Teaching Activity: Ice Core Observations

Introduction: The ice sheets and glaciers that cover 10 percent of the Earth's surface have revealed evidence of a changing Earth. The ice has many tales to tell, of both long and short term changes. Oxygen isotopes trapped in the ice molecules reflect temperature variations, both seasonal and long term. The short term changes recorded in ice cores, or samples of ice sheets obtained by drilling into the ice, are especially interesting because they may be comparable to the recent buildup of greenhouse gases, carbon dioxide and methane, in the present atmosphere.

Drilling projects in Greenland and Antarctica have revealed information about the Earth's climate going back as far as 250,000 years. Ice core taken from both poles indicate changes in the Earth's climate. The Greenland ice sheet covers that island to depths as great as 3200 m. The Antarctic ice sheet consists of two parts, each with different characteristics and histories. The East Antarctic Ice Sheet, like the Greenland ice sheet, is situated totally on land above sea level and approaches 4000 m in thickness. The younger, West Antarctic Ice Sheet, is smaller and rests on land that is below sea level. In addition, enormous ice shelves, including the Ross Ice Shelf, form on the western portion. Radar is used to measure the thickness of the ice sheets and to map the underlying landscape.

Among the materials found within the polar ice records are radioactive isotopes from atmospheric nuclear testing, chlorofluorocarbons, pesticides, lead and volcanic ash. The special value of the ice cores is that they contain actual samples of ancient precipitation and air. The positions of such materials as volcanic dust in the ice layers can be "pinpointed" very accurately, especially in the Greenland cores, where ice accumulates much faster than in Antarctica (Parts of Antarctica are as dry as the Sahara!). The accuracy of dating core samples from Greenland can be as close as a single years over a few centuries to less than a few years over the last 10,000 years.

Objective:

- To briefly describe the Greenland and Antarctic ice sheets;
- To illustrate how information on ancient climates is preserved in ice cores;
- To interpret an "ice core" from the Greenland Ice Record;
- To simulate ice core formation;

Important Terms: Ice core, Greenland, Antarctica, isotope, volcanism, beta activity, acid rain, Ice Age, ice shelf, greenhouse gases, infrared energy, greenhouse gases, global warming, pesticides;

Materials: World map, **Student Activity Sheet** ,paper/pencil;

Procedure:

1. Review the material in the **Introduction** section and in the ice-core time line included.

2. Tell students that their first job is to "interpret" the information in the ice core diagram and answer the questions in the **Analysis/ Conclusions** section.

3. The students' next task is to create an ice core time line for a period in history that interests them. (A blank ice core "section" is included.)
   - They can use the research materials available in class, the Internet or library resources.
   - It can be as long or as short as period of time as they wish, but it must include at least 6 pieces of information related to the events that occurred during the time period they selected.
   - The scientific validity of the information in the false ice core is not an issue. The goal here is to simulate the process of recording information in ice and use it to paint a picture of a specific period in time.
   - Student can use illustrations or written format to present their information.

Student Activity Sheet: Ice Core Observations

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Procedure:

1. Review the material in the **Introduction** section and in the ice-core time line included.

2. Your first job is to "interpret" the information in the ice core diagram and answer the questions in the **Interpretation** and **Analysis/ Conclusions** sections.

3. Create an ice core time line for a period in history that interests you. (A blank ice core "section" is included.)
    - Use the research materials available in class, the Internet or library resources.
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THE GREENLAND ICE CORE RECORD

PRESENT

(Years BP (Before present)

55	----- Increase in beta activity indicates nuclear testing
130 - 150	-----Decreased summer melting indicates cooler climate
165	------ Ash from Tambora volcano causes "Year Without Summer"
655	----- Heavy melting
550-1030	----- Warm period; Viking settlement of Greenland
877	----- Hekla volcano eruption in Iceland
1200-1300	----- Heavy melting
2030	---- Volcanism darkens skies over Rome for one year
6381	-----Crater Lake,Oregon formed from volcanic activity
9700 -9890	----- Acid layers indicate volcanic eruption
10,000	---- Emergence of larger ice crystals;dust period ends
25,000	-----Widespread dust around the globe;
60,000	----- Extensive volcanism may have triggered Ice Age
100,000	----- Older Ice

PAST

Student Activity Sheet#1: Ice Core Observations

PART I: INTERPRETATION

1. Crater Lake in Oregon was formed about _____years BP.

2. The "Year Without a Summer" occurred _____ years BP and was caused by a _____ in Indonesia.

3. A layer of widespread dust in the atmosphere was recorded in _____ BP.

4. Ice formed after _____ years BP is considered older ice.

5. Nuclear testing began about _____ years BP.

6. The Vikings settled in Greenland about _____years BP.

7. During the Viking's rule, the Earth underwent a _____ period.

8. The skies over Rome were darkened for an entire year in _____ BP.

9. The volcanic eruptions of 9700- 9890 BP are indicated by layers of _____ in the ice record.

10. The Ice Age may have been triggered by a period of extensive _____ in about 60,000 BP.

11. _____activity is an indication of nuclear testing.

12. A signal of a cooler climate that occurred about 130-150 years ago was a decrease in _____.

13. A volcanic eruption took place in _____ about 877 BP.

14. _____ is a large volcano in Iceland.

15. Around _____BP ocean temperatures may have been warmer than normal.

PART II: ANALYSIS AND CONCLUSIONS

1. Briefly describe the similarities and differences in the Greenland and Antarctic ice sheets. _____

2. Why can layers be pinpointed much easier in the Greenland ice cores than in those from Antarctica? _____

3. What kinds of information can ice cores provide? _____

4. How are portions of the ancient atmosphere preserved in ice? _____

5. Does the ice record show a correlation between climate change and volcanic eruptions? Explain. _____

6. Theoretically, how could ice cores be helpful in identifying countries using illegal chemicals like CFCs? _____

7. Why would it have been inadvisable for the Vikings to have attempted to colonize Greenland earlier than they did? _____

Student Activity Sheet #2

PART III: ICE CORE SIMULATION