This booklet was created by the
Education Program at the

NJ Sea Grant Consortium

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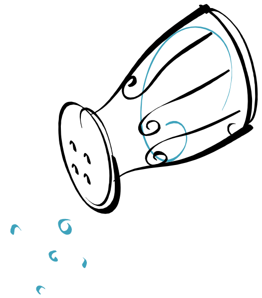
Understanding Salinity

Activity book
created by:

NJ Sea Grant Consortium

NAME: ______________________________

Why is the Ocean Salty?



Since nearly the time the earth began, rain has poured down over land weathering and eroding rocks and transporting their minerals to other places. These minerals make up salt. As rain washes into nearby rivers and streams, minerals are brought along. They eventually flow into the ocean. Salts become concentrated in the ocean because the Sun's heat only evaporates almost pure water from the surface of the ocean, leaving any solids (including salt) behind. Salts do not evaporate into the air. Over many millions of years, the concentration of salts have increased, making the ocean the big salty sea that we know today.

The two minerals present most often in saltwater are chloride and sodium. These two make up over 90% of all dissolved minerals in the ocean. Other salts that can be found in saltwater are calcium, magnesium, sulfur and potassium.

What is Salinity?

Salinity is the saltiness of a body of water. Have you ever been in the ocean and tasted the water? If so, then you know the ocean is very salty. You also know that not all water is salty. Rivers, ponds and the water you drink are not salty like the ocean. If you wanted to know how much salt is in a body of water, you would use special scientific tools. They measure the salt contained in the water, and you would refer to this measurement as salinity. After all, scientists--including you--cannot (and really should not) just taste the water to determine how salty it is. We must be more precise.

Questions to ponder and answer……

1. How do the minerals that make water salty enter into waterways?

2. True or False– the Sun's heat evaporates salts away from the ocean.

3. Name two minerals that make up salt.

4. What is salinity?

Salinity Acitivity #2

Estuairne Layers

When salts are added to water, the water becomes more dense. Salt water then, is heavier than fresh. In an estuary, where salt and fresh water meet, the different densities cause the waters to settle into two layers; a salt water layer on the bottom with a freshwater layer above. Mixing occurs where the layers meet. Further mixing takes place as a result of wind, tides, waves, temperature changes and rainfall.

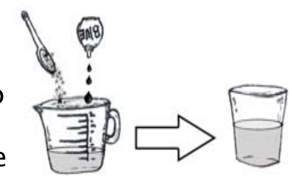
Try this experiment to demonstrate how salt and fresh water in a typical estuary layer and mix.

<u>What you need</u>

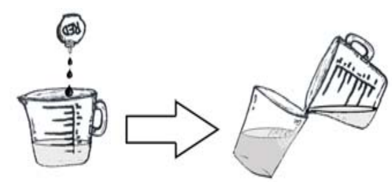
Water (tap water is fine)
Measuring cup
3 teaspoons of salt
2 clear cups or beakers
Red and blue food coloring.

<u>What you will do</u>

1. In the measuring cup, combine 1/2 cup of water with the 3 teaspoons of salt. Stir well to dissolve the salt as much as possible. Add 3 drops of blue food coloring. Pour this into the clear cup. Rinse your measuring cup.



2. Add 3 drops of red food coloring to 1/2 cup of freshwater in your rinsed measuring cup. Very slowly, pour the fresh water down the side of the cup into the salt water. What happened? Why do you think this happened?



3. Now reverse the experiment. First pour the fresh water into the clear cup then very slowly pour the salt water down the side. What happened? Why do you think this happened?

<u>Here's What Happened</u>

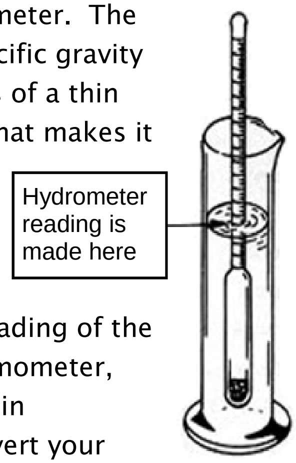
In the first experiment you should have seen two distinct layers form. The fresh water should have floated on top of the salt water because it is less dense (lighter). You can also try slowly dripping the fresh water into the saltwater to form layers.

In the second experiment you should have observed swirls of saltwater sinking to the bottom of the cup. You created an estuarine current!

Salinty Activity #1

Measuring Salinity - First Steps!

A common tool used to measure salinity is a hydrometer. The hydrometer is an instrument that measures the specific gravity of liquids. It is made of glass or plastic and consists of a thin round stem with a thicker weighted bulb attached that makes it float upright. To measure salinity, water is poured into a tall jar or hydrometer tube. The hydrometer is then gently placed into the water until it floats freely. The point where the surface of the water touches the stem of the hydrometer is where the reading of the water's specific gravity is made. Then, using a thermometer, the temperature of the water is taken and recorded in centigrade (C). A conversion table is needed to convert your temperature and specific gravity data into salinity (in ppt).



