SMS-204: Integrative marine sciences.

Lab 2, Pressure lab.

Station 1: Visualizing hydrostatic pressure – does water depth affect pressure?

You have a pipe with 1 small exit hole near the bottom and several large holes plugged with stoppers. By removing the rubber stoppers, you can fix the height of water column above the exit hole.

a. What do you expect to happen when you fill the tube with water and open the exit hole? Explain your observations in terms of the forces acting on the fluid.

b. What do you expect will happen when the water depth is increased? Why?

Begin by removing the lowest rubber stopper. Hold your finger over the small exit hole, and fill the pipe with water until it runs out the hole the stopper was in. Measure the height of the water column above the exit hole. Then let the water run out the small exit hole, and note how far the water travels before striking the ruler. You should note the distance the water travels when first released. Repeat the steps for the four lowest holes.

c. Did the experimental results match your expectations?

Station 2: Comparing water flow from various sizes of holes.

You have a pipe with three holes with different diameters, which can be uncovered one at a time.

a. How do you expect the results to change when water flows out a bigger hole?

b. Hold your finger over the exposed hole, fill the tube to overflowing, then release the water and note how far it shoots out from each size hole. Repeat the experiment for all three hole sizes and record your observations.

c. How will the results change with a fatter tube?
**Station 3:** A manometer is a device used to measure the height of water within tanks (for example a fuel or water tank in which we can’t observe the water level directly).

a. What is its principle of operation?

b. Predict what will happen when you fill the large tube of monometer #1 with water.

c. Fill the monometer #2 with water, and note the height of water in each arm.

What do you think will happen if oil is added into one of the monometers arms? Do it and explain your findings.

d. Now use the third monometer (# 3 with different diameter arms): Predict and observe what will happen when water is added into one of the monometers arms.

**Station 4:** Balloon in a glass.

Insert a new balloon into a glass container with a hole at the end such that the mouth of the balloon covers that of the container.

a. Fill a balloon with air within the glass. Let go. What happens?

b. Fill it again and put a stopper on the hole at the end of the glass container. What happens?

c. Let go of the stopper and empty the balloon. Put the stopper back in and fill the balloon. What is happening now?

d. Explain your observation in terms of forces, pressure and fluid expansion.

**Station 5:** Immerse a pipe in the water, fill it up and cap one side.

a. What do you think will happen when you slowly raise the pipe out of the water with the cap side up? Why?

b. Release the cap. What happens? Why?

b. Explain your observations in terms of the forces acting on/in the fluid.
Station 6: Pascal press.

a. You are about to push liquid from one syringe to another. Predict which will be harder to push the large or small syringe?

b. Push each side and feel which one requires more force.

c. Given that work=force\cdot distance, and that the same work is done in both case, how much more force is required to push one syringe relative to the other?

Station 7: Ideal gas law.

In an Ideal gas \(PV=nRT\) where \(P\) is pressure, \(V\) volume, \(nR\)- constants and \(T\) temperature (in K). Some input: atmospheric pressure=\(10^5 Pa=14.7\text{ lb/inch}^2\). The plunger’s head has an area of 1\text{ inch}^2.

a. You are about to put a weight on the top of the syringe. How do you think it will affect the properties of the air in the syringe? What is the pressure within the syringe? What is the volume?

b. Put the weights on the block of wood (2.5pd, 5pd, 10pd and 15pd). What is happening?

c. Assuming no change in temperature (which is exchange freely with the lab) by what percentage did the pressure increase in the syringe compared to the atmospheric pressure (when the 15lb mass is loaded)? By what percent did the volume change? Is it consistent with the ideal gas law?