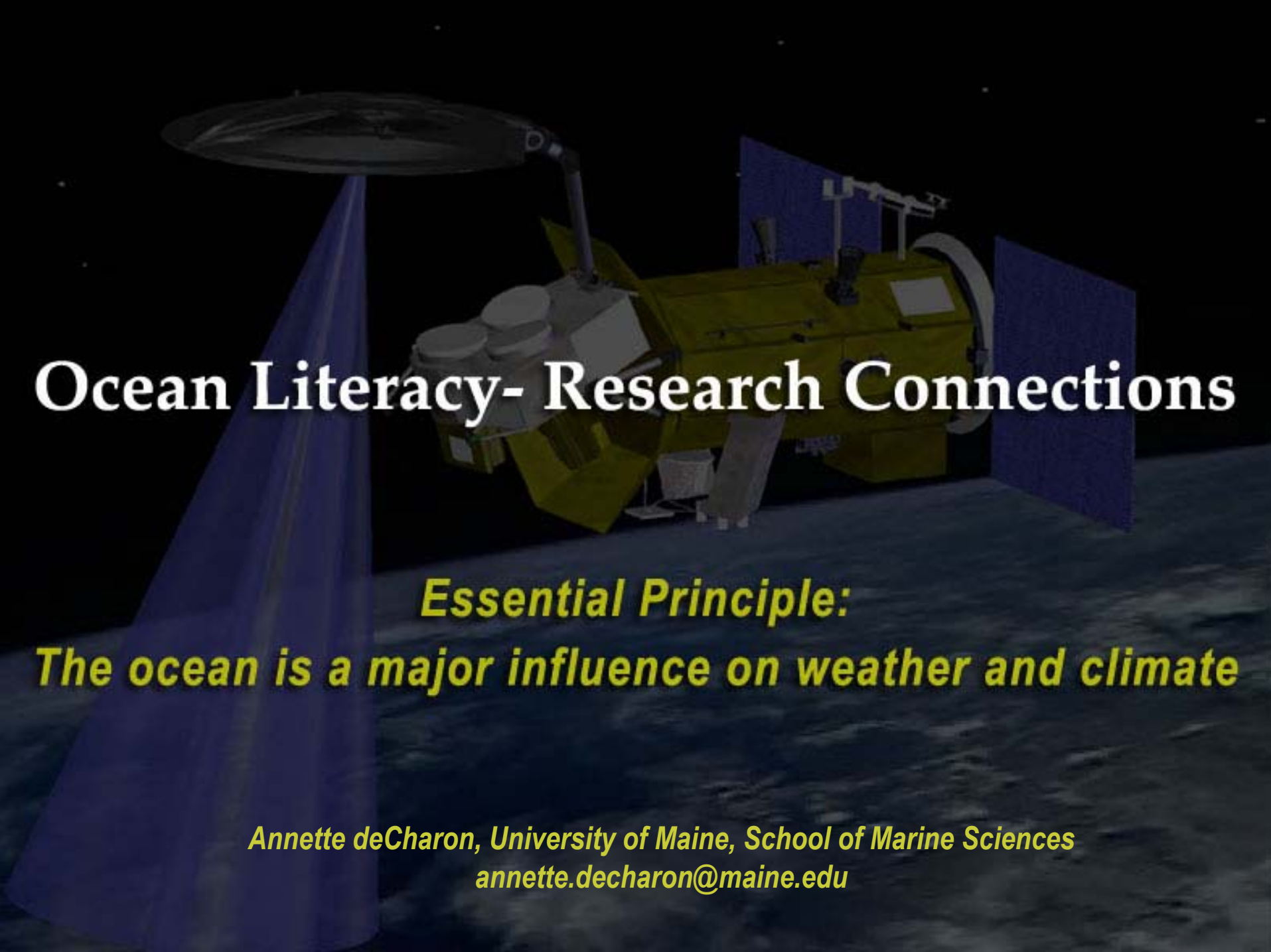

Ocean Literacy- Research Connections

Essential Principle:
The ocean is a major influence on weather and climate

Annette deCharon, University of Maine, School of Marine Sciences
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Ocean Literacy- Research Connections

