UNIT C Fluids

Unit Overview

Fundamental Concepts

In Science and Technology for grades 7 and 8, six fundamental concepts occur throughout. This unit addresses the following two:

- Matter
- Systems and Interactions

Big Ideas

As you work through this unit, you will develop a deeper understanding of the following big ideas:

- Fluids are an important component of many systems.
- Fluids have different properties that determine how they can be used.
- Fluids are essential to life.

Overall Expectations

By the end of this unit, you will be expected to:

1. analyze how the properties of fluids are used in various technologies and assess the impact of these technologies on society and the environment
2. investigate the properties of fluids
3. demonstrate an understanding of the properties and uses of fluids

An industrial pipeline system transports fluids.

Exploring

A child in Malaysia uses a Canadian invention.

When you want a drink of water, you simply need to turn on a tap and use the water pumped to your home from a well, lake, or reservoir. But for many people in the world, access to clean, safe water is a daily challenge. That challenge has been made easier in some developing countries, thanks to an invention by researchers at the University of Waterloo, in Ontario. Their invention is a low-cost, shallow-well hand pump that has the following advantages:

- The pump is durable enough to work continuously for 18 hours a day.
- The pump is inexpensive enough for people in developing countries to afford.
- The pump is simple enough that villagers can maintain and repair it themselves.
- The pump can be manufactured within developing countries, creating jobs and ensuring that spare parts are available.

New Technology from Old

When the inventors were researching pump designs, they noticed a pump at a Mennonite community in southern Ontario that had been used for many years. With this pump as a model, they designed a hand pump with tubing made out of a plastic called polyvinyl chloride (PVC). In the past, pumps were made of iron and steel, materials that are scarce and costly in many developing countries. PVC is inexpensive, available everywhere around the world, and does not rust. The PVC hand pump is light, sturdy, cheap to build, and easy to install and maintain.

The new PVC hand pump is based on a metal pump like this one.

Adapting the Technology

Over 11 000 PVC hand pumps are now in use in 13 developing nations. The pumps are modified for local conditions. For example, in Sri Lanka, a leather washer is used instead of a plastic one. The advantage of the leather washer is that it can be made locally. In Malawi, the spigot on the pump is now made out of black metal instead of the original white plastic. The white spigots looked somewhat like bones, and the local hyenas kept chewing them off the pump.

The PVC hand pump is a good example of the importance of understanding a concept and then applying that understanding to different situations. In this case, the inventors knew about the properties of fluids and how a water pump operates. They applied this knowledge to develop a better pump that could be made locally, work reliably for long hours, and be easy to fix.

In this unit, you will learn about the properties of fluids and discover how fluids can be used to solve a variety of practical problems. You will learn that fluids include both liquids and gases, and that you put fluids to work for you every day.

...MORE TO EXPLORE

C1 Quick Lab

Pump Up the Volume

Many people of the world obtain the water they use from a well. The device used to transfer this water must be reliable, efficient, and sanitary.

Purpose

To test and evaluate several methods of transferring water from a low elevation to a high elevation

Materials & Equipment

- large plastic container
- 5 disposable cups
- felt pen
- water
- stopwatch
- plastic straw
- spoon straw
- small sponge
- spoon
- cardboard tube

Procedure

1. Place a large container of water (the well) on the floor at the base of your table.
2. Label the five disposable cups A, B, C, D, and E. Place them in a row on your table.
3. Predict which "pump" will transfer the most water in 30 s. Your "pumps" are the straws, sponge, spoon, and cardboard tube.
4. Have a partner time 30 s while you use plastic straw A to transfer as much water from the well into cup A. Do not put any of the devices in your mouth. Be careful not to spill any water. Clean up any spills immediately.
5. Repeat step 4 for the remaining pumps, using pump B for cup B, and so on.
6. Determine which cup contains the most water.

Questions

7. Which pump transferred the most water in 30 s? How did this result compare to your original prediction?
8. The best pump is the one that transfers lots of water, lasts a long time, and is the most sanitary. Use these criteria to explain which of the five pumps is the best.

