

## Topic 2.1

# How do chemical reactions affect your daily life?

### Key Concepts

- Chemical reactions support our lives and assist us at home and at work.
- Chemical compounds require safe handling to minimize their hazards.

### Key Skills

- Inquiry
- Literacy

### Key Terms

chemical reaction  
product  
reactant  
dilute

If something has a “practical application,” it has a use that people consider to be important, handy, or helpful. All the products and events in the photos on these two pages involve a chemical reaction. Each of them could be considered a practical application of a chemical reaction.



A car battery



A welder's torch



Fresh-baked bread



Food cooking

## Starting Point Activity

Work in small groups to complete these tasks. Make sure that you reach an agreement in each task.

1. As a group, discuss what a chemical reaction is. Come to an agreement on the definition of a chemical reaction.
2. Discuss the photos on these two pages. Explain why each photo involves a chemical reaction.
3. List at least three other chemical reactions that you consider to have practical applications.
4. List at least three chemical reactions that you consider *not* to have practical applications.
5. What makes your answers to question 3 different from your answers to question 4?
6. Compare your lists with those of other groups in the class. Does everyone agree on what should be considered practical and what should not be? Does it matter if “practical application” means different things to different people? Give reasons to justify your answer.



A flare used to signal for help



Food preservatives



Ethanol added to gasoline



Brightening and disinfecting fabrics

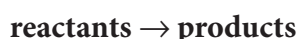
# Chemical reactions support our lives and assist us at home and at work.

**chemical reaction:** a change in matter that produces new substances with new properties

**products:** new substances produced in a chemical reaction

**reactants:** substances that react together in a chemical reaction

Perhaps the most practical application of chemical reactions is life itself. Your body is fuelled by chemical reactions, and the food that supplies the fuel is formed by chemical reactions. A **chemical reaction** is a change in matter that produces new substances with new properties. Recall that, in a physical change, no new substances are produced. The substance just changes its appearance. A chemical reaction also involves energy. Some chemical reactions store energy, while others release energy. For example, when paper burns, the chemical reaction is releasing energy in the form of heat. The new substances that are produced in a chemical reaction are called **products**. The substances that react together in a chemical reaction are called **reactants**. You can write a chemical reaction as:



The arrow indicates that a chemical change takes place. **Figure 2.1** reviews the reactants and products of the chemical reactions that support and sustain your life and most other life on Earth.

## ► Figure 2.1

Photosynthesis and cellular respiration are examples of chemical reactions. Photosynthesis is an example of a chemical reaction that stores energy. Cellular respiration is an example of a chemical reaction that releases energy.



**reactants:** carbon dioxide and water

**products:** sugar and oxygen

Photosynthesis is a series of chemical reactions that stores energy in the form of food (sugar), which you and other organisms depend on.



**reactants:** sugar and oxygen

**products:** carbon dioxide and water

Cellular respiration is a series of chemical reactions that releases energy from the food you eat to “power” all the functions and activities inside your body.

## Chemical Reactions at Home and at Work

Many different chemical products are found at home, including cleaners, foods, and food ingredients. All of these products are produced using chemical reactions or are used to make chemical reactions happen. One common product found in most homes is vinegar.

Vinegar is produced from chemical reactions that involve yeast and fruit sugars. Vinegar is actually a **dilute** solution of a chemical called acetic acid in water. In its dilute form, household vinegar can be used in recipes or as a cleaner. In its concentrated (non-dilute) form, acetic acid has many applications in industry and the workplace, as shown in **Figure 2.2**. However, concentrated acetic acid is not safe for home use. It is so powerful that it can burn through skin and other body tissues.

**dilute:** reduced in concentration by being mixed with a liquid, such as water



◀ **Figure 2.2** Acetic acid is used to make a variety of products that might surprise you. These include costume jewellery, fabrics, medicines, dyes, paint, weed killers, and a high-quality brand of playing cards.

### Inquiry Focus

#### Activity 2.1

#### INFLATING A BALLOON

#### Safety

Use a scoop to put about 15 mL of baking soda inside a balloon. Fit the balloon over the opening of a plastic bottle that is about one-third full of vinegar. Watch the balloon, and feel the bottle. What evidence shows that a chemical reaction is taking place?

