PROCEDURE

1. Have students fill three separate cups with 60 mL (1/4 cup) of each of the three water samples.
2. Next, have students label the samples, 1, 2, 3.
3. Students should mark the water level on each cup with the marker.
4. Next, they should place the cups on a sunny windowsill.

PREDICT

Ask students to predict what they think will happen if they leave the three cups out overnight.

- What will happen to the water?
- Do you think there will be a difference in the results of each sample?
- Will there be anything left over besides water in any of the cups?
- What will happen after two days? One week?
- How long do you think it will take for the water to evaporate completely?

OBSERVE

Have students check the water samples daily, or after 24 hours, 48 hours and one week. They can mark the water level on their cup at each interval. Have students observe and record the following observations:

- How much water evaporated after each time interval? Ask students to draw what they observe in their journals.
- Do you notice anything left behind from any of the samples? What does that tell you about the water?

Discuss with students how dissolved salts form solid crystals and get left behind when the water in saltwater evaporates. Ask students:

- Which sample(s) do you think were freshwater?
- Which were saltwater?
- Which sample had the most dissolved substances in it? Which were saltwater?

Note: Inform students that they will be continuing this investigation in Water Detectives II.

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.

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NASA

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:

- What were the results of your experiments?
- What new things did you learn?
- Do you think you know which water sample is which?
- What surprised you?
- What new questions do you have?

The "Why" and the "How"

There are a number of ways that we can gather information about water salinity, including testing for conductivity and for evaporation. Conductivity is the ability of a material to conduct, or carry, an electrical current. Pure freshwater is a poor conductor of electricity. The higher the amount of dissolved salt in water, the better it conducts electricity. In this investigation, the dissolved salt in the "ocean" and "estuarine" samples conducted electricity and completed the circuit to light the bulb or ring the buzzer. A circuit is a path or route on which an electric current travels.

As saltwater evaporates, the water turns to vapor, but any dissolved substances such as salt get left behind. The "ocean" and "estuarine" samples will evaporate and leave behind salt crystals. Since freshwater contains little-to-no dissolved salts, there should be few or no crystals left behind after the water in the "river" sample evaporates.

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 on two different pieces of construction paper. Observe your results after the water has evaporated.
- Take a field trip and collect real river, ocean and estuary water samples. Repeat the investigations and compare your results with this lesson.

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Water Body Salinities I

Learning Objectives

Students will:

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

Vocabulary Ventures

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

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 testing in a wetland

NJ water bodies (see Appendix)

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.

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 three parts.

Organize and set up materials: 15 minutes
Introduce the lesson: 15 – 20 minutes
Conduct the investigation: 45 – 55 minutes over several days
Student journaling/group reflection: 15 – 20 minutes over several days
Total estimated time: 95 - 110 minutes over several days

Investigation: Water Detectives I

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
- Roll of insulated wire
- Wire stripper

Part 1
- Large map: NJ water bodies (See Appendix) *or your program's state
- Individual outline maps of NJ
- Colored pencils

Part 2
- 250 mL (1 cup) of water samples #1, #2 & #3
- Three 16 oz plastic cups
- 9-volt battery
- Small light bulb or buzzer with 2 insulated wires attached
- Masking tape or alligator clips
- One 12-inch length of insulated wire (ends stripped)
- Two Popsicle or craft sticks
- Aluminum foil

Part 3
- 60 mL (1/4 cup) of water samples #1, #2 & #3
- Three 9 oz plastic cups
- Permanent marker

TIP
Use a 1-liter water bottle to measure 1000 mL (4 cups) of water into a 2-liter colorless soda bottle if graduated cylinders are not available. This lesson will be continued in Water Detectives II. You will need to make fresh solutions for each of these lessons, unless they are done on the same day.

Part 1
Oceans, Rivers and Estuaries

GET READY!

In this two-part investigation, students will conduct experiments using samples from different bodies of water to learn about salinity.

BRAINSTORM
Ask students to brainstorm what they know about oceans, rivers and estuaries. Make a list of their ideas on a flipchart or chalkboard. Students can record their ideas in their student journals.
Ask students:
- How are they similar? How are they different?
- How does the water move in each?
- Do you know of any examples in our area? Where are they located?
- What is the salinity of the water like in each?

