

Lesson 15: Ice Ages & Climate Dynamics

Summary

Discuss the causes of ice ages on Earth and determine if Mars experiences similar climate dynamics as Earth.

Learning Goals

Students will be able to:

- Observe ice ages through time and provide explanations for icehouse/greenhouse periods.
- Determine if Mars goes through similar Earth climate changes
- Distinguish between different drivers of climate change at different scales
- Form an informed opinion regarding global warming

Context for Use

It is advisable that students are familiar with basic lithology and mineralogy to be successful in these activities and homework sets. This learning module may be utilized in any course where global warming and climate change are discussed.

Description and Teaching Materials

In-Class Activity

In-Class Activity 1: Ice Ages through time

Homework/Lab

Homework 1: Ice on Mars

Teaching Notes and Tips

1. Infuse data from <http://climate.nasa.gov/>
Students can make graphs of change over time, focus on a specific region, compare Arctic and Antarctic, etc.
They can also compare Earth's poles to Mars poles OR evidence of ice on both planets

2. It is advisable that students understand that Mars can change its axial tilt prior to completing *Homework 1*. This will enable students to properly evaluate the effect of Milankovitch cycles on Mars' climate.

Assessment

Methods of assessment are within each individual *In-Class Activity* and *Homework*.

Mars for Earthlings

References and Resources

1. Paleogeography through time YouTube video:
<http://www.youtube.com/watch?v=Q2dAmLnR3tA>
2. Ice age references: <http://www.pbs.org/wgbh/nova/earth/cause-ice-age.html>
http://geology.utah.gov/surveynotes/gladasked/gladice_ages.htm
3. Ted Talk 2009 on James Balog: <https://www.youtube.com/watch?v=DjeIpbhAqsM>
4. Extreme Ice Survey website: <http://extremeicesurvey.org>
5. Milankovitch cycle information:
http://www.indiana.edu/~geol105/images/gaia_chapter_4/milankovitch.htm
6. Mars Orbital Parameter reference: : <http://phoenix.lpl.arizona.edu/mars172.php#1>
7. SERC webpage: <http://serc.carleton.edu/climatechange/index.html>



Mars for Earthlings

In-Class Activity 1

Ice Ages_MFE

Ice Ages Through Time

Purpose:

Students should:

- Understand that climate changes over time
- Hypothesize the causes of ice ages on Earth and extrapolate those causes to Mars

Engage

Watch Earth's Paleogeography through time:

<http://www.youtube.com/watch?v=Q2dAmLnR3tA>

Explore

The correlation between continent distribution and ice:

Ask students the following questions and discuss responses as they watch the YouTube video in *Engage*.

1. At what Earth age (ages) was there the greatest extent of ice cover towards the South/Southern Pole?

At what Earth age (ages) was there the greatest extent of ice cover towards the North/Northern Pole?

Explain

Share the following with students:

Ice ages are periods of low temperature when glacial ice develops in continental and polar ice sheets and alpine glaciers. In Earth's geologic record, large-scale ice ages are related to climate, sea level, tectonics (plate configurations and positions), and Earth orbital parameters. Fluctuations in the amount of insolation (incoming solar radiation) are the cause of high frequency changes in Earth's climate during the Quaternary.

This PBS video is one way to visually help explain ice ages.

<http://www.pbs.org/wgbh/nova/earth/cause-ice-age.html>

Another reference page is:

http://geology.utah.gov/surveynotes/gladasked/gladice_ages.htm



Mars for Earthlings

This video shows a simulation of solar insolation and climate feedback relationships for the last 100,000 years.

<http://www.youtube.com/watch?v=WoAvpTdgrfw>

Elaborate

Part 1: Extreme Ice Survey

Watch this 21 min. Ted Talk 2009 movie on James Balog: Time-lapse proof of extreme ice loss: <https://www.youtube.com/watch?v=DjeIpbjAqsM>

Ask student the following questions:

What is he trying to do and show?

How does he power his equipment?

What is his photography showing?

1. Why do glaciers matter? See extremeicesurvey.org/why-do-glaciers-matter/
Give 3 reasons:
 - a.
 - b.
 - c.

Part 2: Milankovitch Cycles and Glaciation

1. What are Milankovitch cycles and how do they affect glaciation? (For help use: http://www.indiana.edu/~geol105/images/gaia_chapter_4/milankovitch.htm)
2. What are some major differences between the Milankovitch cycles of both Mars and Earth? (For help use: <http://phoenix.lpl.arizona.edu/mars172.php#1>)



Mars for Earthlings

3. How might those differences affect climate changes on Mars compared to Earth especially related to ice ages?

Evaluate: Mars and Ice Ages

1. Ask students whether they think Mars experienced ice ages as well. What is their reasoning?

2. Why or how would the orbital parameters of Mars affect potential ice ages?