C2 Thinking about Science, Technology, Society, and the Environment

ST
SE

Fluids on the Move

Suppose you were in charge of designing a pipeline to bring fresh water from a lake to a village at the top of a hill 20 km away.

1. How would you decide what materials to use to build the pipeline?
2. How would you decide which route the pipeline should follow?
3. How would you raise the water from the low level of the lake to the high level of the hill?
4. Who should pay for the pipeline? The villagers desperately need the water, but are unable to pay the full cost.

UNIT C

Contents

Unit Task

Pipelines transport fluids across Canada. Our understanding of the properties of fluids helps us design pipelines to function without spills or problems. In your Unit Task, you will investigate the effect of changing a variable on the movement of fluid in a pipeline that you design.

Essential Question

How do the properties of fluids explain the factors that influence the movement of fluids through a pipeline?

Getting Ready to Read

Thinking Literacy

Probable Passage

You will encounter the following terms in this unit: "fluids," "solid," "liquid," "gas," "volume," "particle theory of matter," and "thermal expansion." Which of these terms can you already define? Which are you unsure of? Write your prediction of what you will learn in this unit.

7.0 Fluids are used in technological devices and everyday materials.

A firefighter relies on an air tank and a powerful water system to battle a blaze.

What You Will Learn

In this chapter, you will:

- explain the difference between solids, liquids, and gases using the particle theory of matter
- recognize a variety of uses for fluid technologies

Skills You Will Use

In this chapter, you will:

- follow safety practices for using apparatus, tools, and materials
- use appropriate science and technology vocabulary
- use a variety of forms to communicate with different audiences and for a variety of purposes

Why This Is Important

When you understand how fluids can change and move, you can more easily put fluids to work for you. Fluids are an important part of many devices and systems.

Before Reading

Thinking Literacy

Making Predictions

This chapter builds on your learning in science in previous years and your everyday life. As you consider the title for this chapter, "Fluids are used in technological devices and everyday materials" and scan the photographs, use your prior knowledge to make a prediction about what you will learn.

Key Terms

- mass
- volume
- matter
- thermal expansion
- particle theory of matter
- fluid

7.0 Getting Started

Figure 7.1 HMCS *Victoria* is one of Canada's four diesel-electric patrol submarines. Each submarine of its class is over 70 m long and can dive to a depth of more than 200 m.

How is a submarine able to dive, travel along at a constant depth, and then rise to the surface of the water? Why does a submarine not simply float, like a boat, or sink, like a huge piece of metal? The answer is related to the weight of the water a submarine takes the place of, or displaces. For example, when HMCS *Victoria* is at the surface, it displaces over 2100 tonnes of water (Figure 7.1). When HMCS *Victoria* is below the surface, it displaces over 2400 tonnes.

In order for a submarine to sink from the surface to the depths, its weight must be more than the weight of the water it displaces. When the submarine rises back to the surface, its weight must be less than the weight of the water it displaces. The weight of a submarine changes depending on whether seawater or compressed air fills its ballast tanks.

When the ballast tanks are filled with seawater, the weight of the submarine is greater than the weight of the water it displaces, and so the submarine sinks (Figure 7.2). When seawater is pumped out of the ballast tanks and is replaced by compressed air, the submarine becomes lighter than the water it displaces and rises to the surface. A balance of seawater and compressed air in the ballast tanks allows the submarine to stay at a constant depth.

The technology that allows a submarine to rise, sink, or stay at a constant level is similar to a technology used by fish. A fish has an internal organ under its backbone called a gas bladder. By making changes to the volume of gases in the bladder, a fish can control whether it stays at a constant depth, rises, or sinks.

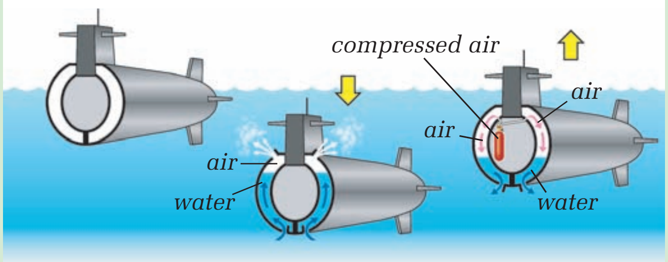


Figure 7.2 The ballast tanks are located between the inner and outer hulls of the submarine.

