

9.1

Putting the Squeeze on Fluids

compress: to pack closely together; squeeze

LINKING TO LITERACY

Making Connections: Text-to-Self

This text asks you to make a text-to-self connection. Think about the last time you squeezed a balloon and felt the air move from one part of the balloon to another.

Making a connection to the text, or thinking about a “time when...” helps you make sense of the scientific principle that is being explained.

Does a water-filled balloon bulge and move in the same way as an air-filled balloon when it is squeezed (Figure 1)? Air and water tend to flow from one place into another when you try to **compress** them or squeeze them into a smaller space.



Figure 1 Compressing a fluid is difficult when the sides of the container are free to move.

TRY THIS: Compressing Fluids

SKILLS MENU: performing, observing, analyzing, communicating

In this activity, you will use a syringe (Figure 2) to observe the effects of compressing a volume of air and then the same volume of water.

Equipment and Materials: eye protection; 20 mL syringe; water

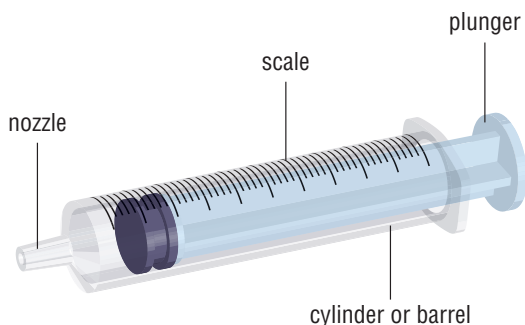


Figure 2 A syringe



Wear eye protection to work with fluids under pressure.

1. Draw 20 mL of air into the syringe and cap the nozzle with your thumb so that no air escapes.
 2. Press the plunger slowly and firmly while keeping the end sealed. Watch for any change in the volume of air. If air escapes from the end of the syringe, cap the end more tightly or use less force on the plunger.
 3. Keep the end sealed, and release the plunger. Observe any changes in volume. Record your actions and observations.
 4. Repeat steps 1 to 4 using water. Record your observations in your notebook.
- A.** Offer a possible explanation for any observed change in fluid volume.

The Try This activity demonstrates that air (a gas) can be compressed into a smaller volume much more easily than water (a liquid) can. Why is that?

The particles of a gas are much farther apart than those of a liquid, allowing us to force the particles of a gas closer together. There is less space between the particles of liquids so they have very little compressibility, while solids have almost none at all. **Compressibility** is the ability of a substance to become more compact when squeezed.

compressibility: the ability to be squeezed into a smaller volume

Types of Fluid Systems

Systems designed to put the squeeze on fluids can be divided into two main types. **Pneumatic systems** (Figure 3) use pressurized air or other gases to do work. **Hydraulic systems** (Figure 4) use pressurized liquids (often oil) to do work. These systems must keep their fluids contained within them in order to work. They are called closed systems. Closed systems are ones in which no material enters or leaves the system.

Hydraulic and pneumatic fluid systems consist of several components:

- a pump (sometimes including cylinders and pistons) forces fluids through a system
- conductors (tubing, hoses, or pipes) provide a pathway to carry the fluid
- valves keep the fluid moving in the desired direction at the desired time
- a pressure gauge monitors pressure within the system

Each component has its own job to do (Figure 5). 

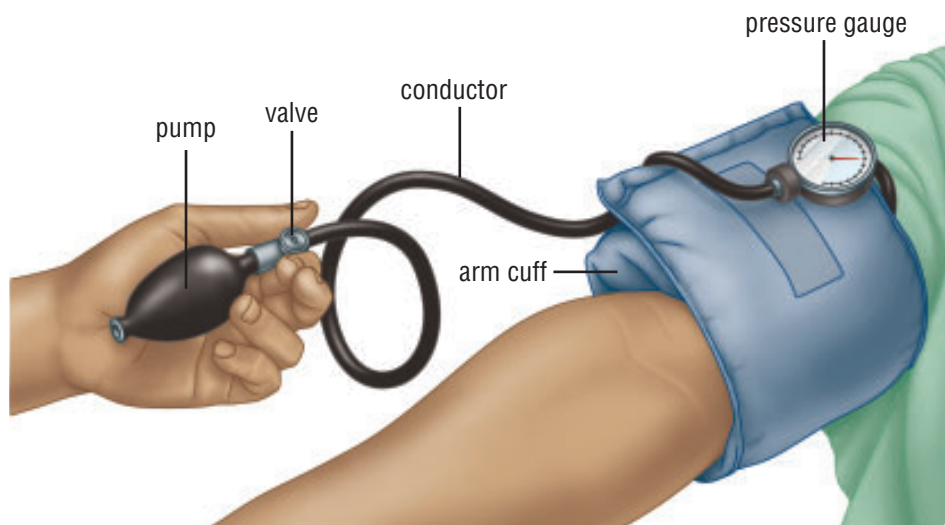


Figure 5 A blood pressure gauge uses the pressure of air to measure the pressure of liquid blood in the body.

Unit Task

How might you address the compressibility of different fluids when planning for the Unit Task?

pneumatic system: a system that uses gases under pressure

hydraulic system: a system that uses liquids under pressure

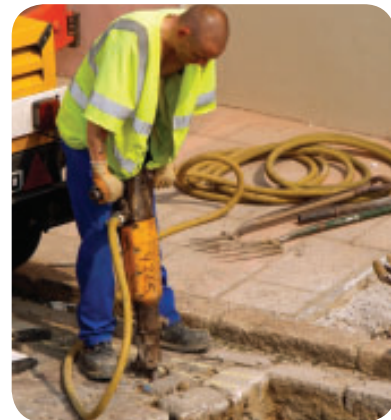


Figure 3 Pressurized air provides the power for this pneumatic hammer.



Figure 4 Rescue workers use hydraulic cutters and spreaders to rescue crash victims.

To learn more about how hydraulic and pneumatic systems work,

Go to Nelson Science 

✓ CHECK YOUR LEARNING

1. Define “compressibility” in your own words. Give an example from your daily life.
2. Using the particle theory, explain why liquids are less compressible than gases.
3. (a) What is a hydraulic system?
(b) What is a pneumatic system?
4. What are the components of both hydraulic and pneumatic fluid systems?