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- **A major area of research is studying the linkages betweens the oceans and climate. Some recent publications:**
  - *Global Warming Will Alter Character of the Northeast (NECIA)*
  - *Climate Impacts of the Atlantic Multidecadal Oscillation (Geophysical Research Letters, 02-Sep-2006)*
  - *Trajectory Shifts in the Arctic and Subarctic Freshwater Cycle (Science, 25-Aug-2006)*
  - *Atlantic Hurricane Trends Linked to Climate Change (EOS-Newsletter of the American Geophysical Union, 13-Jun-2006)*
  - *Snowy Northeast Can Thank La Niña (Discovery News, 14-Feb-2006)*

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- **Salinity is a major component of ocean-climate research. Some recent publications:**
  - *Researchers Link Ice Age Climate-change Records to Ocean Salinity (Nature, 05-Oct-2006)*
  - *Rapid Subtropical North Atlantic Salinity Oscillations Across DansgaardA-Oeschger Cycles (Nature, 05-Oct-2006)*
  - *Climate Change: A Sea Change (Nature, 19-Jan-2006)*
  - *Arctic Ocean Change Heralds North Atlantic Freshening (Geophysical Research Letters, Nov-2005)*
  - *Influence of the Atlantic Subpolar Gyre on Thermohaline Circulation (16-Sep-2005)*

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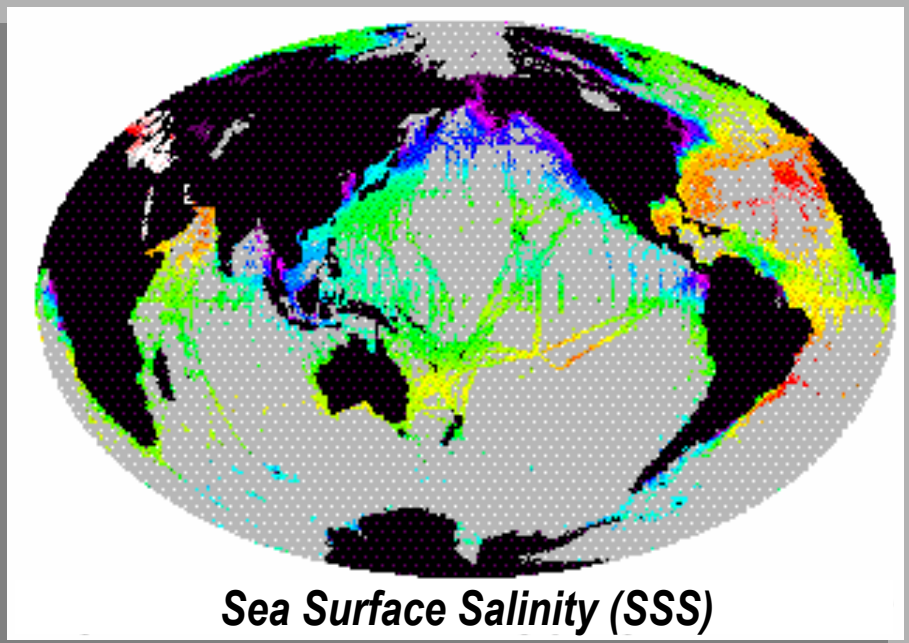

Sea Surface Salinity (SSS)

This map shows <u>all</u> known measurement locations sampled over the past 100 years for Sea Surface Salinity (SSS).

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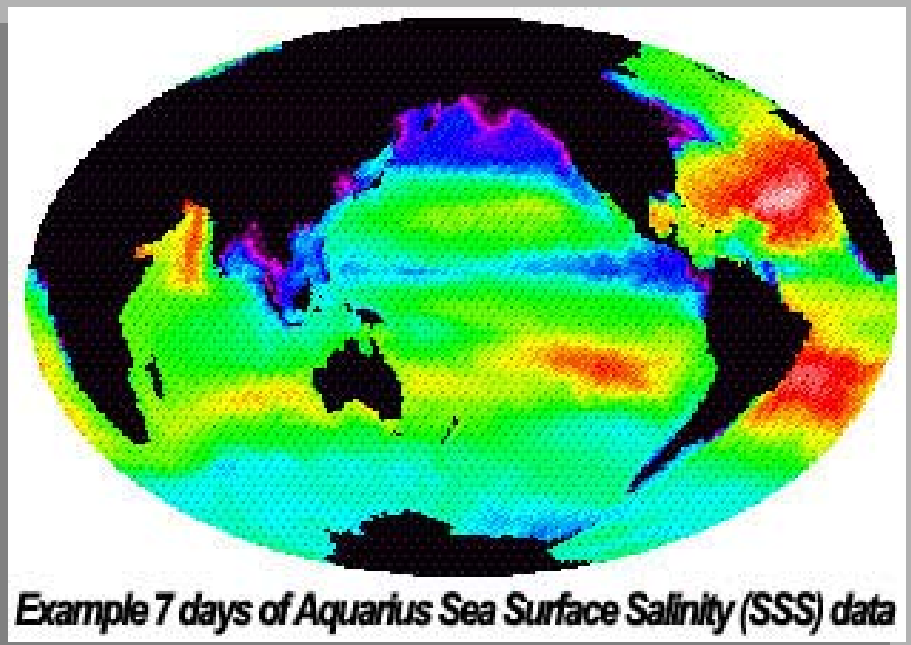