### LEARNING CHECK

1. Name the reactants in the chemical reaction in Activity 2.1.
2. You put some water in the freezer and later it is solid. Has a chemical reaction occurred? Explain why or why not.

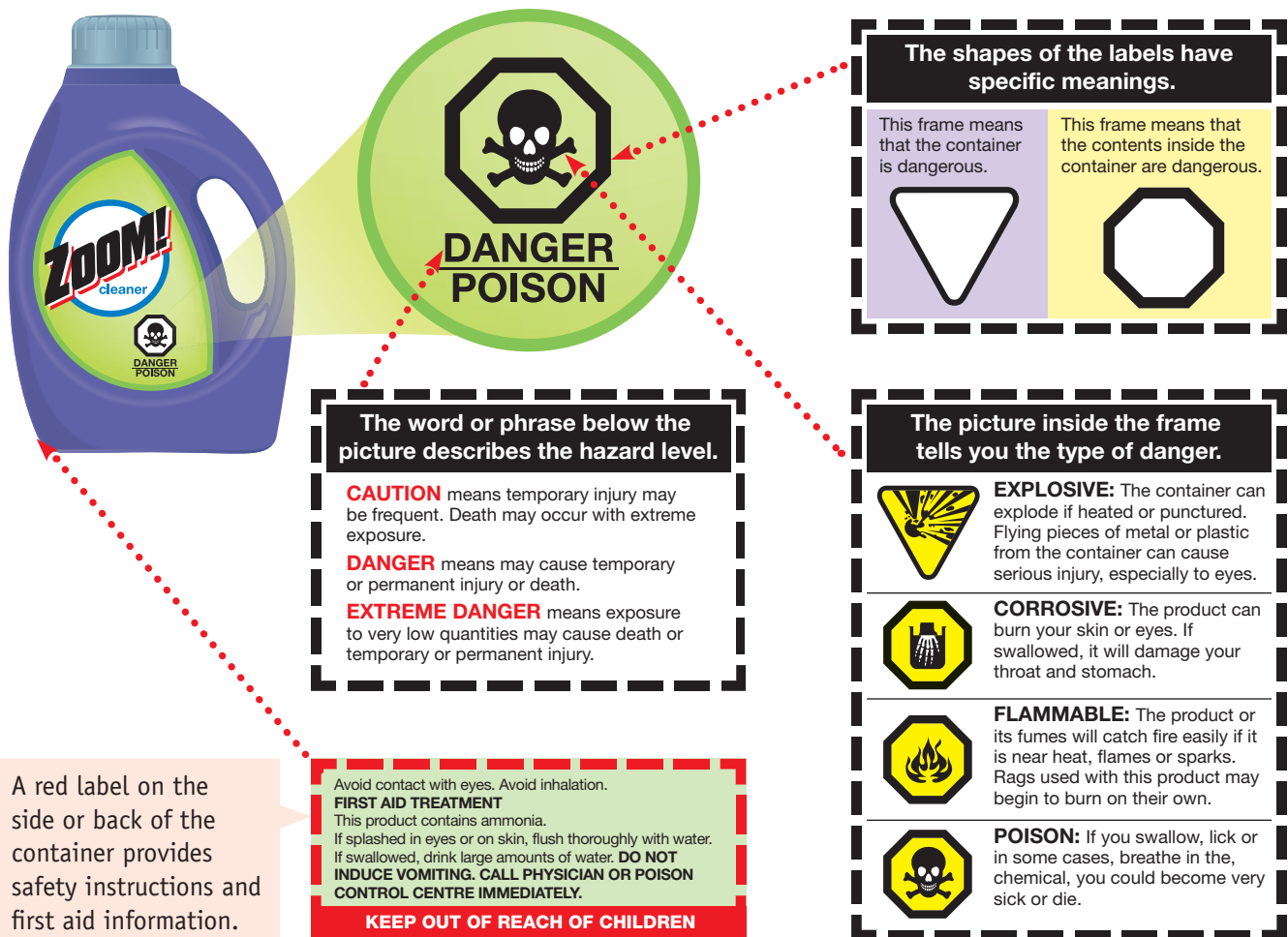
# Chemical compounds require safe handling to minimize their hazards.

