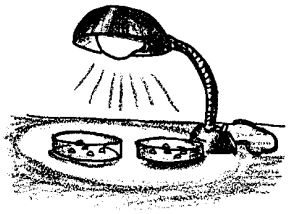
Salty Water

Edited by Pat Williams, Eugene, OR

Key Concepts

1. Sea water differs from fresh water in that it contains greater quantities of dissolved salts.

2. Water is a very effective solvent; it is able to dissolve many substances.



Background

Sea Water

For billions of years, rains have washed into streams and rivers emptying into the sea. This moving water erodes salts and minerals from rocks and soils. These salts and minerals find their way into the seas. Over time, the concentration of these salts and minerals has increased, creating the salty ocean waters we know today.

Oceanographers measure the water's salt content, or salinity, in grams of salt per kilogram of sea water (g/kg) which is usually expressed as parts per thousand (o/oo). Average seawater salinity is approximately 35 grams of salt per thousand grams of water. Salinity values range from nearly zero at river mouths to over 40 parts per thousand in some areas of the Red Sea. Notice the variation of salinity in these bodies of salt water:

Red Sea= 40 ‰
Mediterranean Sea= 38 ‰
"Average" sea water= 35 ‰
Black Sea= 18 ‰
Baltic Sea= 8 ‰

Salinity is altered by processes that add or remove salts or water from the sea. Generally, it is the removal or addition of water, rather than salt, that causes the changes in salinity that we observe. Except in unusual cases, changes due to the addition of salt take a very long time (i.e. tens of thousands of years) to effect. Salinities near shore vary due to the addition of fresh water by rivers and rainfall. Local conditions of temperature and water circulation may also increase or decrease salinity. Salinity also may vary at different depths due to the layering of waters of different densities.

The primary mechanisms of salt and water addition or removal are evaporation, precipitation, river runoff, and the freezing and thawing of sea ice.

In spite of the great volumes of water that are moved in these processes, the salinity of sea water in the open oceans is amazingly constant. On the other hand, salinity changes in local environments, such as tidepools, can be dramatic.

Salinity in a Tidepool

A tidepool exposed during a summer, mid-day, low tide will likely have a much higher salinity than the nearby ocean water. The salinity of the tidepool increases as water evaporates from the surface of the tidepool, leaving behind the dissolved salts (now in less water, and hence, more concentrated).

Salinity is one of the factors which determines where animals and plants live in an aquatic habitat. Each organism has its own range of tolerance. Like land animals, aquatic animals must maintain a constant salt concentration in their bodies. For example, fresh water fish have special adaptations allowing them to retain salts and excrete water so that the fresh water does not dilute their body fluids. Marine fish, on the other hand, excrete salts while retaining water so that they do not lose fluids to the salt water around them. Most marine fish cannot tolerate the sudden changes in salinity found in tidepools.

Tidepool plants and animals have developed a variety of behaviors and structures to deal with these changes. Without these adaptations, the increasing salinity would remove water from the tissues of tidepool organisms, in effect, “drying them out.”

Again, the increasing salinity is due to water leaving the tidepool by evaporation. This means that the increase in salinity is usually coupled with an increase in temperature and a decrease in the amount of oxygen available to tidepool animals (warm water holds less oxygen). Other adaptations help tidepool animals and plants face these conditions. Given the seemingly hostile nature of this environment, we might expect a paucity of life. On the contrary, tidepools demonstrate abundant life.

Materials

Part One: Tasting Saltwater

For each group of 2 students:

- one clear container, shoe box size (preferably with straight sides)
- two clear, plastic drinking glasses
- teaspoon measure
- salt*, 2 teaspoonfuls
- tap water
- masking tape

For each student:

- two drinking straws

* Use rock, kosher, sea or canning salt which can be found at your super market or natural food stores. Regular table salt contains an anti-caking compound that causes the water to become cloudy. Prior to beginning this experiment with your class, dissolve a teaspoonful of your salt in a glass of water to check the clarity of the resulting solution.

