# 8.5 Buoyancy

**buoyancy:** the upward supportive force on an object in a fluid

Have you ever seen a toy wooden boat float on a pond? Why does the boat float? When an object is placed in a fluid, the fluid presses on the object in all directions (Figure 1). The force that presses upwards is known as buoyancy. **Buoyancy** is the upward force that a fluid exerts on an object. It determines whether an object sinks or floats.

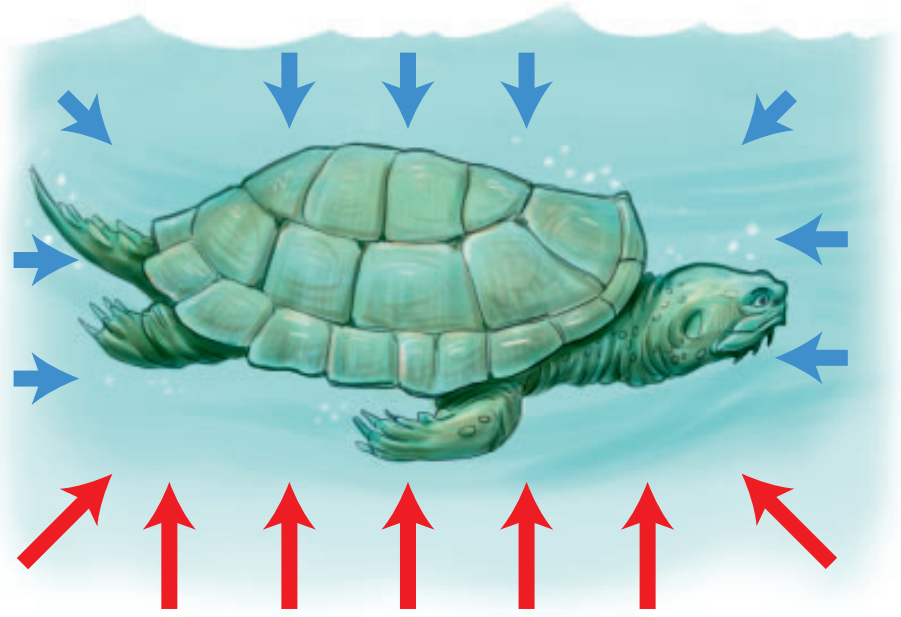

**Figure 1** The upward force exerted by the liquid (shown by the red arrows) is called "buoyancy" or the "buoyant force."

A block of solid metal will sink in water, yet a boat made of the same amount of metal will not. Why does the buoyant force of water keep a boat afloat but not the metal block? Why does the shape of the metal determine whether it will sink or float?

**LINKING TO LITERACY**

**Critical Thinking: Cubing**

Cubing helps you get more meaning from the texts you read.

Make a cube. Write one of the following words on each side: describe, analyze, apply, compare, associate, argue for/against. In a small group, discuss this section. Roll the cube. If you roll:

- describe: talk about what buoyancy is like
- analyze: talk about how buoyancy works
- apply: talk about ways you could use buoyancy
- compare: talk about how buoyancy is the same or different from something else
- associate: talk about what "buoyancy" brings to mind
- argue for/against: talk about what is good or not good about buoyancy

## TRY THIS: Building a Metal "Boat"

**SKILLS MENU: performing, observing, analyzing**

SKILLS HANDBOOK 6.A.2., 6.A.3.

In this activity, you will make a model metal "boat" and compare the weight of the water it displaces with the weight it can hold.

**Equipment and Materials:** cup or beaker; ruler; scissors; balance or scale; overflow can; pennies; heavy-duty aluminum foil; water

1. Measure and record the mass of the cup or beaker.
2. Cut two 15 cm × 15 cm squares of aluminum foil.
3. Keep folding one of the squares in half, squeezing out the air between each fold. Keep folding the foil until you have a small, flat shape. Measure and record its mass.
4. Place the folded foil in the filled overflow can. Measure and record the mass of the displaced water.
5. Dry the cup or beaker and replace it under the spout.
6. Make a small boat with the other foil square. Refill the overflow can, place your aluminum boat in it, and carefully add pennies to the boat until it is just about to sink. Collect the displaced water. Measure and record its mass.
7. Remove the boat with the pennies in it and measure its mass. Record this value in your notebook.

