Classroom Viewing Guide

Real World: ICESat-2 and Earth's Cryosphere http://youtu.be/zirJp--k-5I

Introduction:
Earth's cryosphere, one of Earth's six spheres, is composed of all its frozen structures including sea ice, ice caps, and permafrost. Understanding changes in the cryosphere provides scientists with valuable information about the past, present, and future of the planet. Amazingly, 99% of Earth's fresh water is held in two massive ice sheets. ICESat-2 is a satellite designed to help scientists learn more about Earth's ice and the role ice plays in climate.

Guiding Questions:
1. What are the six spheres that makes up the Earth's system?
2. Which of Earth's spheres is ICESat-2 going to focus on?
3. What are the major differences between ice at the North Pole and ice at the South Pole?
4. How will ICESat-2 use lasers to measure the changes in elevations of the Earth?

Possible Next Generation Science Standards Addressed:

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.

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

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Glossary of Terms:

Cryosphere: the collective parts of the Earth that are frozen and covered with ice

ICESat-2: the Ice, Cloud, and land Elevation Satellite-2

Ice Sheet: a permanent layer of ice covering an extensive area of land

Laser Altimeter: an instrument that measures the time it takes for a laser pulse to return from the ground directly below it. This time is converted into height above the ground

Sea Ice: frozen sea water

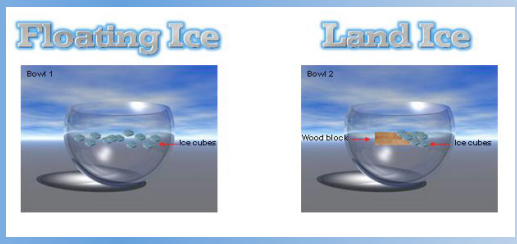
Mini-Lesson

Part 1-Sea Level Change-Floating Ice (Sea Ice) versus Land Ice (Ice Sheets)

Materials needed: 2 large bowls (glass or plastic)-Can also use 2 beakers , flat wood block, Ruler (with cm), 5-7 ice cubes, water

In this activity, students will create a "desktop" example of the differences between floating ice and land ice and their melting characteristics.

1. Label Bowl 1-Floating Ice and Bowl 2-Land Ice
2. Fill each bowl to the same level (about 2/3 full) with cool water
3. In Bowl 1, add about 5-7 ice cubes (These will represent Floating Ice)
4. In Bowl 2, add wood block and place 5-7 ice cubes on wood block set-up (These will represent Land Ice)
5. Measure and record level (depth) of water, radius (at water line) and record in tables below
6. Measure the depth and radius at each timed interval and record in tables provided.
7. Then, calculate the volume at each timed interval



Depth (cm)	Start	5 Min	10 Min	15 Min	20 Min	25 Min
Floating Ice						
Land Ice						

radius [r] at water line	Start	5 Min	10 Min	15 Min	20 Min	25 Min
Floating Ice						
Land Ice						

How to Calculate Volume: Because we will be using a bowl, we will be using the volume equation for a sphere, then simply dividing the value in half.
For example:
Remember, r= 1/2 D, where D=Diameter (measured at water line)

$V=\frac{4/\pi r^3}{3}$ if r=15cm, then $V=\frac{4(3.14)(3375cm^3)}{3}$, then

$V=\frac{42390cm^3}{3}$, $V=14130cm^3$, then

convert for bowl (half of sphere) $V=\frac{14130cm^3}{2}$ $V=7065cm^3$

Volume (cm3)	Start	5 Min	10 Min	15 Min	20 Min	25 Min
Floating Ice						
Land Ice						

ICESat-2 ICE, CLOUD, AND LAND ELEVATION SATELLITE-2

Questions:

1. Did the depth and volume change at each timed interval?

2. How can we translate the small changes you have seen and measured in this activity to a larger global scale?

3. Suggest some reasons why the melting of floating ice (Sea Ice) and land ice (Ice Sheets) have such different effects on sea level.

4. How does NASA measure the melting of sea ice and ice sheets?

ICESat-2
ICE, CLOUD, AND LAND ELEVATION SATELLITE-2