabilizing climate?
- What are the mechanisms by which changes in atmospheric gases impact global climate?
- What is the scientific evidence for climate change?

Objectives

- Define climate change and global warming.
- Analyze hypotheses that explain how human activities are destabilizing climate.
- Describe the mechanisms of climate change and the principle of positive feedback.
- Cite evidence for climate change in the past and today.

Outside the Box!

Write a list of activities you enjoy doing outside.

Choose one of the activities from your list.

Write a sentence about
why you enjoy this activity.

Too **Hot** or Too **Cold**?

Write a short passage to describe how much you enjoy your chosen activity (or don't!) if the day is:

- Very **hot**
- Very **cold**
- Stormy



Include a reference to real weather conditions based on your experience.

What is Climate Change?

With your group:

Discuss the meaning of the terms:

Climate Change
Global Warming

Climate Change and You

Write in your notebook a short passage about the potential impact of climate change on your favorite activity.




Give your passage a relevant title.

- Example titles:
 - How climate change will affect the things I like to do.
 - The impact of climate change on my favorite outdoor activity

Climate Change Words

Using what you have heard in the news or in other lessons, write in your notebook a list of words related to climate change.

 **Tip** Work with a partner to brainstorm words or research climate change words online.

Understanding Climate Change

You will learn about the evidence for climate change and global warming.

Ice Ages and Warming Periods

With your group:

Research research online resources to learn about past ice ages and warming periods.

- Create a table showing showing how scientists investigate prehistoric climates.



Include a list of methods in your table:

- Ice cores
- Sediment cores
- Tree rings
- Coral reef cores
- Historical records

Pop Quiz!

What is the term given to the
warming periods between ice ages?



Answer:

Interglacial: Between times of glaciation (widespread glaciers)

Scientific Evidence for Recent Climate Change

With your group:

Research online resources to explore the scientific evidence for climate change in historic times.

- List hypotheses scientists have proposed to account for recent climate change.



Use your online research to develop summaries of various hypotheses.

Hypothesized Causes for Climate Change

With your group:

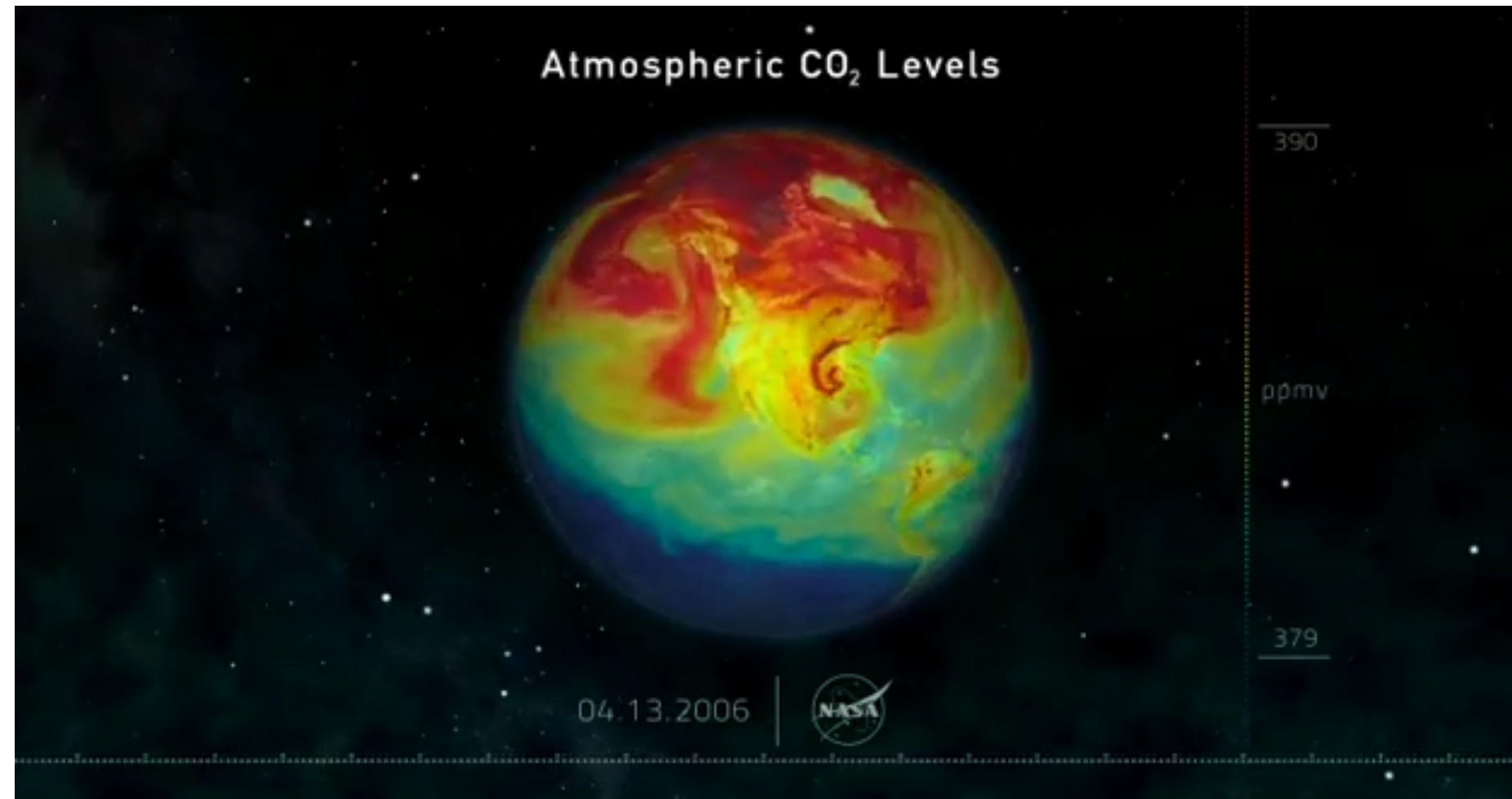
Create a concept map of hypothesized causes for climate change.

