Topic 2.1

In what ways do chemicals affect your life?

Key Concepts

- Everything—including you and everything around you—is made up of chemicals.
- Substances have characteristics that make them useful, hazardous, or both.
- Handling chemicals and lab equipment safely and responsibly is a part of your life at school.

Key Skills

Inquiry
Literacy
Research

Key Terms

matter

Each day, you use substances that have been invented to make your life easier and more enjoyable. For instance, at one time, pop, juice, and other mass-market drinks were sold in glass bottles or steel cans. Due to expense, steel cans were later replaced with cans made from aluminum. Soon glass gave way to plastic. Next time you reach for a drink in a plastic bottle, think about the matter and energy that went into making it. For example, what resources were used? What will happen to that bottle when you finish your drink?

Actually, what happens to the bottle might surprise you. As you can see on these two pages, many different products can be made from recycled PET plastic. (PET is short for a substance called **p**oly**e**thylene **t**erephthalate [PAW-lee-ETH-eh-leen TER-ef-THAL-ate]. It's the type of plastic that is branded with the numeral one in recycling logos for plastic.)

Starting Point Activity

1. What characteristics make glass, steel, aluminum, and plastic suitable for use as drink containers?
2. Why have plastic containers for drinks become so widely used?
3. What do you usually do with plastic drink bottles that you use (if you use them)?
4. Are you surprised by any of the items that are made using recycled soft drink bottles? Explain.
5. Ontario is one of the few provinces in the country that has curbside pickup for plastics and other recyclables. (In most other provinces, people have to take recyclable materials to depots themselves.) And yet statistics in 2004 showed that Ontario had the second-worst rate of recycling PET plastic in the country. Why do you think this is so? What could be done to change this situation?

scouring pads

paint brush

waste receptable

kayaks

veterinary cone

netting

The pictures in the circles are just seven examples of products that can be made from the plastic used to make drinking bottles.

Everything—including you and everything around you—is made up of chemicals.

Literacy Focus

Activity 2.1

CHEMICAL-FREE! (OH, REALLY?)

Consider the three facts below.

- A popular coffee company says it uses a process to remove caffeine without the use of chemicals. The process involves soaking the coffee beans in water to dissolve the caffeine and wash it out of the beans.
- A company that makes environmentally respectful products makes a cleaning cloth that kills bacteria and other germs. The cloth contains tiny bits of silver. The company says, "Silver is a metal, not a chemical."
- Many gardeners proudly proclaim their lawns and gardens are chemical-free. Their results depend on methods that include the use of natural fertilizers such as manure and nutrient-rich compost.

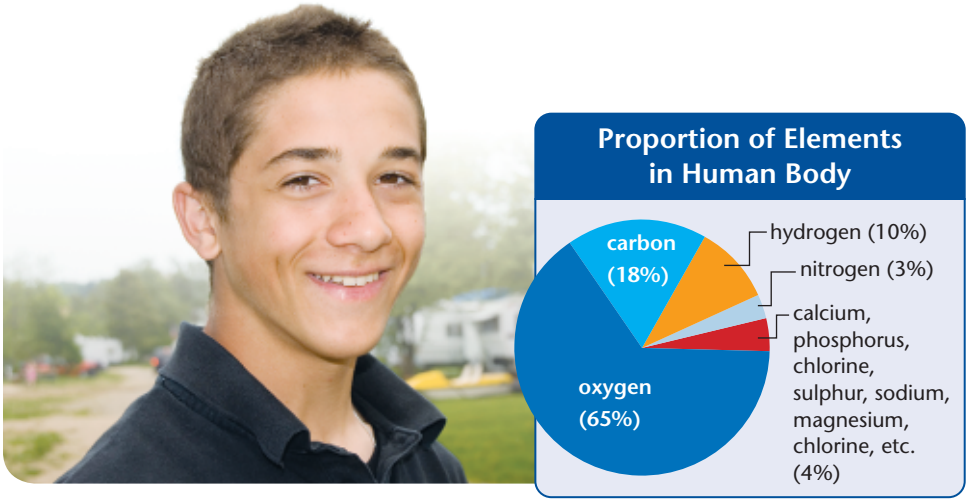
Now work together in small groups to answer these questions. You can refer to books or other information sources if you like.

1. What do you think "chemical-free" means?
2. Is it possible for any product to be chemical-free? Explain.
3. What is a chemical?

Before you got to school today, you probably touched or used any or all of the following items: toothpaste, soap, water, food, paper, fabric, concrete, grass or snow (depending on the time of year), metal.

When you or a family member cleans your home, you probably use some or all of the following items: detergent, vinegar, window cleaner, scouring powders or liquids, furniture polish.

To maintain a car, truck, or bus in good working condition, a mechanic uses some or all of the following items: lubricating oil, engine oil, degreasing liquids, windshield-washer fluid, brake fluid, transmission fluid.



◀ **Figure 2.1** Elements are a certain kind of chemical that you will learn about starting in Topic 2.3. This pie graph shows the most abundant elements that make up the human body. The size of the pie wedges represents the proportion of the body that is made up of that element or elements.

