WRAP-UP

To wrap-up the investigation, bring your students together for a group discussion to help them understand why and how they achieved their results. It is important to share results so that everyone has a clear picture of what happened. To help you facilitate the discussion, review the explanation in "The Why and The How" using the Group Discussion questions as a guide.

GROUP DISCUSSION

Explain to students that scientists learn from each other through discussion, and they build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their experiments, students will now come together as a group to share their results and make conclusions about the investigations they've conducted. Have students record their final results and the explanation in their journals.

Ask students:

- Which water sample do you think came from the ocean, the river and the estuary?
- Did all of the groups get the same results? If not, why do you think this occurred?
- What surprised you?
- What new things did you learn?

man floating in water with high salinity ©Eve Anderson

References

www.epa.gov/bioindicators/aquatic/marine.html
www.onr.navy.mil/Focus/ocean/water/salinity1.htm
www.oceanservice.noaa.gov/education/kits/estuaries/media/supp_estuar10c.html
www.njmsc.org/Education/Lesson_Plans/Salinity.htm
www.epa.gov/owow/estuaries/about1.htm
www.swrcb.ca.gov/nps/docs/cwtguidance/3130fs.pdf
wow.osu.edu/experiments/statesofmatter/psm2/hydrometers.html
www.waterencyclopedia.com/Re-St/Sea-Water-Freezing-of.html
www.msc.ucla.edu/oceanglobe/pdf/densitysalinity/densityentire.pdf
www.saltinstitute.org/11.html

The "Why" and the "How"

There are a number of ways that we can gather information about water's salinity. Conductivity and evaporation were explored in the previous investigation. We can also examine water's density and its freezing point. The saltier a body of water, the denser it is. A hydrometer is used to measure the density of water. Objects will float higher in denser liquids than in less dense liquids. In the hydrometer investigation, the "ocean sample" was both the saltiest and the densest. Therefore, when the hydrometer was placed into this sample it should have floated the highest of the three samples, and had the fewest number of markings below the surface of the water. On the other end of the spectrum, the "river sample" was both the least salty and the least dense. Therefore, when the hydrometer was placed into this sample, it should have floated the lowest, and had the greatest number of markings below the surface of the water.

The salinity of water determines its freezing point, the temperature at which it freezes. The higher the salt content, the lower the temperature needed for the water to freeze. Freshwater freezes at 0 °Celsius (32 °F). However, the freezing point for ocean water can be as low as -2.2 °Celsius (28 °F). The freshwater sample should have frozen first because it had a higher freezing point. The two saltwater samples should have had lower freezing points, with the estuary sample freezing before the ocean sample.

NOTE: The complete data recording table from Lessons 5 and 6 is available in the appendix and in the student journal.

Curriculum Match-Up

- Try painting with colored saltwater and colored freshwater with a paintbrush on two different pieces of construction paper. Observe your results the next day after the water has evaporated.
- Create a bar graph for each group's finding.
- Take pictures of the tests for each sample and make a book or showcase them on the Internet.
- Take a field trip and collect real river, ocean and estuary water samples. Compare your results with the simulation.

This lesson was funded in (whole or part) with federal funds from Title IV, Part B, 21st Century Community Learning Centers program of the No Child Left Behind Act of 2001 awarded to the New Jersey Department of Education.

Water Body Salinities II

Learning Objectives

Students will:

1. Correctly identify local water bodies on a map.
2. Use water samples to compare the salinities of a river, an estuary and an ocean.
3. Test water samples based on density and freezing.

Vocabulary Ventures

biome
brackish
headwater
ocean
saltwater
river
freshwater
estuary
freezing point
conductivity
evaporation
hydrometer
salinity

NOTE: This introduction is repeated from Lesson 5, Water Detectives I.

Different bodies of water make up the freshwater and marine (saltwater) regions in the aquatic **biome.** A biome is a large **ecosystem** (such as a desert or an ocean) with specific types of plants and animals that have adjusted, or adapted, to the conditions in their environment. Water found in freshwater and saltwater regions contains varying amounts of salt. Salinity is the amount of dissolved salts found in water. Saltwater is mostly made of water (H_2O) and the dissolved salts sodium (Na) and chloride (Cl).

An **ocean** is a large body of saltwater. Oceans make up approximately 70% of the water on Earth. Our planet actually has one ocean -- the World Ocean -- that is divided into five smaller ocean basins: Atlantic, Pacific, Indian, Arctic and Southern. The Atlantic Ocean borders the New Jersey coastline.

Salinity is calculated as the amount of salt (in grams) dissolved in 1,000 grams (1 kilogram) of seawater. Salinity is often expressed as "parts per thousand" (ppt). The average salinity level of the ocean is 35 parts per thousand, which means that about 3.5% of the seawater is dissolved salt. Ocean salinity can range from approximately 32 – 37 ppt.

marine water body

A river is a large flowing body of **freshwater** that typically empties into an ocean. A river's source may be a spring, a lake, or a series of small streams, known as **headwaters.** There are several rivers in New Jersey, including the Raritan River, the Hackensack River and Toms River. (See enclosed map.) The water found in rivers tends to range in salinity from 0 - 3 ppt.