Converting your Data to Salinity

Step 1. Follow along the top row of the conversion table to the column with the temperature (in C) you got for the water sample.

Step 2. Follow down the right side of the table, to the reading of Specific Gravity (S.G.) you got from the hydrometer.

Step 3. Where the column and the row intersect on the table you will find the salinity reading for the water sample. It is expressed in parts per thousand (ppt).

The temperature of the water (let's say it was 11 °C) is here.

The hydrometer reading in S.G. (let's say it was 1.015) is found here

Where the temperature and S.G. intersect is the salinity in ppt. Can you find it?

The salinity is 18.6 ppts.

Try it!

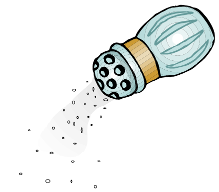
The temperature of the water was found to be 16 °C and the hydrometer reading in S.G. was 1.020.

What is the salinity in ppts?

____

S.G.	Temperature (in Centigrade)							
	10	11	12	13	14	15	16	17
1.012	14.7	14.8	14.9	15	15.2	15.4	15.7	15.8
1.013	15.8	16	16.2	16.3	16.5	16.7	17	17.1
1.014	17.1	17.3	17.5	17.7	17.8	18	18.3	18.6
1.015	18.4	18.6	18.8	19	19.1	19.3	19.6	19.9
1.016	19.7	19.9	20.1	20.3	20.4	20.6	20.9	21.2
1.017	21	21.2	21.3	21.6	21.7	22	22.2	22.5
1.018	22.3	22.5	22.6	22.9	23	23.3	23.5	23.8
1.019	23.6	23.8	23.9	24.2	24.3	24.6	24.8	25.1
1.020	24.8	25.1	25.2	25.5	25.6	25.9	26.1	26.4
1.021	26.1	26.4	26.5	26.8	26.9	27.2	27.4	27.7
1.022	27.4	27.7	27.8	28.1	28.2	28.5	28.7	29
1.023	28.7	28.9	29.1	29.4	29.5	29.8	30	30.3
1.024	30	30.2	30.4	30.6	30.8	31.1	31.3	31.6
1.025	31.3	31.5	31.7	31.9	32.1	32.4	32.6	32.9

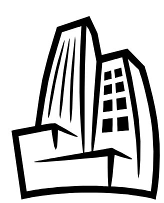
How Much Salt?!



When measuring how much salt is in the water… or more accurately, when measuring salinity, it is reported in **parts per thousand (ppt or ‰).** The salinity of ocean water is about 35 ppt. In other words, if you had 1,000 grams of water and dissolved away all the water, you would be left with 35 grams of salt. This means the ocean is about 3.5% salt. Salinity is not the same in all bodies of water. Most rivers, ponds, and streams have almost no salts with salinity ranging from 0-5ppt. This range of measurement is considered fresh water. In an estuary (bay), the flow of fresh water from streams and rivers mixes with salty ocean water. That mixture is called brackish water, with a range of salinity from .05 to 30ppt. In the Red Sea the water is considered brine, with a salinity up to 50ppt. This is the saltiest lake in the world--even saltier than the ocean!

Types of water based on amount of dissolved salts in parts per thousand (ppt)			
Fresh water	**Brackish water**	**Salt water**	**Brine**
< 0.5 ppt	**0.5 - 30 ppt**	**30 - 40 ppt**	**> 40 ppt**