Matter: The "Stuff" of the Universe

People commonly refer to many items in their daily life as "chemicals." But what is a chemical? You might think that it means something very specific to a scientist. After all, scientists are very careful about the ways that they define and use terms and ideas. However, the word "chemical" does not have a specific scientific meaning. That's because everything in the world that isn't energy is a chemical or contains chemicals. For example, do you think of yourself as being chemical-free? Think again. **Figure 2.1** shows that you are made up mostly of four chemicals of a certain type, with smaller amounts of many, many others.

When people use the word "chemical," they are really talking about matter. Anything—any *thing*—that has mass and that has volume (takes up space) is **matter**.

matter: anything that has mass and volume

LEARNING CHECK

1. Define the term "matter."
2. Use the pie graph in **Figure 2.1** to help you determine which element is most abundant in your body.
3. Refer to the photo of the plastic drink bottle on page 94. Check at home for products packaged in plastic that have the recycling code "1." What products did you find?
4. What kinds of problems in communication and understanding can result when people use the word "chemical" when they are talking about issues involving health and the environment? Describe two examples.

Substances have characteristics that make them useful, hazardous, or both.

Table 2.1 outlines the characteristics of two substances (certain kinds of matter) that are found in many homes. Notice that a substance can be both useful and hazardous at the same time.

Table 2.1 Useful and Hazardous Characteristics of Two Common Substances in the Home

Substance in the Home	Useful Characteristics	Hazardous Characteristics
ammonia (an ingredient in some cleaning products)	kills bacteria and other germs	• can burn skin and other body tissues • poisonous—can cause dangerous irritation if inhaled • releases poisonous gas if mixed with certain other substances such as chlorine
methane (a fuel—natural gas—that is used for heating, cooking, and transportation)	burns cleanly and efficiently in the presence of plentiful oxygen	• explosive • fumes can cause suffocation

Research Focus

Activity 2.2

CONSIDERING PROS AND CONS

What To Do

1. In pairs, choose one of the chemical substances from the list below. Do research to complete one row of the table. Compile the data as a class.

gold	propane	muriatic acid (hydrochloric acid)	acetone
iron	caustic soda (sodium hydroxide)	sulfuric acid	lead
mercury			methanol

Substance	Common (or main) Uses	Useful Characteristics	Hazardous Characteristics	Special Storage and/or Disposal Requirements

Plastics: Not All Are Alike

Many stores and municipalities have banned or phased out the use of plastic grocery bags. But believe it or not, plastic grocery bags were introduced in the 1970s to provide a solution to the problems associated with paper bags. Producing a plastic bag takes less energy than producing a paper bag and does not use trees, a scarce resource. Recycling plastic takes less energy than recycling paper, and plastic bags can be reused for trash, as a lunch bag, or to pick up after your pet. More durable and lightweight than paper, plastic bags provided consumers with a solution to the problems that were identified at the time.

Since then, many hazards have been associated with the use of plastic bags, mostly because they are so durable that they won't decompose over time. The features that made plastic bags so attractive are now the ones causing most of the problems. But not all plastics are alike. For instance, when hospital workers change the sheets on a patient's bed, or collect the laundry after a surgery, they expose themselves to blood, urine, and other body fluids that put them at risk for infection. By collecting the laundry in polyvinyl alcohol (PVA) plastic bags (refer to **Figure 2.2**), the risk of infection is lowered because workers only handle the dirty laundry once.

Huh? How does the laundry get out of the bag? It doesn't have to! PVA bags dissolve in hot water, so hospital workers can load full bags of dirty laundry into the washing machine and turn it on. The bags dissolve in the water, leaving only the laundry behind.

These bags were first developed for use in hospitals, but also can be used to clean up after pets and to hold bait for fishing. Scientists hope that they may be able to further modify this plastic to be used in other applications. However, are there any risks to the environment from using dissolvable plastic? There is not yet enough data to answer this question. It must be answered in future so that people can make informed decisions about whether or not to use products made with dissolvable plastic.

▲ **Figure 2.2** These dissolvable plastic bags hold contaminated laundry.

LEARNING CHECK

1. Refer to **Table 2.1**. Describe one useful characteristic and one hazardous characteristic of ammonia.
2. Explain why hospital workers can load PVA bags of laundry right into a washing machine without having to empty the laundry out of the bag first.
3. Describe how you think a PVA plastic bag could be useful in your life.

Go to **scienceontario** to find out more

Handling chemicals and lab equipment safely and responsibly is a part of your life at school.

Making sure that you know how to handle chemicals safely in the laboratory is an essential part of your exploration of matter. In previous science studies, you have learned and practised safe techniques and procedures for handling chemicals and equipment. Use **Figure 2.3** to help refresh your memory on some of the safety icons and WHMIS symbols that you are likely to see in this unit. The "Safety in the Science Classroom" section on page xv near the start of this book has a more complete list of safety icons and WHMIS symbols. Also, as part of the WHMIS system, there are material safety data sheets (MSDS) that are available for each chemical that you will handle in the lab.

Figure 2.3 The safety icons (in red and white) and WHMIS symbols (in black and white) communicate important information about chemicals, equipment, and procedures in an experiment.

