SMS-204: Integrative marine sciences.

Lab 2, Pressure lab.

Station 1: A manometer is a device to measure pressure differences. It can be used to measure pressure in, for example, the height of water/fuel within an opaque tank fuel.

a. What is its principle of operation (think about the distribution of pressure in the manometer when the fluid is at rest)?

b. Predict what will happen when you fill the large tube of manometer #1 with water. Do it and explain your findings.

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 manometers arms? Do it and explain your findings.

d. Now use the third manometer (# 3 with different diameter arms): Predict and observe what will happen when water is added into one of the monometers arms. How do you explain your observations?

Station 2: Ready set squirt.
Part A.
1. You have a pipe with one small exit hole near the bottom and several large holes plugged with rubber stoppers. Place a ruler perpendicular to the bottom of the pipe. You can fix the height of the water column above the exit hole by simultaneously covering the bottom exit hole with your finger and filling the tube until water flows out one of the upper large holes above.

2. Before you use this apparatus: What do you expect will happen when you fill the tube with water to the height of the first large hole (from the bottom) and release your finger from the exit hole? Explain your expectations in terms of the forces acting on the fluid. What do you expect will happen when the water height above the exit hole is increased? Why? How will it be different if water squirted from a higher hole with the same water level at the start?

3. Test your predictions. Begin by removing the rubber stopper from the lowest large hole. Simultaneously, hold your finger over the small exit hole, and fill the pipe with water until it runs out the hole the stopper was in. (*Think:* Why do we want to maintain a fixed water level within the tube?) Then, remove your finger from the exit hole letting the water run out, while you continually fill the pipe with water to maintain the same height of water column above the exit hole. Note how far the water squirts when it first strikes the ruler. Replace the stopper and repeat the steps for the next four holes, working up one hole at a time. Are the data consistent with your prediction in Step 2?

4. Would the distance that the water travels, for any given hole, change if the holes were bigger? Why?

Part B

Take the second pipe (with three holes of different diameters at the same height), cover all three holes with your finger(s), and fill the pipe with water. Place the ruler perpendicular to the bottom of the pipe. Uncover one hole at a time and measure the distance at which the water first strikes the ruler. Does your observation agree with your reasoning in Step 4 above (Part A)?

Station 3: Tube immersion.

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?

c. Explain your observations in terms of the forces acting on/in the fluid.

d. How could a capped tube be used to monitor changes in atmospheric pressure?

Station 4: 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 times 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 5: 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=10^5Pa=14.7lb/inch^2. The plunger's head has an area of 1inch^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 (2.5lb, 5lb, 10lb and 15lb). What is happening?
c. Assuming no change in temperature (which is exchanged 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?