Part Two: One Step Further

For the class:

- electric light or heating source

For each group of two students:

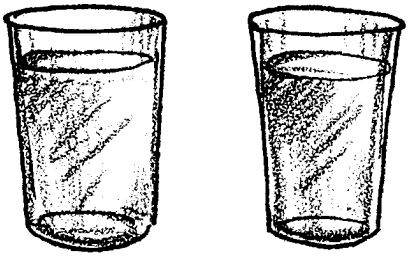
- two pans or dishes**

** Clear plastic petri dishes or similar clear containers work well for "One Step Further." Aluminum pans also work well; avoid white plastic containers.

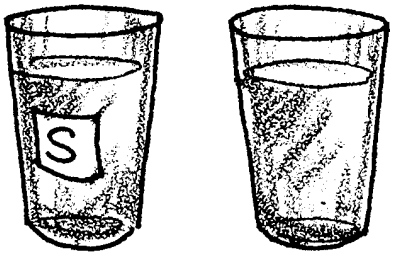
Teaching Hints

Part One: Tasting Saltwater

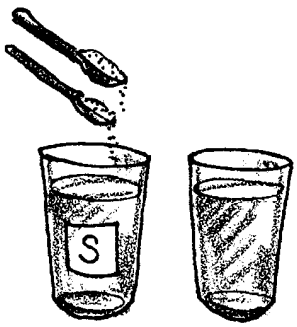
1. Group students as partners. Have each group nearly fill two glasses with tap water. Caution groups to put the same amount of water in each glass.



2. Distribute a piece of masking tape to each team. Have one member of each team write an "S" on the tape and put it on one glass.



3. Have each team add two teaspoons of salt to the glass marked with the "S", stirring well.

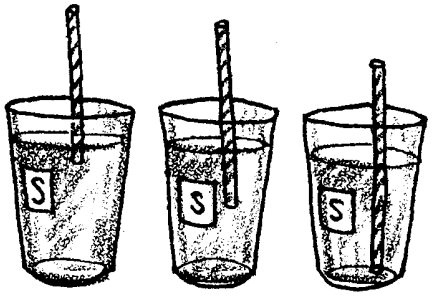


4. Discuss results using questions like:

"What happens to the salt?"
(It disappears or dissolves.)

"Does the water in the two glasses look the same?"
(It will probably look the same. If the salt used contains aluminum silicate or a similar compound added to keep it from caking, the solution may appear cloudy.)

5. Have students taste the water in the glass with the "S" using THEIR OWN straw. Have them taste the water at the top, middle, and bottom.



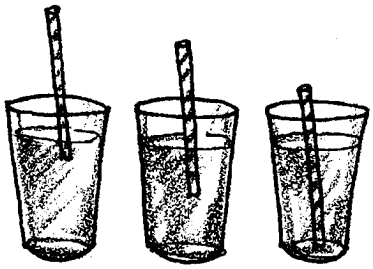
6. Ask:

"How does the water taste?"
(Salty, no doubt.)

"Can you taste salt at the top, in the middle, on the bottom?"
(The expected answer is, yes.)

"Does the water taste the same at the top, in the middle, on the bottom?"
(Depending upon the mixing, the water may taste a little more salty at the bottom of the glass.)

7. Have students taste the water in the unmarked glass using the other straw.



8. Ask:

"How does the water in this glass taste?"

(Hopefully, no salty taste. This glass serves as a control. Any salty taste might have come from the glass or from the water.)

"Does the water taste the same at the top, in the middle, on the bottom?"

(The expected answer is, yes.)

"Does the water in the two glasses taste the same?"

(The water should not taste the same.)

"What makes the waters different?"

(The salt makes the difference, everything else was the same.)

NOTE: The same glasses of water are used in Part 2 of this activity!