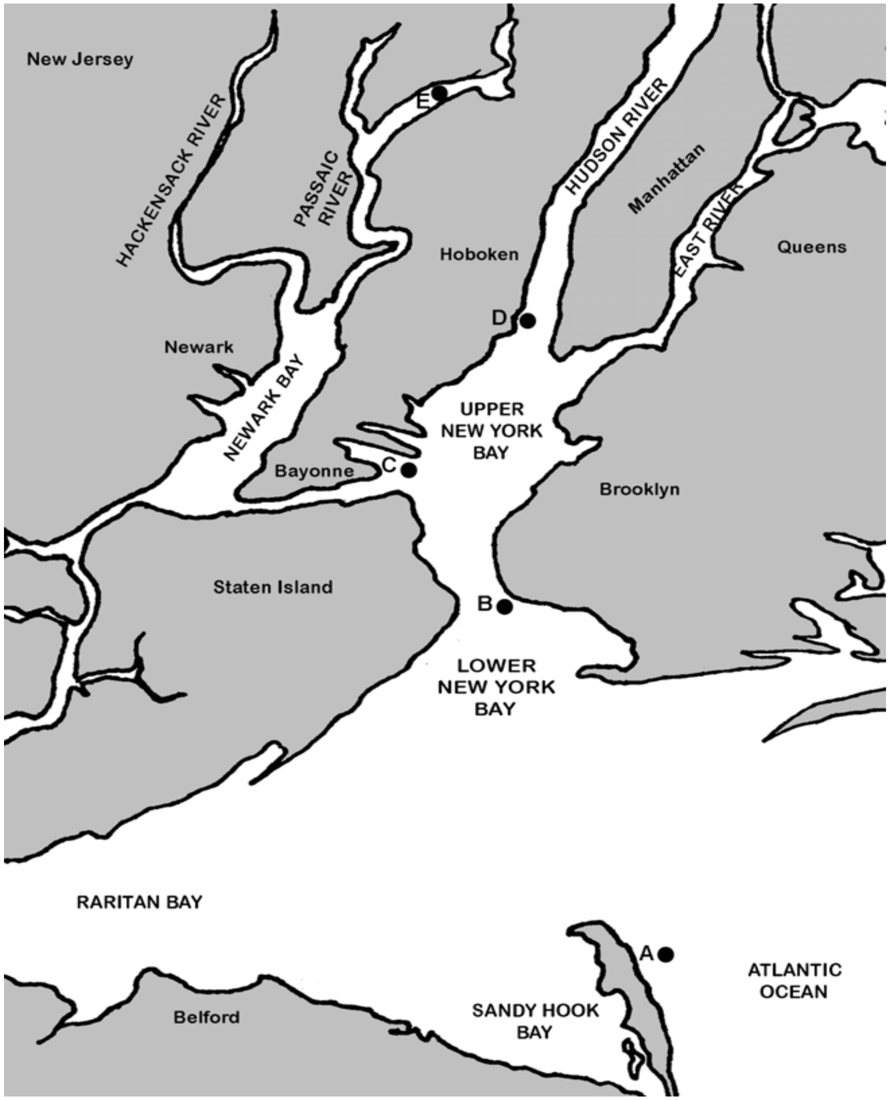
<u>Body of Water</u>	<u>Typical Salinity</u>
A Salty Lake (like the Red Sea)	36-50 ppt
The Ocean	30-35 ppt
Mouth of estuary by a river	1-15 ppt
Entrance of estuary by the ocean	15-30 ppt
Tidal fresh river (tides bring in some saltwater)	.05-14 ppt
Freshwater Stream or River	<1 ppt



By some estimates, if all the salt in the ocean could be removed and spread evenly over the Earth's land surface, it would form a layer more than 500 feet (166 m) thick. That's about the height of a 40-story office building!

What's the Salinty?

Below is a map of the New York/New Jersey Harbor Estuary. Think about what you learned from the previous page of this booklet to determine the salinity of each spot designated (A-E). Report your answer in parts per thousand (ppt).



Use the information on the previous page to help you determine the salinity for each of the place marked on your Harbor Estuary map.

A_______________ D_______________

B_______________ E_______________

C_______________

Answers: A -30-35ppt, B-15-30ppt, C-10-25ppt, D 1-15 ppt, E-.0-1-ppt

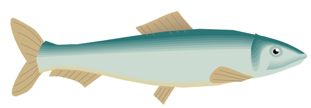
Why Measure Salinity?

Salinity is one of the most important features in determining which plants and animals can live in a body of water and where. Many species prefer to live in a specific salinity, and their bodies cannot tolerate drastic changes in salinity. Changes in salinity affects the balance of water inside an organisms body, and changes can have a detrimental or even deadly effect. Some aquatic animals can tolerate different salinities but may prefer to live in or to reproduce within a certain salinity range. For example, striped bass prefer to live in very salty bays or the ocean. However, when it's time to reproduce, they migrate into freshwater to lay their eggs. After the eggs hatch, their young grow then slowly migrate back to more salty waters to spend their adult lives. For other species of aquatic animals, just the opposite is true.

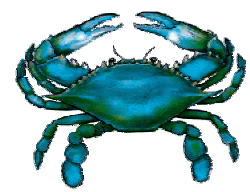
It also important to know that as salinity increases, the amount of oxygen available for organisms to breathe decreases.

Sealife & Salinity

Below are a sample of aquatic creatures and their optimal salinity range.



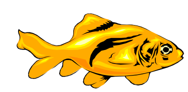
Herring: 0-20 ppt



Male Blue Crab 3-15 ppt

Clams 25-28ppt

Seastar: 28-35 ppt



Goldfish: 0-5ppt

Brine Shrimp: 30-50ppt