

**9/18/09**

## **Where the River Meets the Sea**

### **Activity Description**

This activity shows students how the different densities of fresh and salt water allow for the water to be able to be stacked on top of each other. It also talks about the stratification and what things can change stratification.

### **Take Home Message**

Students should understand that freshwater floats on top of saltwater. This means our drinking water in the wells is floating on top of salt water and if we pump our wells too much we will bring salt water into the well and contaminate it. Also students should understand that there are places where salt and fresh water mix, i.e. estuaries and herring runs.

### **Massachusetts Frameworks**

Physical Science

Properties of Matter #2

### **Supplies**

- Flat bottom glass tubes, 20 ml size
- Pipettes
- Salt
- Ice
- Source for hot water, electric kettle
- Mixing spoon
- 4 Tupperware containers for mixing
- Smaller containers or cups for samples (8)
- Food coloring, 4 colors
- Sponges
- Salt Wedge Estuary Picture
- Density bottle



### **Set-up**

1. Set out four Tupperware containers on the table and add the following
  - i. Container 1 – 1 1/4 cups salt per quart of ice cold water
    1. You can use tap water and then get ice from edible aquifer to make it really cold
    2. This represents the bottom of the ocean
  - ii. Container 2 – 1/2 cup salt per quart of cool water
    1. You can run the tap water until it is cold and put a little bit of ice, a considerable amount less than in container 1
  - iii. Container 3 – 2 tablespoons of salt per quart of room temperature water
    1. You can get the water out of the tap, no ice needed
  - iv. Container 4 – no salt and hot water
    1. You can get the water from the electric tea kettle, you will want to add this shortly before the kids arrive, try not to make it too hot to burn. If it feels like it is, then just add some room temperature water to cool it down a little bit.
    2. This represents the water that is found on the top layer of the ocean and mixing in from the streams

2. Put a different color of food coloring into each of the containers to tell them apart and mix the salt in well. You don't want the kids figuring it out because you didn't dissolve the salt.
3. Put 8 cups in front of the containers and a long paper towel in front of the cups
4. Place one vial for each student on the paper towel
5. When the students are ready to do the activity, transfer some of the mixtures into the cups so that the kids are only sharing a cup with 1 or 2 other people. It decreases the mess.
6. There should be a pitcher that you can use for clean room temperature water as well as a larger Tupperware container. This container is for the kids to discharge their vials after finishing or when they mess up. You should make it through a session with just the one discharge bucket and the mixtures you made up.

**Note – The bigger the temperature and salt differences, the better results the students will get.**



### Activity Procedure/Script

- **Begin by asking the students if they know what happens when rivers meet the sea.**
  - They will give you all sorts of answers, but you are looking for that they mix together.
  - You can prod them some more by asking how they think they mix.
  - They can be well mixed when the wind is at higher speeds but they will stack on top of each other due to differences.
- **Ask the students what they think may cause the differences between the water from the sea and the water from a river.**
  - There are a variety of answers but you want the kids to say that they are different temperatures, that there is salt in saltwater and no salt or little salt in freshwater.
  - Try to get the students to say that they fresh and salt water will weigh different amounts.
- **Ask the students if they think fresh and salt water weigh the same.**
  - You want them to say they have different weights.
  - Try to have them say it is because the salt makes salt water heavier
- **At this point pull out the density bottle (oil and water mixed in 2-liter soda bottle) and ask why they think the two are not mixing.**
  - You can explain that they have a difference in density, which is the mass per volume.

- When something weighs more it has a different density because by weighing more it has more mass per volume.
- **Ask the students which water they expect to float when fresh and salt water mix together.**
  - They should say the saltwater will sink because it weighs more.
- **Ask the students what happens to water that sinks to the bottom, do they think it will be warmer or colder than the water at the surface?**
  - You are expecting the students to say colder water will be at the bottom.
  - Here you can explain that because not as much sun can get through, the water at the bottom of the ocean or sea is very cold and the water in rivers and streams is much warmer because it is closer to the sun.
  - So here you can make the connection for them that the water that comes from the sea is going to go towards the bottom and the water from the rivers is going to be on top.
- **Ask the students if they know of any places on Cape Cod where this happens, where the water stacks on top of each other.**
  - One unique place is an estuary, particularly Waquoit Bay.
  - You can use the Salt Wedge Estuary picture to show how the water comes together. It is important to point out that the fresh water comes in on top and the salt water comes in on the bottom, but there are layers in between.
  - You should explain to the kids that some mixing does occur where they two meet, so you get a gradient difference in temperature and salt content through the estuary.
- **Ask the students if they can think of any reasons why it is important to have estuaries.**
  - You want them to see that they are homes to many different species and the breeding ground for many others.
- Now it is time to point out the colors in front of you. You can make up some type of story to about how you have no idea what is the containers. You know some are hot and some are cold and you need their help in determining the layers of the mini estuary they are going to build.
- **Ask each student to take a pipette and chose their favorite color to put into their vile.**
  - This is a great time to review how to use a pipette or teach the students if they are struggling
- **Next ask the students to tip the vials on a 45° angle and slowly add the next color of their choice to the mixture.**
  - It is really important for you to be demonstrating what they have to do here.
  - Most of them will mess it up the first couple of times they try.
  - Have the students stop after the 2<sup>nd</sup> color is added .
- **Ask the students what is happening.**
  - You are hoping it is working for someone.
  - You want them to tell you that the colors are separating.
  - Ask them what they can tell you about the two colors they have , you are looking for one is warmer and saltier
  - Also ask them why, trying to get them to say they have different densities. Try to reinforce this a number of times.
- **Ask the students to add a third color while keeping their vials tilted.**
  - Tilting the vials gives the best results and limits the amount of mixing.
  - You will find that some students will struggle. Tell them to dump the vial in the dump bucket and start over. You should have them start over if you can see a color separation, especially after adding 3 colors.
- **Ask the students to hold up their vials. Ask the student with the best separation to tell you what the layers in their mini-estuaries are.**

- Make sure to reinforce the idea of density differences and temperature differences, which is salt water from the ocean, freshwater from the river, and the mixed layers in between.
- You can have the students dump all their vials into the dump bucket and quickly review.
  - Density is mass per volume and when there is a difference in density they will float on top of each other like the salt and fresh water in an estuary.
  - Also mention again that estuaries are important habitats and breeding grounds for many different aquatic life species.
  - Also mention that cold water can hold the most dissolved oxygen, or oxygen in water and so many fish like the lower levels of the oceans and estuaries.



## **Clean – Up**

### *During the festival*

- You will have to flip the vials upside down and dry them out as best as possible, making sure to remove the salt that may have gotten in the vials.
- Check to make sure the small cups are full of the different colors and you can check on the temperature differences. If their seems to be only a small difference, you can add some ice or hot water to improve the differences
- If you found that the experiment wasn't working to well, you may also want to increase the salt differences or just start from scratch.

### *After the festival*

- You will need to completely clean out the vials and dry them thoroughly. You also need to empty all the water down the drain. It works best if you can get it all into one or two containers or if you can dump it all into a bucket to bring to the bathroom. Everything is safe to dump down the drain!
- Make sure everything is dry and stacked neatly back in the container.
- Fill out the inventory sheet as accurately as possible. Return all materials to the correct locations and stack the box near the door.
- You may be one of the last ones done, but if not, help other people by moving containers, mopping or sweeping the floor or by loading the cars.