C3 *Quick Lab*

Cartesian Diver

This type of diver is named after Rene Descartes, a French scientist, mathematician, and philosopher who lived about 400 years ago.

Purpose

To model the movement of a submarine by making a Cartesian diver

Materials & Equipment

- 2-L plastic bottle with cap
- medicine dropper
- water

Procedure

1. Completely fill the 2-L plastic bottle with water.
2. Fill the medicine dropper about two-thirds full of water and place it in the bottle. The medicine dropper should float at the top of the 2-L bottle.
3. Continue to increase the amount of water in the medicine dropper until it floats at the top but is almost completely submerged.
4. Put the cap on the bottle and tighten securely.
5. Squeeze the sides of the bottle. Observe what happens.
6. Release the sides of the bottle. Observe what happens.

Questions

7. State what happened to the diver when you:

   (a) squeezed the sides of the bottle

   (b) released the sides of the bottle
8. Did the weight of the diver increase or decrease when you squeezed the bottle? Explain.
9. Suggest a possible explanation for why the weight of the diver changed.

7.1 The Many Uses of Fluids

Here is a summary of what you will learn in this section:

- A fluid is any substance that flows.
- Fluids have many uses, including holding and transporting other materials.
- Substances in their fluid form can be shaped and then cooled to become solids.

Every time you brush your teeth with toothpaste, take a drink of juice, or draw in a breath of air, you are using a fluid. A **fluid** is any substance that flows. The blood flowing through your blood vessels is a fluid. Lava flowing from a volcano and honey flowing from a spoon onto your toast are also fluids. Other fluids include gases, such as oxygen and carbon dioxide, and liquids, such as shampoo, salad dressing, window cleaner, and engine oil. We use the properties of fluids in many different devices and systems to improve our lives.

C4 *Starting Point*

Skills P C

Finding Flowing Fluids

Whether it is a race car or a family car, an automobile needs fluids and fluid technologies to run smoothly, safely, and efficiently (Figure 7.3).

1. With a partner, make a list of all of the different fluids you can think of that are used in an automobile. You can include uses by people who drive and ride in automobiles as well.
2. Group your examples into four different categories. Label each category with a title.

Figure 7.3 There are many uses for fluids in transportation.

Putting Fluids to Work

One of the reasons why fluids are so important is that they make it easier to transport, process, and use different kinds of materials, even if these materials are solids (Figure 7.4).

Figure 7.4 You can use air to move solids, such as leaves and paper.

Fluids Can Transport Solids

A mixture of water and solids is called a **slurry**. Slurry technology — the transport of solids in water — is important in many applications. The paper you write on was once a slurry of wood pulp and water. Hydroseeding is the process of spraying a slurry of seeds, fertilizer, and sawdust to plant difficult-to-reach areas (Figure 7.5). Mines, such as the Campbell Gold Mine in northwestern Ontario, use slurry technology to process the minerals. Some mineral ores are converted to liquids in a method called *froth flotation* so that they can be transported more easily.

Figure 7.5 A slurry of seeds and nutrients can be used to replant an area.

Fluids Can Hold Other Materials

The ability of fluids to hold or carry other materials makes them useful in many applications (Figure 7.6). For example, the watery cytoplasm in your cells holds the organelles that allow a cell to expand, grow, and replicate. Fluids can hold abrasive particles to clean other surfaces, such as marble, metal, and your teeth (Figure 7.7).

Figure 7.6 An airplane drops a load of fluid containing fire retardant on a forest fire.

Figure 7.7 Toothpaste is a fluid that holds materials to clean, polish, and protect your teeth

Figure 7.8 Cement is a mixture of materials, such as limestone, clay, and gypsum.

Fluids Become Solids

Fluids are easy to move, and they take the shape of their containers. Because of these properties, many of the solid objects we see and use were originally prepared as fluids.

