Ice Cores

Audience: Grades 4-8
Duration (Several class periods to complete, including freeze time overnight of several layers)

Background

The NASA Ice, Cloud, and land Elevation Satellite-2 or ICESat-2, measures the height over our planet. It measures how quickly the sea ice and ice sheets are changing. ICESat-2 will provide scientists with height measurements that create a global portrait of Earth's 3rd dimension, gathering data that can precisely track changes of terrain including glaciers, sea ice, forests, buildings and more. Learn more at:
the official ICESat-2 website

Ice is vital for our planet, it helps keep the planet cool. Over our Earth's history, we have seen many changes, environmentally, geologically, atmospherically. One way that we can look how our planet responded to change in the past is by examining ice cores.

An ice core is a vertical, continuous, cylindrical piece of ice that is removed from an ice sheet or glacier with an ice core drill. Ice cores have been recovered from the polar ice sheets of Antarctica and Greenland as well as from mountain glaciers and ice caps around the planet.

As snow falls to the Earth, in the high latitudes and at high altitudes where snow doesn't melt from year to year, there is incremental buildup of annual layers of snow. Snow that lasts more one season is termed firn. Firn is denser than snow, yet not as dense as ice. Ice forms from firn as it is compressed and thinned over time by the ever-increasing buildup of snow layers above it. Deeper layers of ice are therefore older than shallower layers of ice. An ice core contains ice formed over a range of years.

Ice cores are recovered from ice sheets, mountain glaciers and ice caps all over the world. The collection and analysis of these cores allow us to understand how regional and global climate changes over time.

Ice cores contain an abundance of information about our Earth's climate. Substances in the snow of each year remain in the ice, such as dust, ash, pollen, sea salts, atmospheric gases, pollutants. Analyses of these substances within the context of a known timescale for the ice core can then be used to reconstruct a climate record over the age range of the core. Reconstruction of local, regional, hemispheric, and global temperature records and the history of atmospheric composition can be made by comparing the timing and extent of the events recorded in cores from around the world.

Antarctica and Greenland provide environmental records of hundreds of thousands of

years before present, while mountain glaciers provide environmental records several hundreds to a couple of thousand years before present. Mountain glaciers are often important if not primary water sources for populations downstream (e.g. Peru, Himalaya). Places like Afghanistan and Turkey depend on glacier meltwater during the summer months. This is going to disappear when the glaciers in these regions disappear. Equally important for many areas in South America is the generation of hydropower from glacier meltwater. This too will go away if the glaciers melt and disappear. The loss of ice from mountain glaciers reduces not only local water supplies, but also the ability to recover ice cores and understand local and regional environmental conditions.

Safety

When choosing the craft supplies to add to the ice core layers, please make sure that everything is non-toxic.

Task

Students will learn why scientists need to collect ice cores by creating their own using simple craft supplies. Students will be creating up to 20 layers. This will take some extended class time to accomplish.

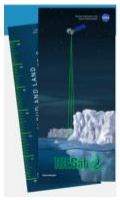
What You Need

Tall, cylindrical container (preferably a 3 or 4-ball tennis ball tube)

Pen or pencil

Access to a freezer

Food dyes and other craft supplies to layer in the ice. (Paper confetti, sand, etc.)



ICESat-2 ruler bookmark or classroom ruler

Safety gloves

Tray

What to Do

1. Using the cylindrical container, add a few ounces/milliliters of water and put it in the freezer until completely frozen. This will require overnight freezing for each of the layers. You can add up to 20 layers.
2. Repeat step 1 until entire container is filled and frozen with ice layers. For each layer, it is not required to add the same amount of water.

a. It is recommended that you add food coloring or paper confetti into the container as you are creating the ice layers. These items can represent different geophysical attributes found in the ice, like volcanic ash, dust, sand, pollen grains, etc.
    i. For example, Food coloring = can help differentiate between layers
    Paper confetti= can represent pollen grains, dust, sea salt, etc.
    It will be the students' choice what materials to add and what they signify.

3. Once you have filled up the cylinder and it is completely frozen, take your ice core out of the tube and place it on a tray to catch any melt and materials. (*Note- if you cannot get the ice core out of the tube, it may need to be cut out. Please inform your teacher or parent and have them cut it out for you.) If your tube is clear, it may not be necessary to pull the ice core out of the tube. Observations can be done looking through the tube. *Note: when handling the ice, please use safety gloves.
4. Using your ruler, measure out each layer's thickness in inches or centimeters.
    a. Record this is the table below
    b. Each inch equals 90 years (or every centimeter equals 35 years)
    c. How old is each of your layers. Record this in the table below.

Ice Core Activity	Thickness (inches or cm)	Age (years)
Layer 1		
Layer 2		
Layer 3		
Layer 4		
Layer 5		
Layer 6		
Layer 7		
Layer 8		
Layer 9		
Layer 10		
Layer 11		
Layer 12		
Layer 13		
Layer 14		
Layer 15		
Layer 16		
Layer 17		
Layer 18		
Layer 19		
Layer 20		

5. As an extension activity, make up a story about events that happened in your environment when your ice core was forming, if in the real world.

My ice core story

6. Once you have measured all your layers and observed what is necessary, keep the ice core on the tray or in the tube and allow to melt. Dispose of any items that were in the ice core appropriately. You may also wish to keep the ice core frozen for future reference. In this case, return your core to the container and place in freezer.

Useful References

For helping to understand our Earth's cryosphere and its ice cores, what geophysical attributes in the ice cores represent, and why ice cores are vital to understanding our planet's climate. These references will greatly help out the students when interpreting their ice cores and writing their ice core stories.

- **NASA Global Climate Change: "Core Questions"**
- **NASA Earth Observatory: "Paleoclimatology: The Ice Core Record"**
- **National Ice Core Laboratory**
- **NOAA Climate: "Climate at the Core"**
- **NASA ICESat-2 Mission**

Next Generation Science Standards

4-ESS2-1: Make observations and/or measurements to provide evidence of the effect weathering or the rate of erosion by water, ice, wind, or vegetation.

5-ESS2-1 Earth's Systems: Develop a model using an example to describe ways the geosphere, biosphere. Hydrosphere, and/or atmosphere interact.

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