- Include non-human as well as human-related hypotheses scientists have proposed to account for recent climate change.



Ensure your concept map includes a basic model of the greenhouse effect.

The Hidden Carbon Dioxide World Video



[Click image above to view video](#)

Nerd Word Alert!



What does the term **anthropogenic** mean?

Answer:

Anthropogenic means “caused by humans.” From the Greek “*ánthrōpos*” meaning “man, human”, and “-genic” meaning producing or generating something.

The Greenhouse Effect

With your group:

- Use your concept map to create an infographic of the greenhouse effect.
 - Share your infographic with other groups.
 - Explain how your model describes the greenhouse effect as a driver of climate change.

The Greenhouse Effect



Ensure your infographic includes:

- Earth's carbon cycle
- Atmospheric carbon dioxide
- Methane
- The role of human activities in the carbon cycle

Fossil Fuels and Climate Change

Working individually:

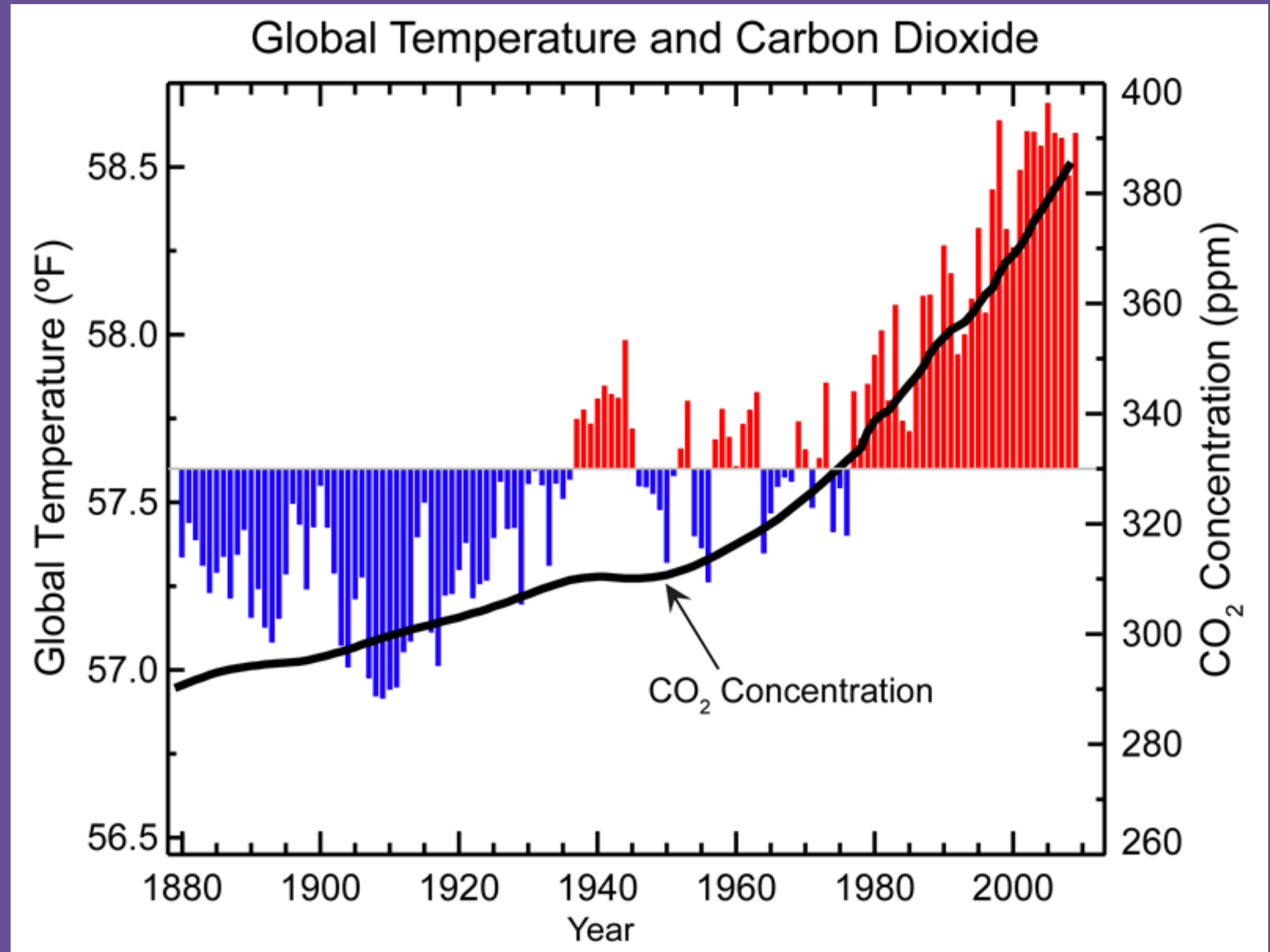
- Write a short passage explaining how human use of fossil fuels contributes to climate change.