Example 7 days of Aquarius Sea Surface Salinity (SSS) data

Not presently measured by satellite, this map shows the weekly SSS coverage that will be achieved by *Aquarius* after its July 2009 launch.

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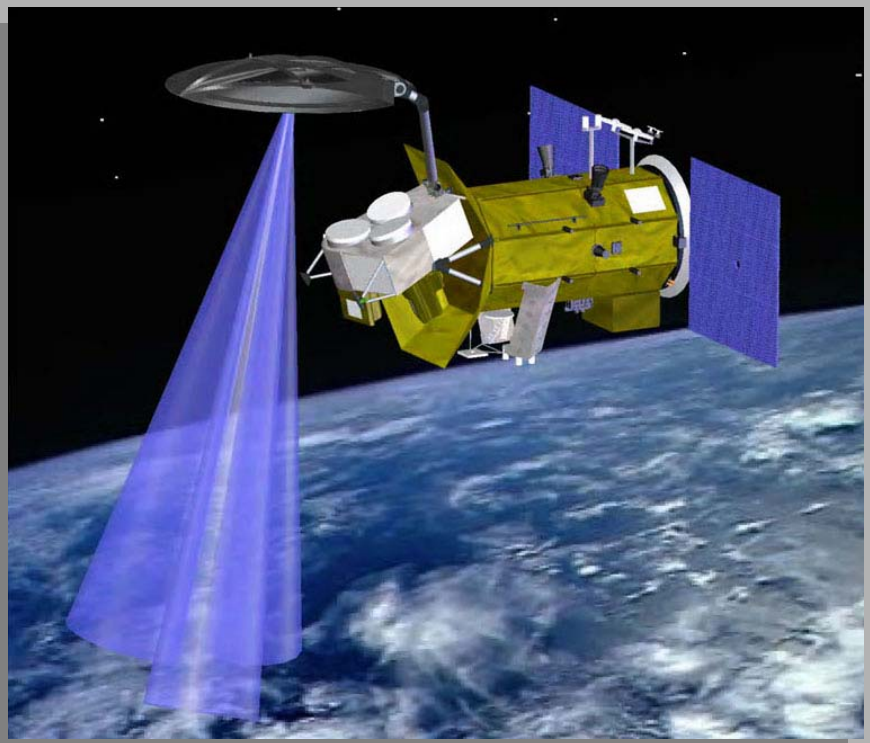

***Aquarius* instrument accuracy will be 0.2 psu*. How much salt should be added to 1 gallon of water to change its salinity by 0.2 psu?**

- **1 tablespoon**
- **1 teaspoon**
- **1/6 teaspoon**
- **1/10 teaspoon**

**Used to describe the concentration of dissolved salts in water, the UNESCO Practical Salinity Scale of 1978 defines salinity in terms of a conductivity ratio, so it is dimensionless. Salinity was formerly expressed in terms of parts per thousand or by weight (parts per thousand or 0/00). That is, a salinity of 35 ppt meant 35 pounds of salt per 1,000 pounds of seawater. Open ocean salinities are generally in the range between 32 and 37.*