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). Use the wire stripper to cut and strip one 12-inch length of wire for each group.

PROCEDURE

1. Review the property of water known as salinity. Discuss the differences in salinities between oceans, rivers and estuaries.
2. Explain to students that you recently collected three water samples, one from the Raritan River, one from the Hudson River Estuary and one from the Atlantic Ocean. *Feel free to substitute names of oceans, estuaries or rivers close to the location of your program.*
3. Show students where these bodies of water are located on the large map of NJ (or your program's state).
4. Have students label these bodies of water on their small maps.
5. Students should create a key on their maps for the salinities of river water (0 - 3 ppt), estuarine water (0 – 30 ppt) and ocean water (32 - 37 ppt), assigning a different color to each.
6. Students should then color each of the three bodies of water with the appropriate salinity color from the key.
7. Explain to students that you need their help solving a problem. The problem is that the three water samples got mixed up before you could label them. Inform students that they will conduct a series of tests on the salinity of the water samples to try to identify the samples from each body of water.

TIP
Do not tell the students what is in each of the three containers. They will discover this information through their tests.

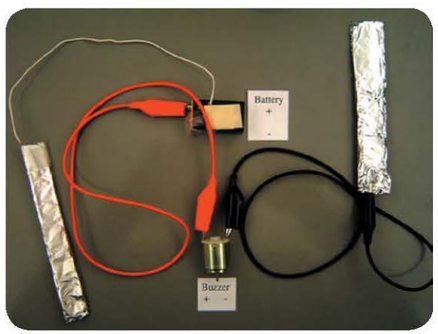
Part 2
Conductivity

Share with students that there are different ways to determine the salinity of water. One way is by measuring its conductivity. Conductivity refers to how well a material conducts or carries an electrical current.

Explain to students that they will create an electrical circuit, a device that creates a path for electricity to follow. Students will test each water sample to see if any of the samples can complete the electrical circuit by lighting the bulb or ringing the buzzer.

PROCEDURE

1. Students should wrap their popsicle sticks in aluminum foil.
2. Next, have students tape or clip the red wire of the light bulb or buzzer to the positive end of the battery. (On a 9V battery the positive and negative symbols can be found on the sides.)
3. Students should then tape or clip one foil-covered popsicle stick to the black wire of the bulb or buzzer.
4. Students should tape the other foil-covered popsicle stick to one end of the 12-inch length of insulated wire.
5. Next, have students tape the end of the other 12-inch length of wire to the negative end of the battery. (It can also be clipped directly to the battery.)
6. Students can check to see if their circuits are complete by touching the foil-wrapped popsicle sticks together. (If the circuit is complete, the bulb will light or the buzzer will ring.)
7. Students should then half-fill each separate plastic cup with the water samples and label them 1, 2, 3.



conductivity set-up

PREDICT

Students should record their predictions in their student journals. Ask students:
- Do you think any of the solutions will conduct electricity? Why do you think so?

To test each water sample, students should place both popsicle sticks into the first water sample. Students should not touch the sticks together in the water as this will alter their results. They should then repeat these steps with the other two water samples.

TIP
The popsicle sticks should be dried off between each test toensure that residual salt on the popsicle sticks does not affect the tests. Students should make sure their circuits still work between each test by touching the sticks together.

OBSERVE

Students should make and record their observations in their student journals. Ask students:
- Which solution was the best conductor of electricity? The worst?
- How did you come to that conclusion?

Discuss with students the relationship between salinity and conductivity. Share that conductivity is a good way to tell if salts are dissolved in a water sample. Ask students:
- Based on our discussion, which solution do you think had the greatest salinity?
- Which solution has the lowest salinity?

Part 3
Evaporation

Explain to students that they will do an additional experiment to identify the origin of each water sample.

BRAINSTORM
Ask students:
- What happens over time when water is left out in the open?
- How does this relate to the water cycle?
- Do you think that there is a difference in what happens to saltwater and freshwater as they evaporate?
- How do you think evaporation can give us clues about water's salinity?

Review the concept of evaporation with students. Evaporation occurs when liquid water turns into water vapor (a gas).