# Mystery Marsh Water

**Grade Level**

5th-12th

**Objectives**

* To examine different solutions and to classify them by density.

* To develop skills in making inferences based on observations.

**N.C. Standard Course of Study**

Grade 8
(8.E.1.4)

Environmental/ Earth Science
(EEn.2.4.2)

**Overview:**

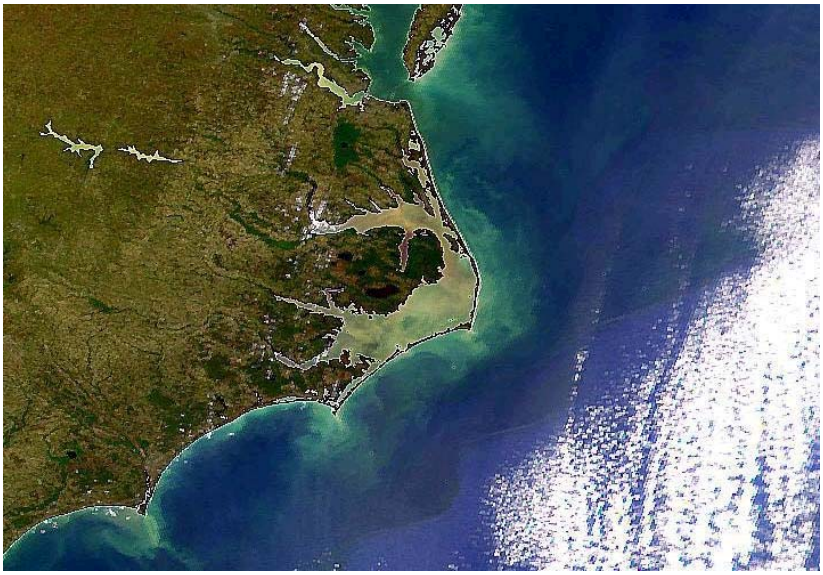
In this activity students will explore density (weight per unit volume or weight for the same amount) of several different salt solutions. The solutions demonstrate the changes in salinity that occur as freshwater streams enter the salty ocean.

**Materials:**

- Clear drinking straws: 12 2-3 inch pieces PLUS one uncut per group
- Modeling clay
- 4-5 shallow trays (1 for each group)
- Pipettes or medicine droppers
- Small cups
- Food coloring
- Kosher salt
- Four empty plastic bottles (soda or water bottles)
- Data sheet (provided)

**Background:**

Estuaries are places where the rivers meet the ocean. In North Carolina, the land slopes gradually to the sea, so incoming tides can push salt water miles inland or large rain events can push freshwater out into the ocean.



Water by itself has a specific density. Density is the mass per unit volume of a substance or weight for the same amount. Many things can change the density of water, such as temperature and salt.

Ocean water has dissolved salts (mostly NaCl, table salt) that make the water salty to taste. Salt is more dense than water, so when combined, salt water is more dense than fresh water. When salt water is gently mixed with fresh water (during the tide rising), salt water will slide under the upper fresh water because it is denser (heavier).

The salinity of ocean water is measured as parts per thousand or ‰. Ocean water averages about 35‰. Humans, on average, can taste the saltiness of water that is greater than 8-10‰ salt.

**Activity:**

**To prepare ahead of time**
Combine salt and food coloring in plastic bottles. Fill up with warm water and stir/shake to dissolve the salt.

Bottle 1: Red food coloring and 15 teaspoons salt
Bottle 2: Green food coloring and 10 teaspoons salt
Bottle 3: Blue food coloring and 5 teaspoons salt
Bottle 4: No food coloring and no salt

**Set the Stage** *(share with students)*

A team of scientists collected a series of water samples from a freshwater stream, a tidal creek, the sound and the ocean. The team was interested in studying the salinity or saltiness of the water. On the way back to the laboratory, the labels came off the samples. Can you figure out which sample came from the stream, the tidal creek, the sound and the ocean?

One difference in the water samples is density. Density is the weight per unit volume or weight for the same amount. The salty ocean water would be denser than the fresh water because it has more salt.

Because the water samples are not clean, we will not taste them. One way we can investigate the density of these samples is to see which water samples mix, and which samples layer one on top of the other. The densest has the greatest saltiness. Which water sample would be the least dense?

Food coloring has been added to help you see the different water samples. By placing drops of the unknown solutions into clear drinking straws, we can see which layers mix and which layers do not easily mix.

*(Pre-Activity discussion questions)*

- Where would you expect to find the densest water?
- Does the change in tide change the salinity? Why?
- How does weather affect salinity?
- How would the density of the marsh water change if a heavy rain occurred?

- If you had a boat that was less dense than water would you expect it to float or sink?
- Is it easier to float in a freshwater pond or in the ocean? Why?

