POLAR TREC
Learning Resources

Details

Completion Time: About 1 period

Permission: Download, Share, and Remix

Ice Cores: Modeling Ice Sheets

Overview

Working in groups students will use common materials to create layers of snow and ice representing thousands of years of stratification. Groups will exchange their ice layers and extract core samples to analyze them.

Objectives

- Notice the phenomenon of stratification.
- Notice that layers can tell a story of change over time.
- Notice that ice layers tell a story of global climate change.

Essential questions to consider:

- How does layering show change over time? What observations can we make about different materials that form layers? How can we compare layers to understand time sequences?
- How does ice form layers? What are the properties of ice layers that hold clues to the history of climate change?

Lesson Preparation

Background Information Required:

Snow is basically ice crystals which have formed from frozen water vapor in clouds. On the ground, these ice crystals are loosely packed with one another, with air pockets between the ice crystals. The structure of ice allows mixing with other substances. Gases flow through, and get trapped. Ice therefore tends to preserve the history of its formation. The middle of Antarctica and Greenland very rarely experience any melting, and so the snow continues to pile up. In the winter, more snow and finer snow falls. In the summer, the warm temperatures create layers of snow with larger crystals. These layers continue to be visible at depth, with thicker, finer winter layers and thinner, coarser summer layers alternating on top of the other. At about 100 m depth, the

Materials

Materials per group:

- Box bottom to construct ice layers
- ¼ cup of blue sand
- ¼ cup of yellow sand
- ¼ cup of salt
- ¼ cup of non-dyed sand
- 2 colors of play dough
- Ruler
- Plastic tubing or clear straws
- Optional: stop watch, colored pencils

snow becomes compressed into ice from the weight of the snow layers above it. The air space between the snow crystals become squeezed out, so that small, isolated air bubbles are left.

Just as tree rings are clues that tell the story of climatic conditions over time, so layers of ice can hold clues to global climate changes. Scientists can use annual snow layers, volcanic dust layers, and fallout from nuclear bomb tests as markers of time in the ice cores. Scientists can analyze gases, dust particles, and other particles that are trapped to model the climatic conditions that explain what they find. Ice layers on Earth preserve the history of global climate change. The bottom of the ice sheet in Greenland is two miles below the surface. That is equal to 100,000 years of ice.

Procedure

Working in groups of three to four, you will create layers of snow and ice represented by the different colors of play dough. Occasionally, I will stop you for a global event, such as a volcanic eruption. You will add something else to your layers to represent this event. One member of the group needs to be a timekeeper, recording the beginning time, global event times, and our ending time. After our layering has stopped, groups will exchange their ice layers and extract a core sample to analyze.

Narrative: [this could be done with different global events that each group draws randomly…or each group has several specific events for 100 or l000 years of time, such as pollution in the-air after the Industrial Revolution began, radioactive fallout, major volcanic eruptions. This version has each group constructing their layers with the same global events)

* Someone in each group should be a time keeper. Note the beginning time, major events, and ending time.

"It is winter and most of the year's snow is falling and accumulating. Use one color of your dough and create the winter snow fall to represent 60 cm of snow. Pat it flat. During the summer there isn't as much snow ... a few centimeters accumulates. Use the other color of dough to represent the summer snow fall.

Continue layering winter and summer snow.

* STOP with whatever layer you are adding. Record the time. There is a volcanic eruption. It is a major volcanic event, sending ash high into the atmosphere. Use your blue colored sand to layer ash over the last snow layer. Make sure you sprinkle it well over the surface. You may want to blow gently so that the 'ash' is not distributed evenly.

Continue your seasonal layers of snow.

* STOP layering, record the time. There is more volcanic ash falling. In fact, it is falling for sev-

eral weeks. Add the non-dyed sand to your last snow layer.
Continue your seasonal layers of snow.
STOP layering. There are acids in the snow from industrial pollution. Nitric acid and sulfuric acid is falling with the snow. Add yellow sand to your last snow layer.
Continue your season layers of snow.
*STOP layering. Record the time. There is fallout in the atmosphere from above ground atomic testing. Add the salt generously so that it covers the last layer.
Continue to add one more year of snow. STOP. Record the time.

Analyze ice layers using ice cores:
Exchange your layers with an adjacent team. Extract an ice core sample for the thickness of the layers using the plastic tubing or clear plastic straws. Leave the core sample in the plastic tube.
• Draw an accurate picture of the ice core. You can use colored pencils to represent the colored layers or symbols for the layers.
• Use a ruler to measure the thickness of the layers of your core and distance from the surface (the top of the ice core is 0).
• Record the color of each layer, including any global events that are present.
• Use a legend to explain what the colors represent.
• Absolute time: If every second counts as ten years (60 sec = 600 years), add dates to your global events (volcanic eruptions and radioactive fallout), youngest and oldest layer.

Questions:
1. What would be the oldest 'ice' in your ice sheet model?

2. How old is the oldest layer in your ice sheet model?

3. When did each of the two volcanic eruptions and radioactive fallout occur?

4. How does layering show change over time?

5. How could we compare layers to understand time sequences?

6. What are the properties of ice layers that hold clues to the history of climate change?

Extension
N/A

Resources
N/A

Assessment
N/A

Learning Resources

Credits

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*Please note: If you try this activity, please email me about changes, improvements, or questions you may have. This activity is not an original thought, but derived from various sources. My students have made improvements already, but I am sure those who try this will also have more ideas. Please share them with me.

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard D: Earth and Space Science
a. Structure of the earth system

Content Standard G: History and Nature of Science
b. Nature of science

Content Standards, Grades 9-12

Content Standard D: Earth ad Space Science
b. Geochemical cycles
c. Origin and evolution of the earth system

Content Standard G: History and Nature of Science
b. Nature of scientific knowledge

Other Standards:
N/A