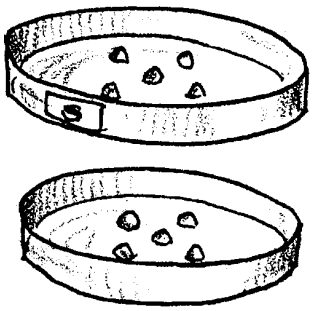
Part Two: One Step Further

The experiment that follows provides for observation of changes in matter as the salt dissolves in the water and is later recrystallized.

1. Demonstrate how to use a straw as a dropper: Place the straw in the water. Cover the top of the straw with your forefinger. Keep your finger over the top of the straw as you move it to the dish. Lift your finger from the top of the straw to drop the water into the dish.

2. Distribute 2 dishes to each team of two students. Have students label one of the dishes with an "S" marked on masking tape. Have one student in the team use a straw to put five drops of saltwater from glass "S" on the dish marked with the "S".

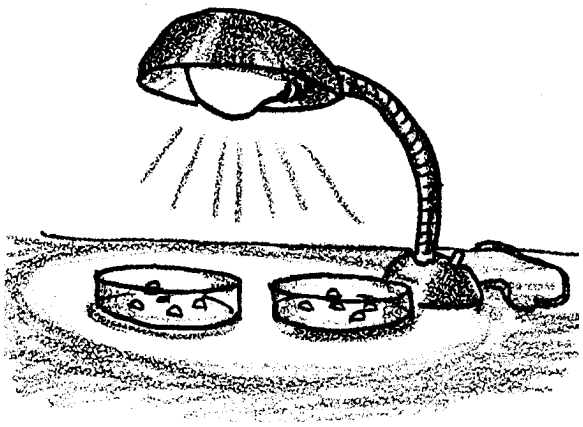
3. Have the other student in the team of two use his or her straw to put five drops of plain water from the unmarked glass on the unmarked dish.



4. Direct students to set the dishes under a light or in a warm place.

SAFETY NOTE: Use caution when using a lamp for a heat source in the presence of water. You may substitute a heater, radiator, or other heat source if it is more convenient than an electric light.

5. Allow adequate time for the water to evaporate. The amount of time will vary with room temperature, etc. You may wish to examine the dishes the following day, or to periodically check the progress.



6. When the water has evaporated, have students observe and discuss the results. Ask:

"What do you see where the drops of water were?"

(Answers will vary depending upon observations, but generally, there are white spots where the water drops were located)

"Are all of the spots the same?"

(No, the five drops from the saltwater will have left a white residue while the other five will have left watermarks or nothing.)

7. Make certain students' hands are clean. Have each team member lick one of her/his fingers to pick up and taste one of the white spots left by the saltwater. Discuss how it tastes. Ask:

"What made the white spots?"
(The water evaporated leaving the salt crystals behind.)

"Have any of you ever seen tidepools at the ocean shore?"
(If no one has seen tidepools, ask if they have seen pictures of tidepools. If they haven't seen pictures, provide a word description.)

"Did you notice white spots on the rocks that made up the tide pool?"
(Answers will vary. Describe the white "bath tub ring" of salt crystals often seen in tidepools on hot days.)

"What do you think those white spots might have been?"
(The spots probably were salt crystals. The intent here is to have students relate their evaporation/recrystallization experiment to conditions in a tidepool.)

