TABLE 12.1
DENSITIES OF COMMON SUBSTANCES (kg/m³) (FOR DENSITY IN g/cm³, DIVIDE BY 1000)

Solids	Density
Iridium	22,650
Osmium	22,610
Platinum	21,090
Gold	19,300
Uranium	19,050
Lead	11,340
Silver	10,490
Copper	8,920
Iron	7,870
Aluminum	2,700
Ice	919
Liquids	
Mercury	13,600
Glycerin	1,260
Seawater	1,025
Water at 4°C	1,000
Ethyl alcohol	785
Gasoline	680

SCREENCAST: Quartz-Gold Problem

FIGURE 12.5
Both Stephanie and the tree are composed mainly of hydrogen, oxygen, and carbon. Food ingestion supplies these to Stephanie, whereas the tree gets most of its oxygen and carbon from the air. In this sense, a tree can be thought of as "solid air."

Weight density is measured in N/m³. Because a 1-kg body has a weight of 9.8 N, weight density is numerically 9.8 × mass density. For example, the weight density of water is 9800 N/m³. In the British system, 1 cubic foot (ft³) of fresh water (almost 7.5 gallons) weighs 62.4 pounds. Thus, in the British system, fresh water has a weight density of 62.4 lb/ft³.

The density of a material depends on the masses of the individual atoms that make it up and the spacing between those atoms. Iridium, a hard, brittle, silvery-white metal in the platinum family, is the densest substance on Earth. Although the individual iridium atom is less massive than individual atoms of platinum, gold, lead, or uranium, the close spacing of iridium atoms in the crystalline form contributes to its greater density. More iridium atoms fit into a cubic centimeter than other, more massive but more widely spaced atoms. Hence iridium has a whopping density of 22,650 kg/m³.

CHECK POINT

1. ***Here's an easy one*: When water freezes, it expands. What does this say about the density of ice compared with the density of water?**
2. ***Here's a slightly tricky one*: Which weighs more: a liter of ice or a liter of water?**
3. **Which has the greater density: 100 kg of lead or 1000 kg of aluminum?**
4. **What is the density of 1000 kg of water?**
5. **What is the volume of 1000 kg of water?**

CHECK YOUR ANSWERS

1. Ice is less dense than water (because it has more volume for the same mass), which is why ice floats on water.
2. Don't say that they weigh the same! A liter of water weighs more. If it is frozen, then its volume will be more than a liter. If you shave the extra part off so that the chunk of ice is the same size as the original liter of water, it will certainly weigh less.
3. Density is a *ratio* of mass to volume (or weight to volume), and this ratio is greater for any amount of lead than for any amount of aluminum—see Table 12.1.
4. The density of *any* amount of water is 1000 kg/m³ (or 1 g/cm³).
5. The volume of 1000 kg of water is 1 m³.

12.3 Elasticity

When an object is subjected to external forces, it undergoes changes in size, or in shape, or in both. The changes depend on the arrangement and bonding of the atoms in the material. A spring, for example, can be stretched or compressed by external forces.

A weight hanging on a spring stretches the spring. Additional weight stretches it further. If the weights are removed, the spring returns to its original length. We say that the spring is *elastic*. When a batter hits a baseball, the bat temporarily changes the ball's shape. An archer, about to shoot an arrow, first bends the bow, which springs back to its original shape when the arrow is released. The spring, the baseball, and the bow are examples of elastic objects. A body's **elasticity** describes how much its shape changes when a deforming force acts on it, and how well it returns to its original shape when the force is removed.