Ghana Summer School

I. Flipping Water

Supply List:
- Cup
- Screen
- Plastic Card
- Wall Tack Putty

Fill your cup partially with water and top it with the plastic card. While holding the card against the cup, flip the cup upside down. Carefully remove your hand from the plastic card.

What has happened? What is the pressure distribution inside the cup when inverted? How does the pressure at the bottom of the cup compare with a typical atmospheric pressure of 1 bar?

Repeat the experiment with the piece of mesh between the cup and the plastic card. You will need to secure the mesh to the cup using the wall tack putty. Completely line the rim of the cup. Once the cup is upside down, carefully remove the plastic card. *Describe what has happened and why? Why is the mesh important? Try to get the water out of the cup without removing the mesh.*

Challenge question- What is the tallest cup of water that you could flip?

II. Melting Ice

Supply List:
- Two Large Containers
- Fresh water
- Salt
- ice cubes
- Food coloring

Two containers hold equal amounts of water and ice; however, one container is filled with fresh water and one is filled with salty water. In which container will the ice melt the fastest? Why?

Now let's test your theory. Fill both containers equally with about 1600 ml of fresh water. Mix 35 ml of salt into container #2 (make sure all the salt is dissolved). Place a few ice cubes in each container. Observe what happens.

Now drop a (very) little food coloring on to the ice in the containers. What does this reveal? Once the ice has completely melted in one of the containers, discuss how you might induce the ice to melt faster in the other container. Draw temperature, salinity, and density profiles in each cup at the beginning, in the middle, and at the end of the experiment.

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III. Buoyancy Frequency

Supply List:

- 2 Large Containers
- Small Vial w/ String
- Stick
- Eye-Dropper
- Fresh Water
- Salt Water
- Timer
- Dye

Make a two-layer fluid: Fill one container about ½ full with fresh water and ½ with salt water. Gently pour the fresh over the salt water until the container is nearly full' use a piece of styrofoam to prevent mixing between the two fluids.

The goal is to adjust the density of a small vial with air and water so that the middle (roughly) of the bottle floats at the interface of the two fluids. Lower the bottle carefully with the attached string. Adjust the buoyancy of the bottle by adding or removing water from inside the bottle with an eyedropper. Try not to mix the interface during this process.

Once floating at the interface, depress the bottle slightly with a stick and estimate the period of oscillation T. It is easiest to time several oscillations and divide by the number of oscillations, rather than timing one cycle.

Compute buoyancy frequency: $N = 2\pi/T$ (radians/second). Estimate the density difference from the buoyancy frequency

$$N^2 = -\frac{g}{\rho_o}\frac{\partial \rho}{\partial z} = -\frac{g}{\rho_o}\frac{\Delta \rho}{h}$$

where h is the height of the small vial.

W*hat is happening to the bottle in terms of the forces acting upon it? How does the movement of the bottle relate to internal waves?*