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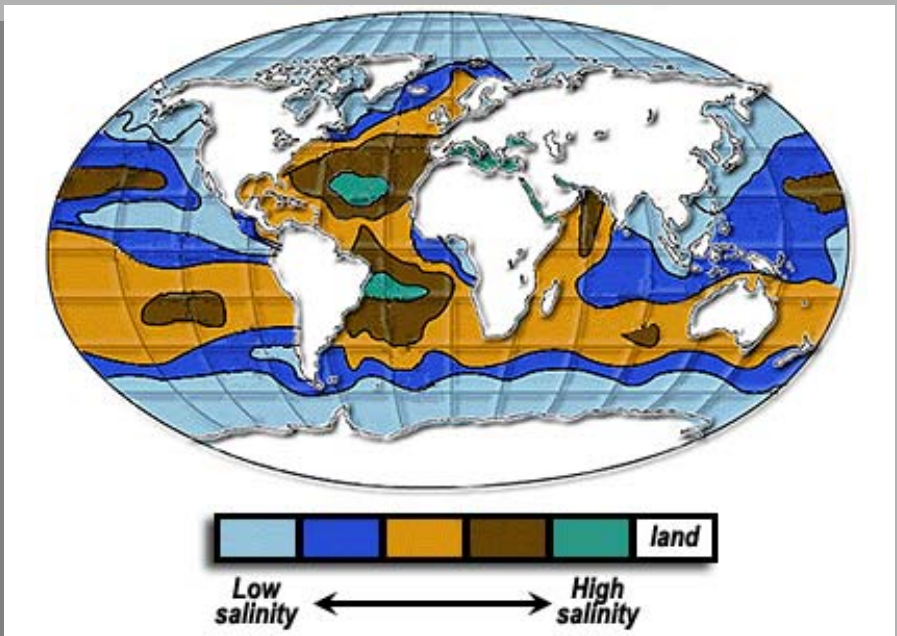

The mission will help answer questions about how our oceans respond to climate change and the water cycle.

Like on land, some areas of the ocean are rainy whereas others are arid. *Aquarius* SSS data will reveal the water cycle's ever-changing "fingerprint."

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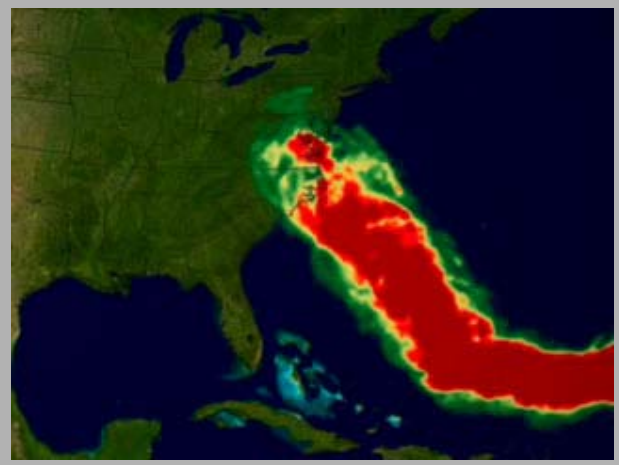
Isabel develops in the North Atlantic

Red areas show areas of heavy rainfall



Isabel hits the U.S. southeastern coast

Hurricane Isabel (2003) accumulation of rainfall as measured by the NASA TRMM satellite. Over <u>400 trillion tons of freshwater</u> were dumped on the North Atlantic Ocean during this event.

