AT SEA: INVESTIGATING SOME OCEAN DYNAMICS

About three-quarters of the Earth’s surface are covered by water in the form of oceans. These giant bodies of water have fascinated and intimidated people for as long as we know. What makes them the dynamic systems that they are?

Let’s explore!

Before you begin, stop and list any static and dynamic properties of oceans that you know from experience or previous study. Indicate a possible cause for each property.

Activity 1: Watch Those Winds!

Recall what you investigated about air movement in the atmosphere.

Do winds always blow in the same direction? Explain.

Are there large scale atmospheric currents that cause particles in the atmosphere to move in one direction or another? Explain.

You probably recall that in the northern and southern hemispheres, air masses in the mid-latitudes move from west to east (since the winds come from the west they are called westerly). In the polar and equatorial regions of both hemispheres, the prevailing winds move from east to west.

Do these winds have an effect on the ocean currents in the Atlantic Ocean? Explain.
1. Get a large plastic container and fill it half-way with water. Obtain 2 drinking straws and 10-15 paper circles (from a hole punch). Designate two members of your group as “wind generators” and the rest of the group as observers.

2. Place the circles on the water carefully in one corner as shown in the diagram here.

3. Position two people with straws as shown in the diagram.

4. **Predict** what will happen as the two people (wind generators) blow air through the straws over the top of the water. Write or draw the prediction here.

From what you know of winds, can these two wind generators be in the same atmospheric cell? Explain.

5. Now each wind generator should blow continuously for 1-2 minutes. Be sure to keep the straws parallel to the water not angled toward the water. The observers should watch and record what happens in the box below (which represents the water container). Use one color pencil to illustrate wind direction and another color to show water movement.

6. Repeat the experiment with: 1) stronger winds; and, 2) winds that are not balanced in both directions. Indicate how the results were the same and different.
7. Repeat the experiment with winds from only one direction. You may want to enlist both wind generators on the same side to boost the wind power. Start the paper circles in the middle at one edge. Describe what happens.

Surface ocean currents that are generated by the frictional dragging of air from the prevailing winds over the water are called drift currents. The Gulf Stream is a drift current.

8. We know from the history of the 18th century that ships crossing the Atlantic were able to make the trip from the colonies in America to England in two weeks less time than the time required to go from England to America. Why?

9. Think about the experiment where the wind was blowing from only one direction. What happened to the water movement as it hit the end of the container? What do you think this end of the container might represent on Earth?

Based on your observations, is it possible to have currents that flow in both directions in the same hemisphere? Explain.
Activity 2: Does Density Matter?

Is it easier to float in a pool filled with tap water or in the ocean? Why?

Let’s explore how liquids of different densities behave and how this might affect ocean dynamics.

1. Obtain two 400 mL beakers and place 250 mL of tap water into each.

2. Take a 150 mL beaker and add 25 mL of tap water and 2 drops of blue food coloring. Mix well. To a second beaker add 25 mL of water, one teaspoon of table salt, and 2 drops of green food coloring.

3. Fill a medicine dropper with the blue colored tap water. Place the medicine dropper against the inside of one of the 400 mL beakers just above the water surface. Very gently release the colored water by slowly squeezing the bulb. Repeat the process several times.

Describe what happens with the two different water samples.

4. Repeat what you did in #3 but use the green, salty water instead.

Does the same thing happen with the salty water sample? Why or why not?

If fresh water flowed into an ocean or salty bay, where would the fresh water go first?

Could a difference in density set up a current? Explain.
Activity 3: The Hot and Cold of It

Observe the demonstration that the instructor will set up. Draw a diagram of the equipment and label the contents of each container below when the demonstration begins.

What is in the main part of the larger container?

What is in the flask at the start of the demonstration?

Explain what happens as the flask is placed in the larger container.

Why do you think this is happening?
The experiment with the colored, salty water and temperature demonstration show the development of a **density current**. The salty water is denser than the tap water (fresh water) and so it sinks. In the process, it can generate vertical movement that can result in a vertical current. Water expands when it heats up and so less mass is in the same volume for hot water compared to cold water. As a result, hot or warm water is less dense than cold water. The hotter water rises while the colder water sinks. This process also generates a density current.