

SMS-303: Integrative marine sciences III.

Lab 3, Mixing.

Stations and activities:

I. Convective mixing:

You have two tanks. In one you have two heating elements one near the surface and one at the bottom.

Q: Which do you expect to cause the most mixing through entrainment of adjacent waters? What oceanic process can these setups represent?

Plug both heating element and use food coloring to trace the waters.

In the other tank float a colored ice chunk.

Q: Which of the two heating elements is it a close analogue of? Observe the circulation and speculate where in the oceans does such a circulation takes place.

II. Kelvin-Helmholz billows:

In a long skinny cylinder you have water overlaid by mineral baby oil. You are about to lift one side (the right one) and observe what happens at the interface between two fluids flowing in opposite directions (why do will they flow in opposite direction?).

Q: What do you think will happen at the interface between the two fluids?

Lift the right side 10-20cm above the table and observe the interface.

Q: Why don't the two fluids mix?

III. Mixing of dyed water:

Fill a small rectangular tank with water from the tap. Put a divider between both sides of the tank and put 4 drops of green food coloring in one side and 4 drops of yellow food coloring at the other side. Mix each side and wait until the fluid is at rest.

Q: What will happen when you raise the barrier between the two sides?

Raise slowly the barrier and observe what happens. Write carefully the time when you opened the barrier on the tank and come periodically to observe the evolution of the fluid.

IV. Diffusion of momentum:

You have two round vessels full of water one of which is on a rotating table.

Q: How will the fluid react when you start/stop the rotating tank?

Q: Assuming a fluid is in solid body rotation (rotates at the same rate as the rotating table), how will lateral mixing be affected?

Use dye to check your answers. Compare the rotating and non-rotating tanks. Use the ping pong ball to determine how fast the fluid is rotating.

V. Wind mixing:

You have two tanks filled with water and a hair dryer. One tank is stratified the other is not.

Q: How can you use the food dye to determine which is stratified?

Q: How different will the mixing be in the stratified tank compared with the non-stratified one?

Perform the experiment and explain the observations. **BE VERY CAREFUL NOT TO INSERT THE HAIR DRYER IN THE WATER.**

Homework:

You are hired by a consulting firm to study a lake in Maine which is 50m deep and 1km wide and where contaminants have been disposed off. The questions that follow are based on the mixing processes you studied in the class and lab.

1. What mixing processes that may disperse the pollutant will you take into account and why?
2. Which mixing processes will dominate the different seasons?

I encourage you to study relevant material regarding the annual cycle in lakes in the library or on the WWW.