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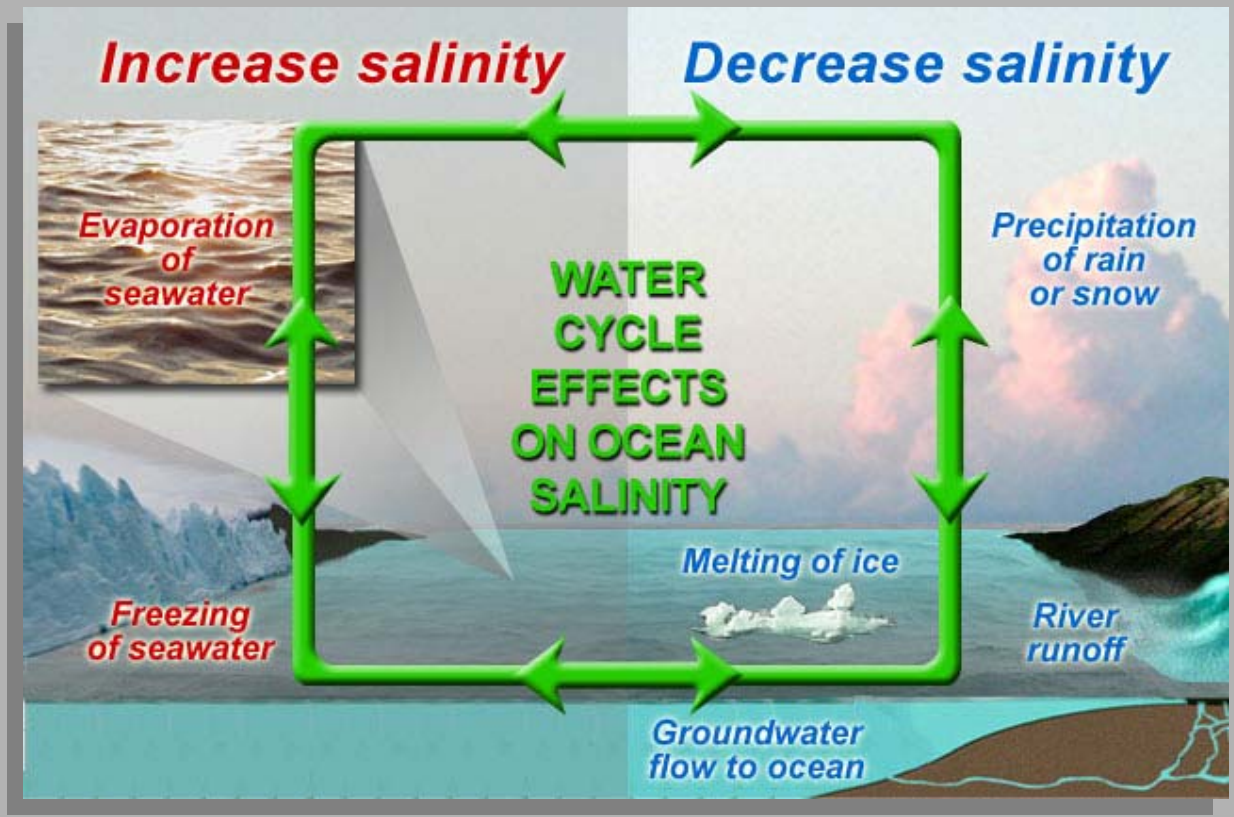
SSS maps can be used to directly track variations in the water cycle such as river runoff, sea ice freezing & melting, ocean evaporation & precipitation:



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Our education deliverables – "Salinity Patterns & the Water Cycle" – are activities designed to meet physical science content standards for grades K - 12.

http://aquarius.nasa.gov/education.php

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”Can Sea Water Freeze?" is a middle school classroom activity.

After making ice from fresh and salt water, students learn the differences between sea ice and ice bergs.

FREEZER EXPERIMENT

Record your observations below:

JAR	Starting salt / water content	1 hour in freezer		24 hours in freezer		48 hours in freezer	
		Temp	Notes	Temp	Notes	Temp	Notes
A							
B							
C							
D							

BUOYANCY EXPERIMENT

	Ice from "A"	Ice from "B"	Ice from "C"	Ice from "D"
Solution "A"				
Solution "B"				
Solution "C"				
Solution "D"				

Sea ice photos from the Arctic

Iceberg photos from the Antarctic

Photos from Bigelow Laboratory for Ocean Sciences and the Australian Antarctic Division

HOME | OVERVIEW | SCIENCE | TECHNOLOGY & OPERATIONS | GALLERY | EDUCATION | NEWSROOM | LINKS | SITE MAP

EDUCATION: Classroom Activities

SEA WATER FREEZE

Grade Level: *Middle* | Time: *3 class periods* | Content: *Physical Science*

Principles & Student Learning Objectives

- Substances have characteristic properties (e.g., density) that are independent of sample amount
- Observe how salinity affects the time it takes water to freeze
- Understand that salt is left behind as salt water freezes, this process forms brine
- Through experimentation, learn that ice is essentially salt-free whether formed from fresh or salt water
- Learn about sea ice vs. icebergs; see that they float higher in salt water than in fresh water

***BACKGROUND:* Sea ice is frozen seawater that floats on the ocean surface. Blanketing millions of square kilometers near the North and South Poles, sea ice can form and melt during different seasons, affecting both human activity and biological habitat. Almost all Antarctic sea ice (near the South Pole) melts away and re-forms each year. On the other hand, in the Arctic (near the North Pole) some sea ice persists year after year. Icebergs are also important in polar regions. Unlike sea ice that is formed from salty seawater, icebergs are composed of ice originating from land-based glaciers that flow into the sea. Glaciers are formed by snow that accumulates on mountains over many years. Ask the students whether snow is made of saltwater or freshwater. How do they know this? (Taste.)**