Directions

Provide each group of 2-4 students with:

1. Twelve 2-3 inch straw test tubes.
2. One uncut straw (regular straw length).
3. A small cup of each sample with a pipette for each sample (remember, no labels!).
4. Modeling clay and shallow tray
5. Data sheet.

Make your test tube holder by pressing the clay in shallow tray and sticking test tubes into the clay.

Complete the exercise on the data sheet.

**Discussion questions:**

1. Does the change in tide change the salinity?
2. How does weather affect salinity?
3. How would the density of the marsh water change if a heavy rain occurred?
4. If you had a boat that was less dense than water would you expect it to float or sink?
5. Is it easier to float in a freshwater pond or in the ocean? Why?
6. What are some animals that live in more than one of the sample areas?
7. Does the salinity in the sound change? When/why?
8. When might the ocean salinity be different?

**Extension:**

1. If you can take a coastal field trip, use a refractometer or salinity test kit to measure the salinity of water at various locations along the estuary and on the beach. Discuss how tides affect the salinity of the estuary.

2. Research the definition of osmoconformers and osmoregulators and determine if we have any of these animals on our coast.

*Hint: Blue crabs and oysters are good examples.*

**Vocabulary:**

- Density
- Liquid
- Salinity
- Saltiness
- Sample
- Solution
- Tidal creek

**References:**

Duxbury, A. & A. Duxbury. 1991. An Introduction to the World's Oceans (3rd Ed.). WM. C. Brown, Dubuque, IA. 446 pgs. (ISBN: 0-697-09765-X)

**National Science Standards:**

| | |
|---|---|
| *Contents Standards* | *Science as inquiry. [K-4] [5-8] [9-12]* |
| | *Physical Science. [K-4] [5-8] [9-12]* |
| | *Earth and Space Science. [K-4] [5-8] [9-12]* |

**Ocean Literacy Principles:**

| | |
|---|---|
| *Essential Principle #1.* | *The Earth has one big ocean with many features. (Fundamental Concepts - e, g)* |

*Discussion questions: Teacher page*

1. Does the change in tide change the salinity?
   *Yes. Incoming tides carry salty water inland; outgoing tides allow more fresh water from rivers to flow seaward.*

2. How does weather affect salinity?
   *Rain can decrease salinity. Wind can mix everything up and cause a more uniform salinity in the sounds and tidal creeks.*

3. How would the density of the marsh water change if a heavy rain occurred?
   *It would decrease.*

4. If you had a boat that was less dense than water would you expect it to float or sink?
   *Float.*

5. Is it easier to float in a freshwater pond or in the ocean? Why?
   *Ocean. Salt water is dense; so many things (that are less dense) float on top of salt water, including people. (Some students may say pools because of lack of waves).*

6. What are some animals that live in more than one of the sample areas?
   *Blue crabs, bull sharks, menhaden fish, and eels are just some examples. For an extension, students could study to find more animals that live in more than one sample area.*

7. Does the salinity in the sound change? When/why?
   *Salinity changes with tides: Incoming tides will bring ocean water and make the water more salty, outgoing tides will allow more fresh water to flow towards the ocean.*

8. When might the ocean salinity be different?
   *Sudden rain or a storm will add fresh water and reduce salinity. Large rivers such as the Mississippi and the Amazon push fresh water far into the ocean.*

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**Mystery Marsh Water datasheet**

Part 1: Experiment

Test each of the combinations of water samples to see which water sample is the most dense and which is the least dense. Add 10 drops of each colored water sample to the straw "test tube" following the chart below.

Put a circle around those sample pairs that layered. ◯

Place an x on those samples that mixed. X

| | **Test tube 1** | **Test tube 2** | **Test tube 3** | **Test tube 4** | **Test tube 5** | **Test tube 6** |
|---|---|---|---|---|---|---|
| **Drop 2nd** | Blue | Blue | Blue | Clear | Clear | Clear |
| **Drop 1st** | Green | Red | Clear | Blue | Red | Green |

| | **Test tube 7** | **Test tube 8** | **Test tube 9** | **Test tube 10** | **Test tube 11** | **Test tube 12** |
|---|---|---|---|---|---|---|
| **Drop 2nd** | Red | Red | Red | Green | Green | Green |
| **Drop 1st** | Blue | Clear | Green | Blue | Clear | Red |

Part 2: Test your results

Place one end of your large clear straw into the clay. Based on your results in part 2, layer all 4 unknown samples in the straw. Indicate location in the straw and location of the sample (freshwater stream, a tidal creek, the sound, and ocean).

| | **color** | **location** |
|---|---|---|
| Top sample (least dense) | | |
| Next to top | | |
| Next to bottom | | |
| Bottom sample (most dense) | | |