Estuaries are bodies of water that are partially surrounded by land, and where freshwater from rivers meets with saltwater from the ocean. In an estuary, the salty water from the ocean mixes with freshwater from rivers to form a layer of **brackish** water. Estuarine water has a salinity between 0 - 30 ppt. The salinity of an estuary can vary depending on a number of factors, including the tides and the amount of freshwater runoff. Areas of the estuary closest to the freshwater source typically have a lower concentration of salt, while the waters nearest the ocean have a much higher concentration of salt.

Time Needed to Conduct Investigation

This investigation has two parts.

Organize and set up materials: 15 minutes
Introduce the lesson: 5 - 10 minutes
Conduct the investigation: 45 - 55 minutes over several days
Student journaling/group reflection: 15 minutes over several days
Total estimated time: 75 - 95 minutes over several days

Investigation: Water Detectives II

Materials

For groups of four
Student journals and writing tools

Preparation
- Three 1000 mL graduated cylinders or 2-liter soda bottles
- Distilled water
- Kosher salt
- Balance

Part 1
- Plasticine or clay
- Drinking straw, clear
- Ruler
- Permanent marker
- Tap water
- Four 16 oz clear plastic cups
- Small nails or steel shot to fit inside straw
- 375 mL (1 ½ cups) of water samples #1, #2 & #3
- Paper towels
- Optional Hydrometer Lab Kit from sciencekit.com

Part 2
- 250 mL (½ cup) of water samples #1, #2 & #3
- Plastic ice cube tray
- Freezer
- Thermometers
- Real hydrometer, optional

Continued from Water Detectives I

Preparation:
Gather all materials prior to the start of the activity. Label the 1000 mL graduated cylinders #1, #2 and #3, and fill each cylinder with 1000 mL (4 cups) of distilled water. In cylinder #1, mix 35 g (2 tablespoons + 1 teaspoon) of Kosher salt. This is your "ocean" sample. In graduated cylinder #2, mix 17 g (1 tablespoons + 1/2 teaspoon) of Kosher salt. This is your "estuary" sample. Graduated cylinder #3 will serve as your "river" sample (no salt).

TIP
You may need to make multiple batches of the samples depending on the number of students in your group. You will need to make fresh solutions for each of these two investigations unless they are being done on the same day.

Part 1
Making a Hydrometer

Review with students what they learned in Water Detectives I. Explain to students that they will continue conducting experiments to identify each water sample.

Inform students that they are going to create hydrometers. Hydrometers measure the density of a liquid.

BRAINSTORM
Ask students to brainstorm what they know about density:
- What is density?
- What clues does the density of water tell us about its salinity?

Answer: Density is how much stuff is packed into a certain amount of space. In this investigation, density is a measure of how much salt is packed into a container of water.

PREDICT

Invite students to record the following prediction in their journals:
- Based on our previous tests, can you predict which water sample will have the greatest density? The least? Why do you think so?

PROCEDURE

1. Students should press a small ball of clay the size of a marble into one end of a straw to form a plug.
2. Starting at the top of the straw, students should draw horizontal lines with a permanent marker down the length of the straw at 1 cm intervals.
3. They should then half-fill one of the cups with tap water.
4. Students should put the straw hydrometer clay-end down into the tap water.
5. They should remove or add clay until the hydrometer floats without touching the bottom of the cup.


hydrometer set-up

TIP
If the hydrometer is not floating upright, add two or three small nails or steel shot to the straw.

OBSERVE

After they have created their hydrometers, students can use them to test each of the water samples in the other three plastic cups. After placing the hydrometer clay side down into a sample, students should count the number of markings below the surface of the water. The fewer the number of marks below the surface (or the higher the straw floats), the greater the density (and salinity) of the water.

TIP
Students should dry their hydrometers with a paper towel between each sample test so their results are not affected by the previous sample.

Students should make the following observations and record findings in their journals. Ask students:
- Which water sample had the greatest density? The least?
- Which sample had the greatest salinity? The least?
- Did all groups get the same results? If not, why do you think that is?

Part 2
Freezing Point

Invite students to think about what happens to a freshwater lake versus an ocean when the weather gets very cold. Ask students:
- What happens to water when it gets cold?
- What does this have to do with the water cycle?
- At what temperature does freshwater freeze? *Answer: Freshwater freezes at 32 °F (0 °C).*
- Do you think that there is a difference between how saltwater freezes and how freshwater freezes?

PROCEDURE

1. Have students label three sections of a plastic ice cube tray: #1, #2 and #3.
2. They should then fill each section with the appropriate water sample.
3. Place the trays in the freezer.

OBSERVE

Ask students to make observations and record the temperature of each water sample after 1 hour, 24 hours and 48 hours in their journals. Temperature readings should only be taken for liquid water in the ice cube tray. If no liquid water is present, students should record this result in their journals.

TIP
If your program does not meet daily, take photos of the trays at these intervals and share them with students after they have completed the set-up.

Ask students:
- Which water samples experienced some freezing?
- Which sample froze first?
- Did you notice any layering of ice and water? Draw what you see in your journals.
- What is the texture of the water samples after being in the freezer?

Discuss with students that the salinity of a body of water determines its freezing point -- the temperature at which water freezes.

Ask students:
- Based on our investigation, which water sample do you think has the greatest salinity? The least?
- What does this investigation tell you about how icebergs form?