Inquiry Focus

Activity 2.3

SAFETY FIRST

When performing an experiment, you must be able to recognize the safety icons and symbols that are used and know the precautions you need to take. Can you easily recognize all the potential hazards associated with the instructions below?

What To Do

1. Read over the list of safety icons and the list of WHMIS symbols in the "Safety in the Science Classroom" section on page xv.
2. The instructions in the column of text to the right of this column of text describe eight different lab procedures. As you read the instructions, draw the symbols that apply to each instruction. You should use every icon and symbol at least once in this activity. (An instruction might need more than one symbol.)

Instructions

A. Make sure that your lab station is clear and dry. Then plug in the electric hot plate and turn it on.

B. Do not add water to the sugar before heating the sugar.

C. Light the Bunsen burner. Then heat the test tube gently by holding it above the flame.

D. Let the steel pin cool for 10 min. When the pin has cooled, put it into the container as the teacher has shown.

E. Heat the test tube with a Bunsen burner gently at first, and then more strongly. Do not breathe the irritating ammonia gas that forms.

F. Using a medicine dropper, add the acid, one drop at a time, to the base. Be careful that you do not spill either the acid or the base.

G. Add two drops of the solution. The solution can be absorbed into the skin, so be careful that you do not get any on you.

LEARNING CHECK

1. What information is communicated by the safety icons and WHMIS symbols in this textbook?
2. Which safety icons could be used for almost any laboratory experiment. Explain your answer.
3. Write a "Caution!" statement for each of the instructions in Activity 2.3 to draw attention to one safety hazard. Here is an example for Instruction C: "Caution! Wear safety goggles to protect your eyes."
4. Make a sketch of your science lab or classroom to show the location of the emergency exits, eyewash stations, fire extinguishers, and any other emergency equipment.
5. List any safety rules that your teacher has given you that apply specifically to your classroom.

Strange Tales of Science

MINDING
SCIENTIFIC INQUIRY

He helped invent the method of scientific inquiry that scientists use today. And in his spare time he created a new type of mathematics. But after he died, someone took his brain! BWAAHHAHAHAHAHAHAH!

Um...Okay, so they didn't take his brain, but they did take his skull, and much of the rest of his remains. Sixteen years after the celebrated French Thinker, René Descartes, was buried in Denmark, far from his place of birth, someone dug up his coffin and made off to France with his head and bones.

So... What do you think?

1. Did someone really dig up Descartes' body and take his head and bones?
2. Find out two things that Descartes did to help invent science inquiry.
3. Stating a hypothesis is one of the skills of scientific inquiry. Which of these skills have you used in your science course this year?

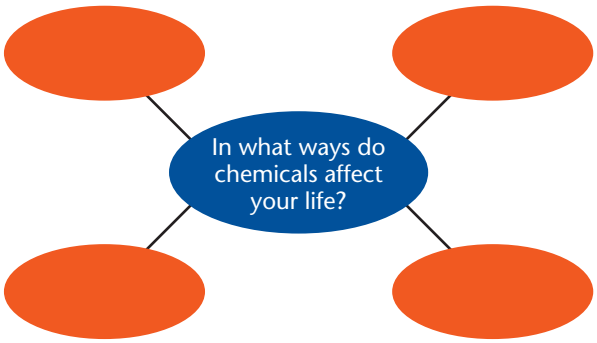
Topic 2.1 Review

Key Concepts Summary

- Everything—including you and everything around you—is made up of chemicals.
- Substances have characteristics that make them useful, hazardous, or both.
- Handling chemicals and lab equipment safely and responsibly is a part of your life at school.

Review the Key Concepts

1. K/U Answer the question that is the title of this topic. Copy and complete the graphic organizer below in your notebook. Fill in four examples from the topic using key terms as well as your own words.



2. T/I The table below lists the ten most common elements in Earth's crust. They are listed in alphabetical order. Use the data in the table to make a pie graph. (The numbers have been rounded off and will add up to 100.)

Element	Approximate Percentage in Earth's Crust
aluminum	8
calcium	4
iron	5
magnesium	2
oxygen	47
potassium	3
silicon	28
sodium	3

3. K/U In your own words, define "matter."

4. A Recycling code "1" represents PET plastic. Recycling code "4" represents LDPE plastic—the type of plastic used to make plastic shopping bags. (LDPE stands for low density polyethylene.) Search the Internet to find out what products are made from LDPE.

a) List four products that are made from LDPE.

b) List at least two products that are made from recycled LDPE.

c) Describe how your life would be different if you eliminated all products made with LDPE from your life.

d) Describe how your life would be different if you eliminated all products from with plastic from your life.

5. C Explain using words or a picture how a common product such as toothpaste, deodorant, shampoo, dish soap, perfume, soap, hair mousse, or hair gel could affect your life, the environment, or both.

6. C Use a concept map to explain to a Grade 3 student what the word "chemical" means.

7. A Some cities in the province of Ontario have banned the sale of bottled water in certain city-run facilities such as arenas and community centres. List the pros and cons of such bans, and then write a brief paragraph expressing your opinion of banning bottled water.