

What Can Arctic Ice Tell Us About Climate History?

Overview

A video introduction shows how scientists can use ice to learn about the Earth's past atmosphere and climate and use the data they gather to predict future changes. Students then collect data and discuss their findings.

Guiding Question

What information can scientists gather from an ice core and how can that information help scientists determine what Earth's past atmosphere was like?

Objectives

Students will be able to investigate ice cores and discover what scientists can learn from past atmospheric conditions.

Background

The Earth is approximately 4.6 billion years old and has gone through numerous changes, including in its atmosphere. Among other techniques, scientists can use ice cores, or samples made from drilling deep into ice, to find trapped material or air bubbles and learn about Earth's past atmosphere.

As snow falls onto glaciers, it can carry materials such as smoke or ash with it, depositing them onto existing snowfall. Additionally, gases can be trapped as the snowfall contracts to become glaciers. By drilling into existing glaciers, scientists can essentially go back in time to find out more about the materials or air bubbles trapped. Chemical analysis can reveal what types of gases were present in our atmosphere and at what percentage. Scientists can compare the gases trapped in one layer of the ice to those in other layers in order to understand how Earth's atmosphere changed at different times. Using this information, scientists may be able to predict future changes to Earth's atmosphere and the impact that humans have on its Time: 15-20 minutes

Grade Level: 6-8

Vocabulary

- Atmosphere
- Climate
- Glacier
- Ice core

Standards

NGSS MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

NGSS MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

NGSS MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

CCSS.ELA-Literacy.RST.6-8.3. CCSS.Math. Content.6.SP.B.5.B.



climate. By studying the past atmosphere, scientists can learn about the composition of gases or any volcanic events of the time. They can compare the past atmosphere to the present and can even make inferences about what the future atmosphere might look like based on the changes already observed. Humans can use this information to predict and prepare for changes in the future.

Preparation

For this activity, the educator will need the following:

- Video: What Can Arctic Ice Tell Us About Climate History? (2:31) (English | Spanish)
- A way to show the video to students
- Extra pieces of paper

For this activity, each student will need the following:

- 1 copy of *Ice Core Investigation* (English | Spanish | Answer Key)
- A pencil

For this activity, each group of 2-3 students will need the following:

- A printed image of an ice core
- Check out this image from the NASA Earth Observatory or this image set from the U.S. Antarctic Program Data Center, or use other images of your choice.
- 1–2 rulers or measuring tapes (if the images you choose do not include a scale)

EiE® Connections

Continue your classroom activities with this unit:

Engineering Everywhere®

• Engineering Remote Sensing Devices

Museum of Science Connections

Check out our climate change content, including <u>Wicked Hot Mystic, Ask a Scientist: Climate Science</u>, and <u>Pulsar: A Podcast "Climate Change Resilience in Boston.</u>"

Visit our new *Arctic Adventure* exhibit in person at the Museum of Science, Boston, and <u>online</u> to see how climate change has affected our planet and the ice found in the Arctic.





Family Connections

Continue the learning at home with this game:

• Water in Extreme Environments

Credits

MOS at School programs are offered at no cost, thanks to the generosity of the Akamai Foundation, Bloomberg Philanthropies, BNY Mellon, Gordon Foundation, Hood, Lincoln and Therese Filene Foundation, Lowell Institute, Mabel Louise Riley Foundation, MathWorks, Richard K. Lubin Family Foundation, Sanofi, and TJX.



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Activity Instructions

These steps offer support for implementing the *What Can Arctic Ice Tell Us About Climate History*? video introduction and follow-up activity with students.

1. Before showing the video introduction, discuss these questions:

Q: What do you know about the history of the Earth?

A: Accept all responses.

Q: What are some ways the Earth changes?

A: Accept all responses.

Q: What are some things scientists can study to learn about what the Earth was like millions and billions of years ago?

A: Accept all responses.

2. Play the video *What Can Arctic Ice Tell Us About Climate History?* (2:31). This video shows how scientists can study ice cores to understand what Earth's past atmosphere was like and use that information to predict changes to Earth's atmosphere in the future.

watch video

3. After showing the video, discuss these questions:

Q: Why do scientists look at ice cores?

A: Accept all responses. Possible responses include learning about past atmosphere conditions, geological events, and future trends.



Q: What are some ways you think studying ice cores might help us predict what Earth's atmosphere might be like in the future?

A: Accept all responses. If necessary, explain to students that scientists can determine the composition of gases and the temperature of past atmospheres. This information allows scientists to determine that certain gases may indicate a warmer climate. Since humans are increasing the concentration of these gases in the atmosphere, scientists can predict that temperatures will increase as well.

- 4. Distribute the ice core pictures and *Ice Core Investigation* (English | Spanish) handouts to students and instruct them to follow directions for the data collection.
- 5. Have students work together in groups. Give each group about five minutes to collect data and record observations. Explain that students can either fill out one handout as a group or each fill out a handout. If students are filling out handouts as a group, you can have them assign specific roles to each group member, such as measuring, making qualitative observations, and recoding data. Depending on the size and complexity of the ice cores in the images, you can have each group observe an entire image or only part of one.
- 6. After data collection, bring all students back together.
- 7. Pair each group with another group and give each pairing 2–3 minutes to share their data and observations with each other.
- 8. After completing the activity, discuss these questions: After completing the activity, discuss these questions

Q: What do you know about ice cores?

A: Accept all responses. Possible responses include that the low temperature of the ice preserves materials and that air bubbles can be trapped in the ice.

Q: What data can we gather from ice cores?

A: Accept all responses. Possible responses include that ice cores can provide data about Earth's past atmosphere conditions, including concentration of gases and temperature.

Q: Why do ice cores provide detailed information about the Earth's past climate?

A: Accept all responses. A possible answer is that because the ice is mostly undisturbed, it maintains regular layers.



Q: Why do we want to study Earth's past conditions?

A: Accept all responses. A possible answer is that we can compare Earth's past conditions to what they are now to see how much has changed. We can use this information to predict future changes that the Earth might experience.

Explain to students that scientists are particularly interested in learning about Earth's atmosphere because humans have contributed significantly to the concentration of gases that increase the temperature of the atmosphere. By understanding how these gases have changed our atmosphere in the past, we can predict future changes and also develop technology to prevent an even further increase in the concentration of these gases.



Glossary

Atmosphere

the combination of gases surrounding a planet (on Earth, 78% nitrogen, 21% oxygen, 0.9% argon, and 0.1% other gases)

Climate

the long-term average of weather conditions for an area

Glacier

an enormous mass of ice formed by snow falling over many years, compressing, and then freezing solid

lce core

cylindrical sample of ice made from drilling down through many layers