# 7.2 Characteristics of Fluids

## Key Question: How do fluids move?

Fluids do not have a definite shape. Instead, a fluid takes the shape of its container (Figure 1).

**Figure 1** Fluids take the shape of their container.

Liquids and gases are both fluids, but they have different properties. For example, liquids have a definite volume. If you pour 100 mL of liquid from a thin container into a wide one, its volume will still be 100 mL (Figure 2).

**Figure 2** These containers hold the same volume of liquid, even though they have different shapes.

Gases do not have a definite volume. Imagine spraying a small amount of perfume into the air. The liquid perfume evaporates and becomes a gas. This gas can fill a whole room!

## The Particle Theory

**particle theory of matter**
a theory that explains what matter is made of and how it behaves

The **particle theory of matter** helps explain why fluids behave the way they do. The theory states that

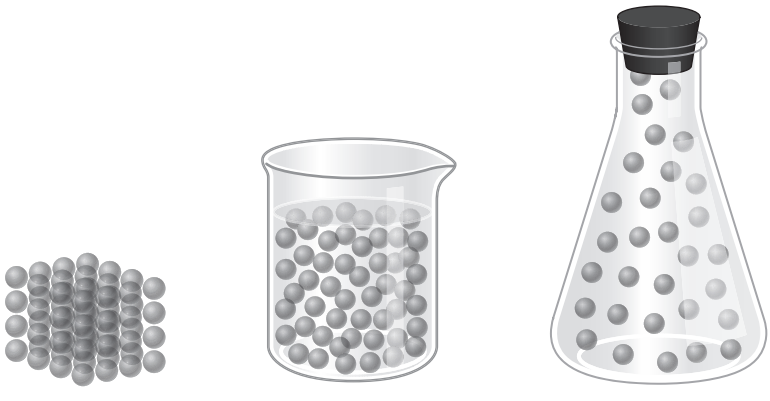
- all matter is made of tiny particles
- particles have empty spaces between them
- particles are moving randomly all the time
- particles move faster and spread farther apart when they are heated
- particles attract one another

This theory helps explain why solids, liquids, and gases behave differently.

The particles of a solid (Figure 3(a)) only vibrate. They do not move very far because the force of attraction between them is so strong. They are stuck together so tightly that they cannot even slide past one another. This strong attraction between particles gives solids their definite shape and volume.

The particles of liquids (Figure 3(b)) are farther apart than particles of solids. Their force of attraction is strong enough to hold the liquid together. That is why liquids have a definite volume. The force is weak enough that the particles can move past one another. That is why liquids do not have a definite shape.

The particles of a gas (Figure 3(c)) are much farther apart, and their force of attraction is weak. That is why gas particles do not have a definite shape or volume.



**(a)** solid **(b)** liquid **(c)** gas

**Figure 3** (a) Particles of a solid are tightly packed and only vibrate in place. (b) Particles of a liquid can slide past each other. (c) Particles of a gas have large spaces between them and spread out to fill their container.

Table 1 shows the characteristics of solids, liquids, and gases.

**Table 1** Characteristics of Solids, Liquids, and Gases

| | Attraction between particles | Definite shape? | Definite volume? |
|---|---|---|---|
| Solid | strong | yes | yes |
| Liquid | not so strong | no | yes |
| Gas | weak | no | no |

## Ability to Flow

Particles of liquids and gases are free to move about. That is why fluids are able to flow. The ability to flow is a key characteristic of fluids.

Here are some examples of how fluids flow:

- Oil can flow through a pipe.
- Air can flow around the wings of a plane.
- Water can flow over rocks in a river.

You might ask, "Don't some solids also flow? I can pour salt, sugar, or sand."

These solids can seem to flow. However, if you look closely at each grain of salt, you will see that it has a definite shape (Figure 4). That is how you can tell that salt is not a fluid.