**A.** Use the equation *weight = mass (kg) × 9.8 N/kg* to calculate the weight of

(i) the folded aluminum

(ii) the water displaced by the folded aluminum

(iii) the aluminum boat with pennies in it

(iv) the water that the boat (with pennies in it) displaced

**B.** Compare these four weights. What do you notice?

The Try This activity shows that the weight of floating objects is equal to the weight of the water that they displace. The force of gravity acting downward on a floating object is equal to the buoyant force of the water acting upward on the object (Figure 2). The flattened foil displaces a small amount of water, so the buoyant force acting on it is very small and cannot support the weight of the foil. However, the boat-shaped foil displaces more water, so the buoyant force is much larger. The buoyant force on the foil boat supports the foil plus many pennies as well. This is why large metal ocean freighters can carry so much cargo: the displacement of so much water by the large, hollow shell results in a very large buoyant force.

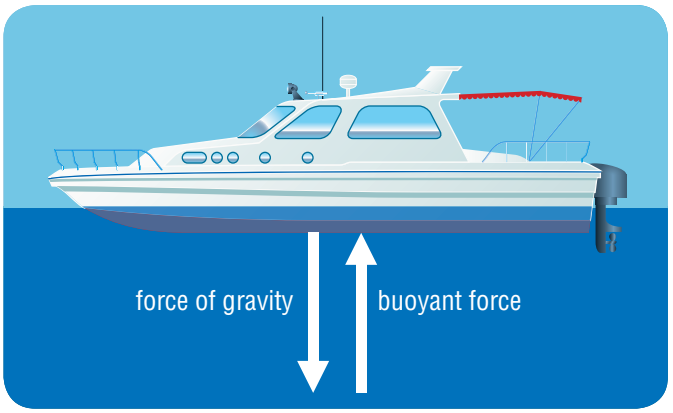


**Figure 2** The buoyant force equals the weight of the water displaced by the object.

Hydrometers float at different levels in different liquids because the liquids push upward on the hydrometer with different forces. In other words, each fluid has a different buoyancy. Salt water, for example, is more dense than fresh water, so it provides a greater buoyant force. That is why ships have a Plimsoll line painted on their sides (Figure 3). The markings show at what level the ship will float in different types of water. Freshwater markings are on the left and saltwater markings are on the right.

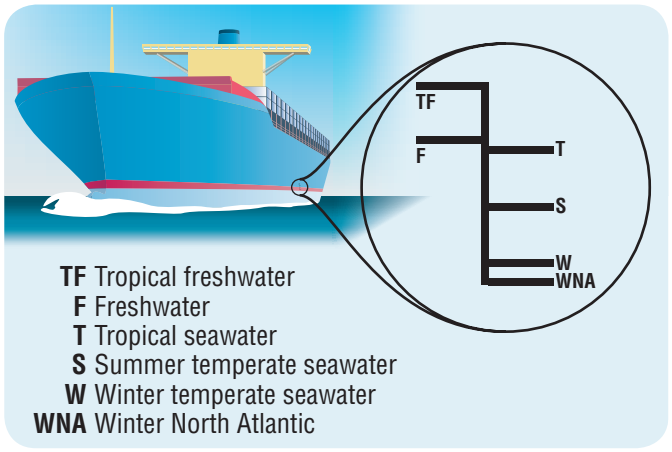


**Figure 3** A Plimsoll line allows observers to easily see whether a ship is floating high enough in the water to withstand rough seas without getting swamped.

**Unit Task** How will you be able to use the concepts of density and buoyancy in designing your toy?

## CHECK YOUR LEARNING

1. Define buoyancy and add a visual to the explanation.
2. What is the relationship between density and buoyancy for objects and substances?
3. Explain how a dense substance, such as metal, is able to float on a less dense substance, like water. Use an example from this section in your explanation.
4. Why does a ship float at different levels depending on the type of water it sails in?