

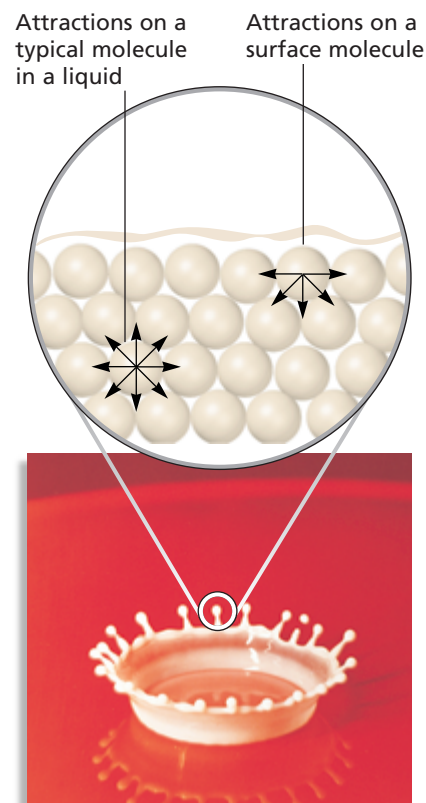
## Surface Tension

A property common to all liquids is **surface tension**, a force that tends to pull adjacent parts of a liquid's surface together, thereby decreasing surface area to the smallest possible size. Surface tension results from the attractive forces between particles of a liquid. The higher the force of attraction, the higher the surface tension. Water has a higher surface tension than most liquids. This is due in large part to the hydrogen bonds water molecules can form with each other. The molecules at the surface of the water are a special case. They can form hydrogen bonds with the other water molecules beneath them and beside them, but not with the molecules in the air above them. As a result, the surface water molecules are drawn together and toward the body of the liquid, creating a high surface tension. Surface tension causes liquid droplets to take on a spherical shape because a sphere has the smallest possible surface area for a given volume. An example of this phenomenon is shown in **Figure 6**.

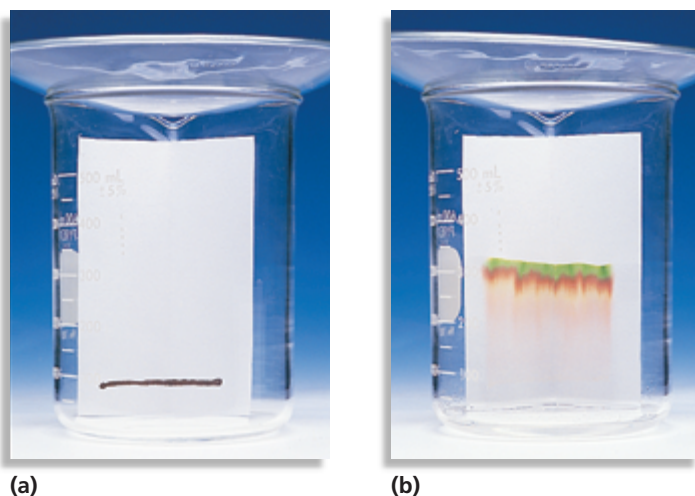
**Capillary action**, the attraction of the surface of a liquid to the surface of a solid, is a property closely related to surface tension. A liquid will rise quite high in a very narrow tube and will wet the tube if a strong attraction exists between the liquid molecules and the molecules that make up the surface of the tube. This attraction tends to pull the liquid molecules upward along the surface and against the pull of gravity. This process continues until the attractive forces between the liquid molecules and the surface of the tube are balanced by the weight of the liquid. Capillary action can occur between water molecules and paper fibers, as shown in **Figure 7**. Capillary action is at least partly responsible for the transportation of water from the roots of a plant to its leaves. The same process is responsible for the concave liquid surface, called a *meniscus*, that forms in a test tube or graduated cylinder.

## Evaporation and Boiling

The process by which a liquid or solid changes to a gas is **vaporization**. Evaporation is a form of vaporization. **Evaporation** is the process by which particles escape from the surface of a nonboiling liquid and enter the gas state.



**FIGURE 6** As a result of surface tension, liquids form roughly spherical drops. The net attractive forces between the particles pull the molecules on the surface of the drop inward. The molecules are pulled very close together, which minimizes the surface area.



**FIGURE 7** The attraction between polar water molecules and polar cellulose molecules in paper fibers causes the water to move up in the paper. The water-soluble ink placed near the bottom of the paper in (a) rises up the paper along with the water, as seen in (b). As the ink moves up the paper, it is separated into its various components, producing the different bands of color. This separation occurs because the water and the paper attract the molecules of the ink components differently. These phenomena are used in the separation process of paper chromatography seen here.