611-2270 (30-140) Diving Bell

Additional Materials Needed:

- Large Container for water
- Laboratory Balance (0.1g scale)
- Water

Brief History:

For thousands of years, underwater exploration has fascinated us. In fact, devices that would allow us to breathe and explore beneath the surface were first described by Aristotle. The bell was a jar that would rest on the diver's shoulders and the diver would then be able to breathe the air that remained inside the jar, while making a decent to the bottom of the sea floor. Submarines were also designed using the same principle that allowed divers to discover the ocean floor.

Warranty and Parts: We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

Description:

Whether a submarine is floating or diving depends on the ship's buoyancy. Primarily, if an object is denser then the fluid, the body will sink. And, if an object is less dense then the fluid, then the body will float. With the help of the *Diving Bell*, you can demonstrate this law of "buoyancy" called Archimedes' Principle, which states "when a solid object is partially or completely immersed in fluid (gas or liquid), the apparent loss in weight will be equal to the weight of the displaced liquid, creating a buoyancy effect " which is how a submarine works. By immersing the diving bell in water, and using the syringe to remove air from the diving bell, this principle will be recreated. Archimedes principle can be verified by comparing the density of the Diving Bell at a neutrally buoyant state. At this point the volume of the water displaced is equal to the volume of the Bell thus the mass of the Bell and the mass of the water displaced should be equal.

Visit us online at:
www.sciencefirst.com

Basic Submarine Experiment:

1.) Fill the large container with water.

2.) Attach the tube to the diving bell and syringe. (Make sure the syringe is fully closed).

3.) Place the diving bell in the water, making sure that the syringe is pushed all the way in. The diving bell should float, with approximately half the cylinder in the water and half out. We can say the diving bell has **positive buoyancy**.

4.) Slowly pull the syringe, extracting air out of the diving bell. When the diving bell starts to sink, stop pulling the syringe. At this point, your diving bell has **neutral buoyancy**.

5.) Continue pulling slowly until the syringe handle is pulled up as far as it can. The diving bell will sink. At this point, the diving bell has **negative buoyancy.**

6.) To make the diving bell rise again, push the air back in.

Advanced Experiment: Verifying Archimedes Principle

1.) Remove the rubber tubing from the diving bell.

2.) Use a laboratory balance to record the mass of the empty Diving Bell ($\mathbf{m}_{empty\ Bell}$).

3.) Record the mass of an empty 500ml beaker ($\mathbf{m}_{beaker}$).

4.) Fill a large container with water and record the temperature in C° with a thermometer (**t**).

5.) Reattach the rubber hose to the top of the Diving Bell and place in the water.

6.) Press in on the syringe plunger to purge any air from the syringe.

7.) Slowly pull out the syringe plunger until the top of the Diving Bell just slips under the surface of the water.

8.) Quickly remove the partially filled Bell from the water and place it into the 500ml beaker.

9.) Remove the rubber tubing and record the mass of the neutrally buoyant Bell in the beaker (**$m_{Bell + beaker}$**). It is alright if the water leaks from the bell into the beaker.

10.) Measure the diameter of the Bell and divide by 2 to obtain the radius (**r**).

11.) Calculate the volume (**v_{Bell}**) displaced by the sphere using the formula **$4/3\ \pi r^3$**.

12.) Calculate the density (**ρ**) of the neutrally buoyant sphere using the formula **$\rho = m/v$**.

Compare with the standard density of water in the table to verify Archimedes principle.

Standard Densities of Water	
Temperature (**t**) (C°)	Density (**ρ**) (g/cm^3)
100	0.9584
80	0.9718
60	0.9832
40	0.9922
30	0.9956
25	0.9970
22	0.9977
20	0.9982
15	0.9991
10	0.9997
4	0.9999
0	0.9998

Visit us online at:
www.sciencefirst.com

Calculations:

Mass of the empty Bell:

$m_{empty\ Bell}$ = ____(g)

Mass of the empty beaker:

m_{beaker} = ____(g)

Mass of the partially filled Bell and beaker at neutral buoyancy:

$m_{Bell + beaker}$ = ____(g)

Subtract the mass of the beaker to obtain just the mass of the neutrally buoyant Bell:

$m_{Bell + beaker} - m_{beaker}$ = $m_{neutral\ Bell}$ ____(g)

Measure the radius of the Bell:

r = ____(cm)

Calculate the volume of the Bell using the following formula:

$v = 4/3\ \pi r^3$ = ____(cm^3)

Use the density formula **$\rho = m/v$** to determine the density of the partially filled ball at neutral buoyancy:

$\rho = m_{neutral\ Bell}/v$ = ____(g/cm^3)

Use the table to determine the approximate density of your water at a given temperature:

t = ____(C°)

Compare the density of your water at temperature (**t**), to that of the partially filled ball to verify Archimedes principle.

30-166 Density Ball Curriculum
Content: Physical Science
Structure and properties of matter;chemical reactions; interactions of energy and matter.
Grades 5-8: *Properties and changes of properties in matter.*
Grades 9-12: *Interactions of energy and matter*

Experimental Errors:

The standard table of densities is calculated for pure water. Tap water will have impurities which will alter the density slightly. Distilled water may be used for more accuracy.

The volume calculation is based on a spherical Bell. This does not account for the top and bottom plugs. A more accurate calculation may be achieved by plugging the top and bottom vents and submersing in a graduated cylinder to find the volume.