A slurry of water and cement is easy to transport. As it hardens, the cement can be shaped to become a smooth and level concrete sidewalk (Figure 7.8).

Steel is an example of the use of fluids in processing materials. Steel consists of a mixture of iron, carbon, and small quantities of other substances. This mixture is heated to 1650°C to melt everything together so that more materials can be added. The fluid steel is then shaped into the desired forms and allowed to cool (Figure 7.9).

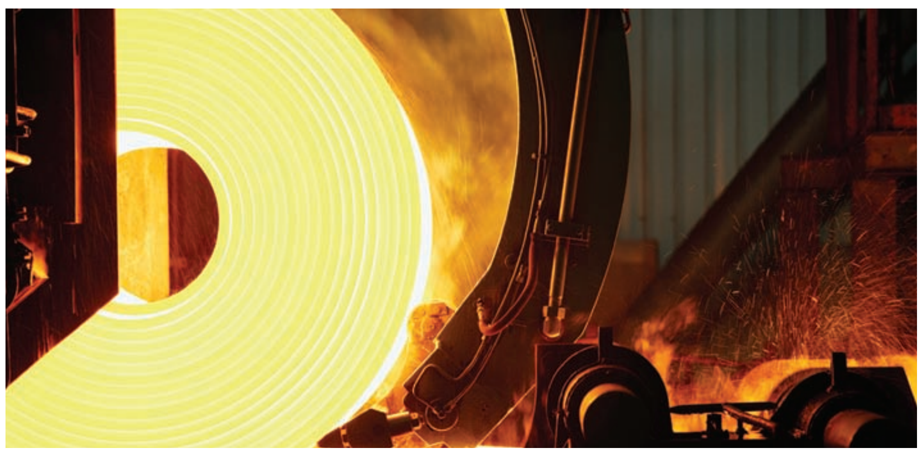


Figure 7.9 Molten steel on a rolling mill

C5 *During Reading*

Thinking Literacy

POE (Predict, Observe, Explain)

Readers often make an "educated guess" about what will happen as they approach new or unfamiliar text or topics. This same strategy can help us in science. This chapter contains several Quick Labs and an Inquiry Activity. Set up a three-column chart in your notes with the headings: Predict, Observe, and Explain.

Read through C6 Quick Lab, Functions of Fluids, on page 195. Notice the title, purpose, and procedure. How can you connect them to other learning or experiences you have had? Use this background knowledge to predict what you think will happen when you do the lab. Record and explain your prediction in the first column of your chart. You have now formed a hypothesis about what you think will happen!

As you do the lab, record what did happen in the Observe column. The Explain column is a place for you to connect to your learning in this chapter and explain the results of the Quick Lab.

Other Uses for Fluids

Fluids have many other uses. For example, oil is added to the engine of a car to decrease friction, and to reduce noise, heat, and wear. Paint is applied to iron to create a barrier that prevents rust from forming. A fluid circulating in the back of a refrigerator keeps the temperature cool, and a fluid circulating in a radiator can warm a room. Some fluids, such as gases, can be forced into a smaller volume, such as the air that pumps up a bicycle tire or the air in a breathing apparatus for scuba divers (Figure 7.10).

Take It *Further*

Plasma is considered to be a fourth state of matter. How is plasma different from a gas? Begin your search at ScienceSource.

Figure 7.10 Scuba tanks are sometimes filled with a mixture of gases that includes slightly more oxygen than what is found in ordinary samples of air.

C6 *Quick Lab*

Functions of Fluids

You are at a birthday party and all around you are colourful balloons. Helium balloons are floating near the ceiling and air-filled balloons cover the walls. A balloon is an example of an everyday object that requires a fluid to function properly.

Purpose

To identify, describe, and explain a variety of everyday common devices that require a fluid to function

Materials & Equipment

- chart paper
- fluid-operated device supplied by your teacher
- felt pens

Procedure

1. Brainstorm with your partner objects or devices that require the use of a fluid to operate. List your ideas on the chart paper.
2. From your list, identify 10 objects or devices that use a variety of different fluids.
3. Create a chart that explains how each object or device functions. You may want to use a chart like Table 7.1.

