

◆ Measurement of the Depth of the Ocean ◆

Grade Level: 8th-12th

Length of Lesson: Five 45-minute class periods

Goals:

- Comprehend the physical properties of pressure and Boyle's Law
- Construct a capillary depth gauge
- Calculate the calibrated depth marks of the capillary tube
- Determine the margin of error of the depth gauge

National Science Standards:

- PS1.A: Structures and Properties of Matter
- PS2.A: Forces and Motion
- PS3.C: Relationship Between Energy and Forces
- ESS2.A: Earth Materials and Systems
- ETS1.B: Developing Possible [Engineering] Solutions

Materials:

- Clear tubing – 3.5 inches (aquarium style tubing)
- Hot melt glue
- Colored blackboard
- Permanent marker
- Line with depth measurements
- Meter stick
- Calculator
- SeaPerch with underwater camera attached
- Monitor to view video images

Background

Imagine this scenario: While running tests with a SeaPerch ROV, the depth sounder on the research ship breaks. You and your fellow research scientists must build a depth gauge and calibrate it so that when you release your experiment, you can calculate the depth of the ROV in the water. Because you are at sea, you have to construct something with objects found on the vessel.

Hint: an air bubble caught in a tube with water will contract as more pressure is put on the tube.

However, you must know how much error exists in your measurements so you can evaluate your data. Is the bubble the size you expect it to be at a known depth? What are different ways you can test this while your ROV is in the water?

Lesson: LAUNCH

1. Attach the tubing on the blackboard in a vertical orientation with the hot melt glue.
2. Plug the upper end of the tube with glue.
3. Calculate the bubble size for a depth of 17 feet.
4. Place the various calibration marks from 17 feet to 0 feet deep.
5. Attach the capillary depth gauge to the SeaPerch so that the camera sees the calibrated depth marks and the gauge is in a vertical position.
6. Submerge the ROV underwater to a known depth. Observe and record the capillary gauge reading.

Lesson: INVESTIGATE

1. Submerge the ROV underwater to a known depth. Observe and record the capillary gauge reading.
2. Compare the known depth to the observed reading on the capillary gauge.
3. Analyze how close the observed reading is to the predicted measurement.

Lesson: PRACTICE

Determine the margin of error for your capillary gauge. How closely does it mirror the actual depth of the water? If you have a large margin of error, troubleshoot: how can you make your capillary gauge more accurate?

Lesson Credits: John Langella, Mike Jarrett and Joyce Doblmeier

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