Materials: *Per Student Group – one cup of ordinary table salt, tablespoon, plastic ice tray with divided watertight sections, tap water, thermometer, 8 jars (at least 8 oz.), beakers (at least 300 ml) or cut 2L plastic soda bottles, ruler, graph paper.*

Preparation: *Students will need access to a freezer. An earth globe will also be shown to the students.*

Activity

- Begin with a class discussion of the locations of the North Pole (Arctic) and South Pole (Antarctic). Ask the students which Pole is covered by land (Antarctic) and which is covered by seawater (Arctic). Ask students which Pole is more likely to have glaciers nearby (North Pole).
- Ask the class to hypothesize about the affect of water salinity – or amount of salt – on the formation and buoyancy of sea ice. Do they think ice formed from salt water will freeze more quickly or more slowly than fresh water? Do they think that sea ice (i.e., formed from salty water) will be more buoyant or less buoyant than ice formed from fresh water (e.g., icebergs)? Do they think that the size of sea ice or icebergs affects their buoyancy (e.g., percentage above and below the water line)?

Label 8 jars as follows: 2 marked “A”; 2 marked “B”; two marked “C”; and two marked “D.” In each jar mix salt and water solutions as follows:

In each jar marked "A": mix 9 T salt with 1 cup water

In each jar marked "B": mix 6 T salt with 1 cup water

EDUCATION

SALINITY BASICS

CLASSROOM ACTIVITIES

Salinity Patterns & the Water Cycle

SALINITY DATA & TOOLS

LINKS

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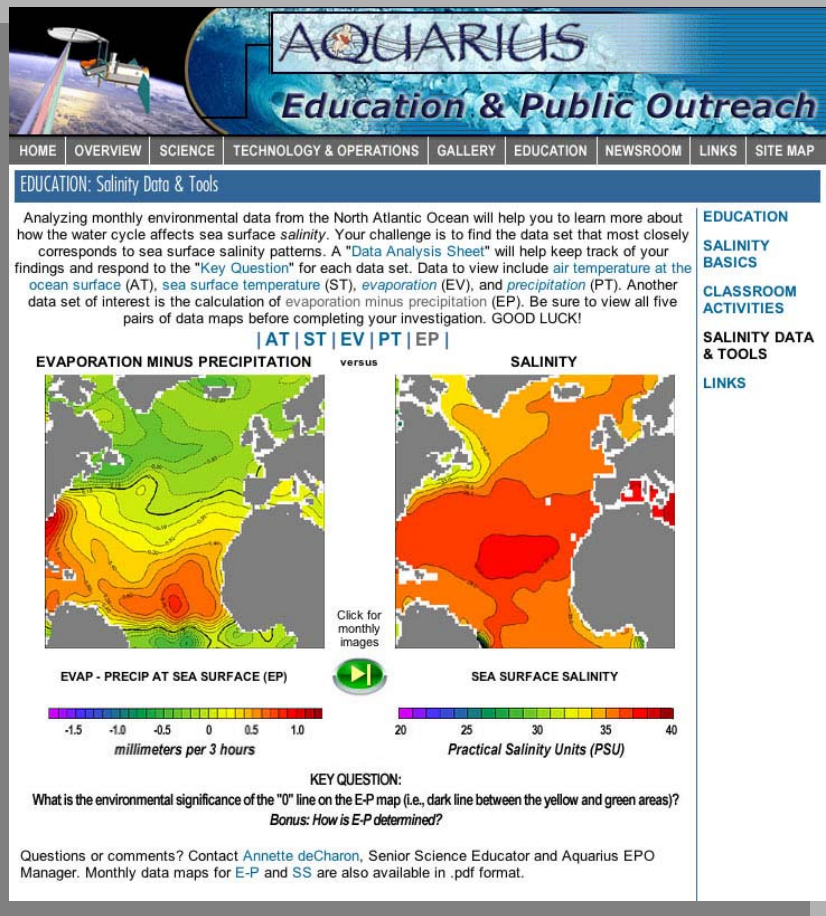
A web-based data interaction is "Salinity Data & Tools."

Users compare monthly sea surface salinity maps from the North Atlantic Ocean with:

- *Air temperature*
- *Sea surface temperature*
- *Evaporation (E)*
- *Precipitation (P)*
- *E-P*

Their challenge is to find the data type that most closely corresponds to sea surface salinity patterns.



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If you have any questions, please let me know.

annette.decharon@maine.edu

Thank you!