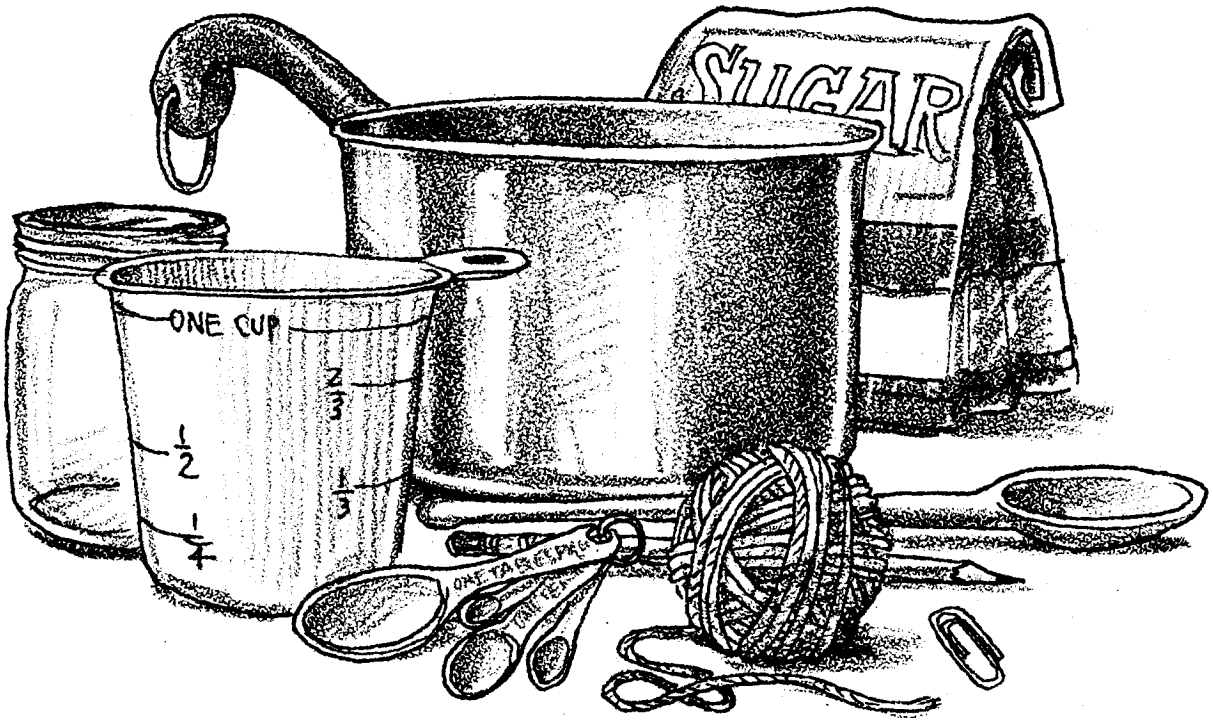
Key Words

crystals - A body that is formed by the solidification of a chemical element, a compound, or a mixture and has a regularly repeating internal arrangement of its atoms and often external plane faces.

dissolve - To separate or disconnect, as when water molecules come between the portions of a salt crystal, separating the parts from one another, and dispersing them within the liquid.

evaporation - The process by which a liquid becomes a gas.

Salty Water– One Step Further
a take home experiment



We have experimented with salt dissolving in water. Salt is not the only thing that will dissolve in water. To help your child learn more about dissolving, evaporation, and crystals, try this experiment.

Here is what you will need:

- measuring cup
- water, 1/2 cup
- small saucepan
- tablespoon
- sugar, 1 cup
- wooden spoon
- small glass jar
- piece of string
- pencil
- paper clip

Here is what your child and you do:

1. Put a 1/2 cup of water in the saucepan.
2. Put a tablespoonful of sugar in the water. Stir.
3. **WITH ADULT HELP**, heat the water slowly.
4. Stir in the rest of the sugar, one tablespoonful at a time, as the water heats.
5. Heat slowly until all of the sugar is dissolved. Keep stirring!
6. Turn up the heat. Heat water to boiling. Boil for one minute while stirring. Remove from heat.
7. Pour the sugar water into the jar. Careful, it is very hot.
8. Tie one end of the string to the paper clip and tie the other end of the string to the pencil.
9. Lay the pencil on top of the jar. Hang the string and paper clip in the solution.

10. Put the jar in a cool spot. Do not touch or move the jar for several days. If you let the crystals grow for a long period (over a week) you will get large pieces of rock candy.
11. Remove the candy and observe the shape of the crystal.
12. Can you do the same thing with salt? Try it!