Table 7.1 Functions of Fluids

Object or Device	Type of fluid used to operate object or device	How the fluid helps the object or device to function

4. Your teacher will provide you with a device that requires a fluid to operate. Add the name of this device to your chart and complete the chart.
5. Present your chart to the class.

Questions

6. (a) List the different fluids that you and your classmates identified.
   (b) Explain how the fluids were used in various objects and devices.
7. What was the most common state of matter for the fluids you identified?
8. Choose one object or device. How could it operate if another fluid were used in place of the one usually used?

7.1 CHECK and REFLECT

Key Concept Review

1. Name two fluid technologies that make use of air.
2. Name two fluid technologies that make use of water.
3. Describe an example where materials are prepared as fluids so that they can be moved more easily.
4. Explain why it is important for steel to go through a fluid phase as it is being produced.

Connect Your Understanding

5. Review the list of fluids and their uses that you made for Figure 7.3 on page 192. What changes would you make based on what you have learned?
6. Add at least three other examples of fluids to your list in question 5. Make one new category for your list.

Practise Your Skills

7. Describe how different fluids are used to operate the can of spray paint shown below.

For more questions, go to ScienceSource.

C7 *Thinking about Science and Technology*

Useful Properties of Fluids

Each of these photographs shows fluids in use.

1. How are our lives improved by each of the uses shown?
2. How have advances in technology contributed to each use?
3. What are environmental issues raised by each use?

(a)

(b)

(c)

7.2 Fluids and the Particle Theory of Matter

Here is a summary of what you will learn in this section:

- Matter is anything that has mass and volume.
- The particle theory of matter is a way of explaining the behaviour of matter.
- Solids hold a definite shape because their particles are packed closely together and vibrate in one place.
- Liquids can flow and take the shape of their container because their particles have partly overcome their attraction for each other.
- Gases can flow and spread out because their particles are far apart and have overcome their attraction for each other.

In how many different states is water shown in Figure 7.11? There is liquid water around the kayak, water in its solid state in the iceberg, and water in its gaseous state in the air. The water, the iceberg, and the clouds are all examples of matter. The kayak, the person, and the paddle are also matter. **Matter** is anything that has mass and volume. **Mass** is a measure of how much matter there is in a substance. **Volume** is a measure of how much space a substance takes up.

Figure 7.11 Three states of matter are shown in this photograph.

C8 *Starting Point* Skills A C

Colourful Crystal

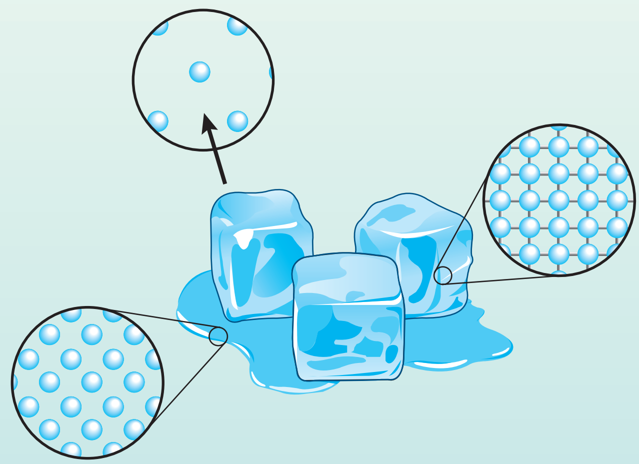
A crystal of potassium permanganate was carefully added to the still water in Figure 7.12(a). The photograph in Figure 7.12(b) shows the potassium permanganate after 5 min. What do you think happened? How do you think this happened?

Figure 7.12 Potassium permanganate in water

The Particle Theory of Matter

In earlier grades, you may have learned about the particle theory of matter. The **particle theory of matter** is a simple way of describing matter and its behaviour. You can use the particle theory of matter to help you understand how matter behaves in each state. The particle theory has six main points that describe the structure of matter.