Use the group infographic and concept map to guide the conclusions in your passage.

Explain the Graph!

- **Red bars** indicate **temperatures above** and **blue bars** indicate **temperatures below** the 1901-2000 average temperature.
- What does this graph tell us about **global temperature** and **CO₂ concentration**?



Positive Feedback

With your group:

- Research and discuss the concept of positive feedback.
- Create a list of positive feedback examples.
- Draw diagrams to illustrate your examples.



To think about positive feedback, first consider some familiar examples of negative feedback, such as a thermostat that maintains a steady room temperature.

Methane and Positive Feedback

With your group:

- Research the role of methane in the Permian-Triassic extinction event.
- Discuss the question: “How could methane be part of a climate change positive feedback loop?”

Plankton Decline Video



[Click image above to view video](#)

Research Question

With your group:

Discuss the questions:

- Could human activities affect Earth's capacity to limit changes in global temperature?
- How could human activities result in positive feedback causing increased in global temperature?

Positive Feedback and Climate Change

With your group:

- Research examples of positive feedback in Earth's climate.
- Choose a specific example of positive feedback in Earth's climate.
- Create a short presentation providing evidence to support your example, relating the example to extinctions today.
- In your presentation, make a case for or against action needed to prevent positive feedback in Earth's climate.

Positive Feedback and Climate Change



Some positive feedback examples include:

- Melting of permafrost methane
- Reduction of cloud cover
- Increase in water vapor
- Lowering of Earth's reflected light (albedo)

Hypothesized Causes for Climate Change

Consider:

- Units to quantify consumption:
 - Biomass
 - Calories
 - Soil and water
- Including dairy as well as meat and fish

Debate!

As a class:

Debate the motion:

“The evidence for human-caused climate change justifies taking action.”



In a debate, it's okay to argue in favor of a position that you might not agree with!

Whodunit: CO₂ Emissions

The Environmental Protection Agency says that carbon dioxide emissions are one of the major culprits of climate change. But, how did we get to this point? Whodunit?



Evaluation

1. Take the NASA quiz “[Warm Up.](#)”
2. Write a short passage describing the role of global warming in climate change.
3. List three ways in which humans are changing the atmosphere and oceans.
4. Describe one example of a positive feedback mechanism that can destabilize the climate.
5. Write one sentence to explain how the greenhouse effect warms Earth’s atmosphere.
6. List three types of scientific evidence that demonstrate the increase in global temperatures since the 19th century.

Resources

- NASA: [Earth's Fidgeting Climate](#)
- Geological Society of America: [Evolution of Earth's climatic system: Evidence from ice ages, isotopes, and impacts](#)
- *Proceedings of the National Academy of Sciences*: [Ice-core evidence of abrupt climate changes](#)
- NASA Earth Observatory: Paleoclimatology: [The Ice Core Record](#)
- NASA Earth Observatory: [Global Temperatures](#)
- NASA Global Climate Change: [Climate change: How do we know?](#)
- American Physical Society: [The Discovery of Global Warming \(Timeline\)](#)
- *Behavioral Analysis*: [Climate Change: The Evidence and Our Options](#)
- EPA: [Causes of Climate Change](#)

Resources

- American Chemical Society: [What are the greenhouse gas changes since the Industrial Revolution?](#)
- *Philosophical Transactions of the Royal Society*: [Climate change and trace gases](#)
- How Stuff Works: [How the Ice Age Worked](#)
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- NOAA National Climatic Data Center: [What are positive feedbacks?](#)
- UK Met Office: [Climate feedbacks](#)
- NASA: Warm Up: [Global Temperature Quiz](#)