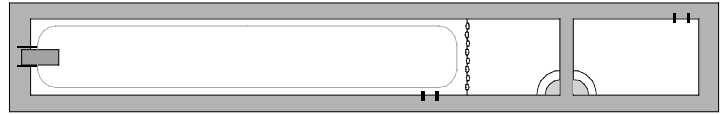
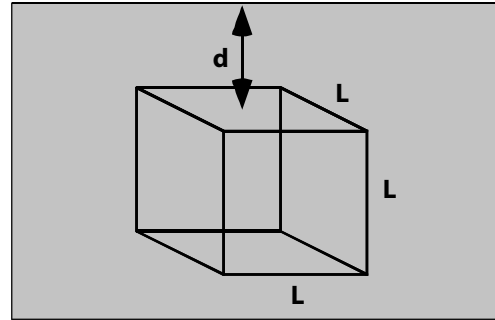


# PHYZ SPRINGBOARD: BUOYANCY BASICS



## BOX OF WATER

Consider a cube of water with each side length  $L$ . The water is housed in a container that has the same density ( $\rho$ ) as water. Suppose the cube were submerged to some depth in a container of water and released.



1. The cube would be in a state of \_\_\_\_\_.
2. The downward force on the cube of water is its own \_\_\_\_\_.
3. The upward force on the cube of water is the \_\_\_\_\_ force.
4. Which force is greater and why?
5. What is the pressure (gauge pressure) at some point  $d$  below the surface of the water?

Suppose the top of the submerged cube of water is at a depth  $d$ .

6. Determine the fluid force pushing the downward on the top of the cube.
7. Determine the fluid force pushing upward on the bottom of the cube.
8. What is the net fluid force acting on the cube?
9. Simplify if possible. (Eliminate  $L$  and generalize to any shape with volume  $V$ .) The net fluid force is the **buoyant force**,  $B$ .

10. What is the mass of an object in terms of its density and volume?

11. Express the weight of the cube in terms of  $\rho$ ,  $V$ , and constants.

12. How does the weight of the water cube compare to the buoyant force on the water cube?

### **METAL CUBE**

Suppose the cube of water were replaced with a cube having the same dimensions but made of a metal having 3 times the density of water.

13. What would the weight of the metal cube be?

14. If submerged in water, what would the buoyant force on the metal cube be?

15. What would the net force (magnitude and direction) on the immersed metal cube be?

### **FOAM CUBE**

Suppose the cube of water were replaced with a cube having the same dimensions but made of a plastic foam having 0.3 times the density of water.

17. What would the weight of the plastic cube be?

18. If submerged in water, what would the buoyant force on the plastic cube be?

19. What would the net force (magnitude and direction) on the immersed plastic cube be?

### **FLOATING**

20. Under what condition will an object float?

21. Why can the metal cube NOT float?

22. How deep will the plastic cube float (how much of the cube will be submerged)?