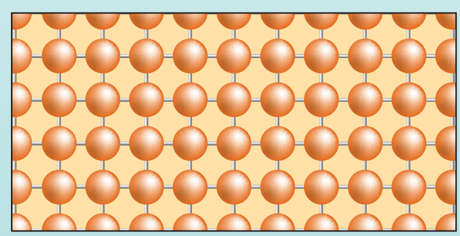
1 All matter is made up of tiny particles.



2 All particles are in constant motion.

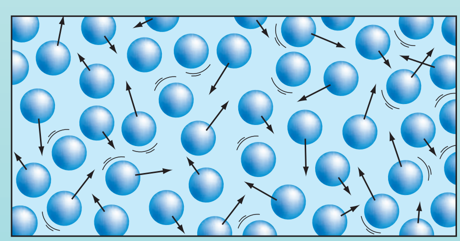
3 All particles of one substance are identical.

4 Temperature affects the speed at which particles move.



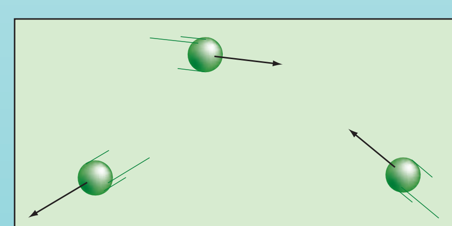
solid

5 In liquids and solids, the particles are close together and have strong forces of attraction between them.



liquid

6 In a gas, there are spaces between the particles.



gas

C9 *Learning Checkpoint*

Understand the Text

Answer the following questions. You can check your answers by looking back through the previous two pages.

1. Which has more particles in the same volume, liquid water or water vapour?
2. In which state of matter do particles stay in more or less the same position?
3. In which state of matter is there the greatest space between particles?

How the Particle Theory Explains Properties of Fluids

The particle theory states that particles are attracted to each other. However, particles in some substances may be more attracted to particles in other substances than they are to each other. For example, when potassium permanganate is placed in water, its particles are more attracted to the water particles than to other potassium permanganate particles. Since the water particles are continually moving, the potassium permanganate particles are moved farther apart. This is the process we call dissolving.

Liquids Can Flow

Particles in a liquid can overcome some of their attraction to each other and slide past each other. This is why liquids flow and take the shape of their container. For example, water takes a different shape in a vase compared to in a bowl.

Gases Can Flow

Gas particles move so quickly and are so far apart that they overcome almost all of their attraction to each other. This is why gases flow and spread out to all parts of their container. For example, if you spray some air freshener in one part of a room, you can soon smell it in other parts of the room.

Suggested Activities

C10 Quick Lab on page 200
C11 Inquiry Activity on page 201

Figure 7.13 When the temperature drops, the particles in the tube move closer together and the level of liquid falls.

Take It ***Further***

You have probably heard about atoms. How are atoms related to particles? Find out about atomic structure at ScienceSource.

Thermal Expansion and Contraction

When the temperature of a solid, liquid, or gas increases, its particles move faster and farther apart. As a result, the substance expands. **Thermal expansion** is an increase in the volume of a substance in response to an increase in its temperature.

When the temperature of a solid, liquid, or gas decreases, its particles move more slowly and closer together. As a result, the substance shrinks, or contracts. Substances expand or contract with changing temperature at their own particular rate.

A thermometer shows the temperature by the expansion or contraction of a liquid in a narrow tube (Figure 7.13). When the temperature rises, the particles in the tube move farther apart as their motion increases. Even a slight expansion results in a large change on the temperature scale.

C10 *Quick Lab*

Balloon Tricks

Purpose

To observe evidence of the particle theory of matter

Materials & Equipment

- 2 round balloons
- measuring tape
- heat lamp
- felt pen
- bowl of ice water

Procedure

1. Make a table to record your data.
2. Blow up the two balloons about three-quarters full, and tie them off.
3. Use the felt pen to label one balloon “cool” and the other balloon “warm.”
4. Measure and record the circumference of the largest part of each balloon.
5. Place the balloon labelled “cool” in a bowl of ice water until you observe a change in its size.
6. Place the balloon, labelled “warm” near a heat lamp until you observe a change in its size.
7. Measure and record the circumference of the largest part of each balloon.