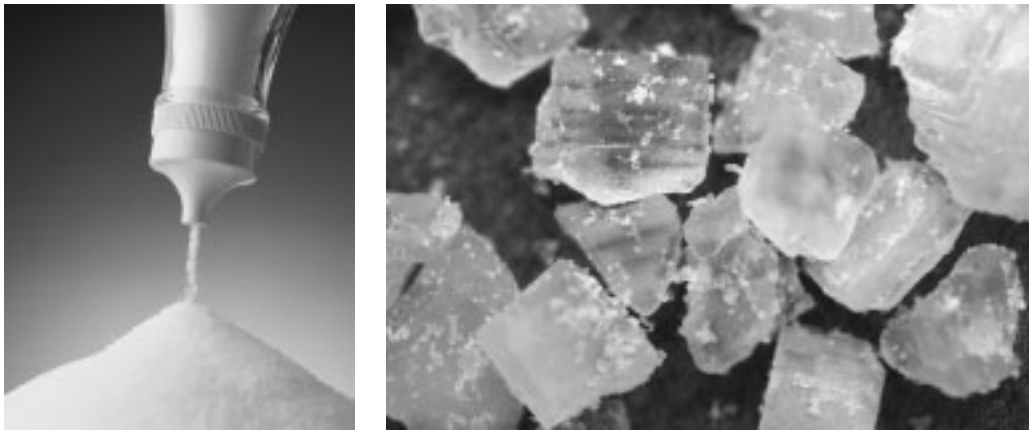


**Figure 4** Salt might seem to flow, but it is not a fluid. Each grain of salt has a definite shape.

## Types of Flow

Fluid can flow in two different ways:

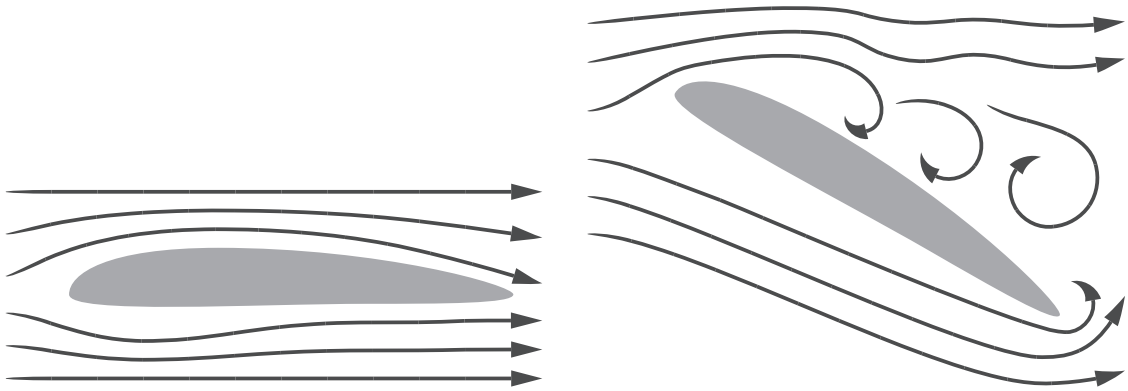
- laminar flow
- turbulent flow

**laminar flow**
a smooth pattern of flow

**Laminar flow** is smooth and regular (Figure 5(a)). For example, the water in a hose has laminar flow. Laminar flow allows fluids to move along quickly with less energy.

**turbulent flow**
an irregular, mixing flow pattern

**Turbulent flow** is choppy and irregular (Figure 5(b)). For example, water flowing over rocks has turbulent flow.



**(a)** Laminar flow **(b)** Turbulent flow

**Figure 5** (a) Laminar air flow around the wing of a plane helps the plane move quickly. (b) Turbulent air flow around part of a plane slows down the plane.

Imagine a river flowing down a hill. The white foam that splashes up shows that the water has turbulent flow.

Turbulent flow in rivers and streams adds oxygen to the water. Fish, insects, and other organisms need this oxygen to survive.

People who ride kayaks, canoes, and rafts enjoy the thrill that turbulent flow provides. They learn about turbulent flow so that they can safely ride down the river.

**eddy**
an area of slower-moving fluid that occurs behind an obstacle

For example, when river water hits a rock, the water right behind the rock is calm. The calm water is called an **eddy.** Boaters know that they can rest in eddies on their way down the river (Figure 6).

**Figure 6** The water in this river has turbulent flow.

Turbulence can also be found in the human body. In a healthy body, blood flows smoothly through arteries. Over time, material called plaque can build up in arteries. Plaque build-up creates turbulence in the blood flow.

Turbulent blood flow can cause blood clots. These blood clots can block the arteries and cause heart attacks or strokes. Understanding turbulence in the blood flow can help doctors save lives.

## Taming Turbulence

Objects such as cars, boats, and planes move through fluids. Laminar flow around these objects lets them move more easily through the fluid. Laminar flow makes the object more efficient because less energy is needed to push the object through the fluid.

**streamlined**
a smooth shape designed to decrease resistance to fluid flow

Scientists and engineers study laminar and turbulent flow so that they can make fluids flow more smoothly. They may also design objects that are **streamlined**. Streamlined objects have shapes that create more laminar flow. Scientists often use wind tunnels and smoke trails to study how air flows around objects.

Name: _____ Date: _____

## CHECK YOUR UNDERSTANDING

1. What are two characteristics of fluids?

2. Why can't solids flow?

3. Why can't 10 mL of liquid fill a 20 mL container?

4. Think back to the Key Question. Fluids move in two ways. Describe the two types of flow.





END