Questions

8. (a) How did the balloon change when it was cooled?

   (b) How did the balloon change when it was warmed?
9. How would you explain your observations using the particle theory of matter?

DI Anchor Activity

C11 *Inquiry Activity* Toolkit 2

SKILLS YOU WILL USE
- Measuring
- Drawing conclusions

Mixtures of Matter

Question

How does the particle theory of matter explain what happens when substances are combined?

Materials & Equipment

- 50 mL of small marbles in a 250-mL beaker or graduated cylinder
- 50 mL of sand
- 50 mL of water

Procedure

Part 1 — Predict and Measure

1. Copy the following table into your notebook. Give your table a title.

Table 7.2 Data Table

	Predicted Volume (mL)	Actual Volume (mL)
50 mL of marbles + 50 mL of sand		
50 mL of marbles and 50 mL of sand + 50 mL of water		

2. Predict and record the volume that will result when you add 50 mL of sand to 50 mL of marbles.
3. Slowly pour the 50 mL of sand into the container of marbles. Measure and record the total volume.
4. Predict and record the volume that will result when you add 50 mL of water to the mixture.
5. Slowly pour the 50 mL of water into the container of marbles and sand. Measure and record the total volume. Be sure to wipe up any spills immediately.

Part 2 — Combining Two Liquids

6. A lab technician measured 20 mL of rubbing alcohol into one graduated cylinder and 20 mL of water into a second graduated cylinder as shown in Figure 7.14(a). She then combined the two liquids. The combined liquid filled the graduated cylinder to a level of 39 mL in Figure 7.14(b).

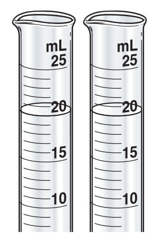


Figure 7.14(a) 20 mL of rubbing alcohol and 20 mL of water in separate 25-mL graduated cylinders

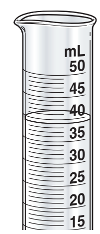


Figure 7.14(b) The two liquids combined in one graduated cylinder

Analyzing and Interpreting

7. (a) Would the end total volume in Part 1 be the same if you added the marbles to the sand instead of vice versa?

   (b) Why or why not?

8. (a) Would it make a difference to the total volume if you added the water to the marbles before the sand in Part 1?

   (b) Why or why not?

Skill Builder

9. What are possible sources of error when the technician combined the liquids in Part 2?

Forming Conclusions

10. If no error occurred in Part 2, why was the sum of the volumes of the liquids less than 40 mL?

7.2 CHECK and REFLECT

Key Concept Review

1. (a) What does "mass" mean?

(b) What does "volume" mean?

2. According to the particle theory of matter:

(a) How is the motion of particles in a liquid different from the motion of particles in a solid?

(b) How is the motion of particles in a gas different from the motion of particles in a liquid?

3. (a) What determines a liquid's shape?

(b) What determines a gas's volume?

4. Which two states of matter can flow?

Connect Your Understanding

5. Why did the potassium permanganate crystals in Figure 7.12 on page 197 start to dissolve in water without being stirred or shaken?

Practise Your Skills

6. Explain why highways and bridges must be built with gaps, as shown in the photograph below.

For more questions, go to ScienceSource.

C12 *Thinking about Science and Technology*

When Water Freezes

The volume of most fluids decreases when they cool from a liquid to a solid. Water is an exception. When water freezes, the resulting ice takes up more volume than the liquid water did. The repeated freezing and thawing of water in cracks damages roads by causing potholes, bumps, and cracking.

What to Do

With a partner or in a group, discuss and record your ideas about the following questions.

1. What are the safety issues of water that freezes and thaws?

2. Suggest a method that could be used to prevent damage to roads caused by water freezing and thawing.

3. What are the costs associated with water freezing and thawing? Who pays? Who should pay if there is an accident?

Glowing Glass

Figure 7.15 Blowing molten glass with a blowpipe

Figure 7.16 Glass can be sculpted into many colourful shapes and forms.

The art and technology of making beautiful glass sculptures began over 3500 years ago. In the early days of glass making, silica sand was heated to more than 1700°C. At this temperature, the sand melts and becomes a fluid, resembling syrup on a cold day. When the fluid slowly cools, the hardened material becomes glass, similar to that in windows.

Coloured glass was created by adding other compounds to the silica sand. For example, green-brown glass was created by adding iron oxide. Light blue and red glass needed copper compounds to be added.

Today, there are several different techniques for creating glass art that involve the glass being heated to different temperatures.

- *Slumping* involves heating the glass to temperatures around 600°C so it can be shaped in a mould. Slumping is sometimes used to make objects such as glass bowls.
- When glass is heated to between 700°C and 800°C, it starts to become "sticky." *Glass fusing* involves placing various pieces of glass on a surface so that they are in contact. When the assembled pieces are heated, they adhere and become one solid piece. Mosaic tiles and some stained glass windows are made this way.
- *Glass blowing* involves using air to shape the fluid glass, much like blowing a bubble with bubblegum. Glass blowing involves temperatures around 1000°C. At these temperatures, the liquid glass flows much more easily than at lower temperatures. A hollow blowpipe is dipped in the molten glass so that the end of the blowpipe is covered in glass, much like dipping a straw in liquid honey. The artisan then blows through the blowpipe to create the hollow bubble of glass. By using different tools and techniques, this bubble can be shaped and sculpted.

Questions

1. Explain what happens to how glass flows as it is heated.
2. Which of the three methods do you think would be used to create the glass in a light bulb? Explain.
3. In your opinion, is it more important for a glass sculpture to be beautiful or to be practical? Explain.

7.0 Chapter Review

Assess Your Learning

Key Concept Review

1. Describe the process for getting rid of broken glass in your class. (k)
2. What are the safety procedures for tasting and smelling substances in the science room? (k)
3. What are the six main points of the particle theory of matter? (k)
4. Make a particle sketch showing how the volume of a liquid changes when heat is added. (k)
5. Explain how a fluid is different from a solid in terms of its shape. (k)
6. Describe an example where materials are prepared as fluids to make it easier to use them. (k)

Connect Your Understanding

7. What symbols would you expect to find on containers of the following fluids? (k)
   - oven cleaner in a spray can
   - bleach
8. What is an example of thermal expansion that you have observed in your daily life? (a)
9. How does applying oil to a bicycle help the bicycle to work better? (a)

After Reading Thinking Literacy

Reflect and Evaluate

Revisit the prediction you made at the start of this chapter. Was your prediction correct? How did what you already know (your prior knowledge) help you make a prediction? Did making a prediction before a Quick Lab or Inquiry Activity help you? Share your ideas with a partner.

ACHIEVEMENT CHART CATEGORIES

(k) Knowledge and understanding (t) Thinking and investigation (c) Communication (a) Application

10. Arrange the following list into two columns titled "Fluids" and "Non-fluids." a

- sunscreen
- baby powder
- hand lotion
- helium
- carbon dioxide
- syrup
- ketchup
- mustard
- flour
- sugar
- orange juice
- soy sauce

11. Use the particle model to explain the difference in appearance between steam and liquid water. t

12. Why does a liquid take the shape of the container but not expand to completely fill the container? t

13. Suppose you had to remove a tight-fitting lid from a jar. Would it be a good idea to heat the lid or cool it before trying to remove it? Explain your answer. a

14. If you pour sand into a container, it appears to take the shape of the container. How could you prove that sand is not a fluid? t

Practise Your Skills

15. Identify a fluid technology you have recently used to make your life easier or better. Draw a chain of events that shows the fluid, how you used it, and how it improved your life. a

Unit Task Link

In your Unit Task, you will investigate the effect of a variable, such as temperature, on the movement of fluid in a pipeline. The fluid in this task will be a liquid. Use the particle model to explain how temperature will affect the liquid in your pipeline.

C13 *Thinking about Science and Technology*

STSE

Technology Tools

The goal of technology is to provide solutions to practical problems. With a classmate or as a whole class, discuss the following questions.

1. What are three problems that fluid technology helps to solve?
2. How does a fluid help to solve each of the problems?