Hazardous chemicals are not only found in laboratories and industries—they are also found in the home. Wherever you find them, you will find labels that explain possible hazards.

## Hazards in the Home

Many of the products in homes, supermarkets, and hardware stores have symbols on them to warn of possible danger. These Hazardous Household Product Symbols (HHPS) use different shapes and easy-to-recognize icons to display some basic safety information about a product. Figure 2.3 shows the meanings of the HHPS. The four categories of danger—explosive, corrosive, flammable, and poison—are kinds of chemical reactions.



▼ **Figure 2.3** These Hazardous Household Product Symbols (HHPS) were established by Health Canada in 2001.



**Zoom! cleaner**

**DANGER POISON**

**The shapes of the labels have specific meanings.**

This frame means that the container is dangerous.	This frame means that the contents inside the container are dangerous.
	

**The word or phrase below the picture describes the hazard level.**

**CAUTION** means temporary injury may be frequent. Death may occur with extreme exposure.

**DANGER** means may cause temporary or permanent injury or death.

**EXTREME DANGER** means exposure to very low quantities may cause death or temporary or permanent injury.

**The picture inside the frame tells you the type of danger.**

**EXPLOSIVE:** The container can explode if heated or punctured. Flying pieces of metal or plastic from the container can cause serious injury, especially to eyes.

**CORROSIVE:** The product can burn your skin or eyes. If swallowed, it will damage your throat and stomach.

**FLAMMABLE:** The product or its fumes will catch fire easily if it is near heat, flames or sparks. Rags used with this product may begin to burn on their own.

**POISON:** If you swallow, lick or in some cases, breathe in the, chemical, you could become very sick or die.

A red label on the side or back of the container provides safety instructions and first aid information.

Avoid contact with eyes. Avoid inhalation.  
**FIRST AID TREATMENT**  
This product contains ammonia.  
If splashed in eyes or on skin, flush thoroughly with water.  
If swallowed, drink large amounts of water. **DO NOT INDUCE VOMITING. CALL PHYSICIAN OR POISON CONTROL CENTRE IMMEDIATELY.**

**KEEP OUT OF REACH OF CHILDREN**

## Hazards in the Workplace

Workplaces, such as restaurants, repair shops, industrial plants, and schools, have many hazardous substances. The “Safety in the Science Classroom” section of this book lists the eight WHMIS symbols on page xv. WHMIS stands for **W**orkplace **H**azardous **M**aterials **I**nformation **S**ystem. WHMIS provides detailed information about how to store, handle, and dispose of chemical substances that are used in the workplace. It also provides first aid information.

There are two kinds of WHMIS labels: a supplier label and a workplace label. A supplier label, like the one in [Figure 2.4](#), is applied by the people who make the chemical product. A workplace label, like the one in [Figure 2.5](#), is applied to a container into which a product has been transferred from its original container. A workplace label is also attached to containers of employer-made products. Both kinds of labels must refer to a **Material Safety Data Sheet (MSDS)** for the product. An MSDS contains information about the composition and properties of a chemical substance, as well as steps for handling and storing it safely.

Go to [scienceontario](#)  
to find out more



**ACETONE**

SEE MATERIAL SAFETY DATA SHEET FOR THIS PRODUCT

**DANGER! EXTREMELY FLAMMABLE. IRRITATES EYES.**

**PRECAUTIONS:** Keep away from heat, sparks, and flames. Ground containers when pouring. Avoid breathing vapours or mist. Avoid eye contact. Avoid prolonged or repeated contact with skin. Wear splash-proof safety goggles or face shield and butyl rubber gloves. If acetone is present in concentrations greater than 250 ppm, wear a NIOSH-approved respirator with an organic vapour cartridge. Use with adequate ventilation, especially in enclosed areas. Store in a cool, well-ventilated area, away from incompatibles.

**FIRST AID:** In case of contact with eyes, immediately flush eyes with lots of running water for 15 minutes, lifting the upper and lower eyelids occasionally. Get medical attention immediately. In case of contact with skin, immediately wash skin with lots of soap and water. Remove contaminated clothing and shoes. Get medical attention if irritation persists after washing. Wash clothing before reuse. If inhaled, remove subject to fresh air. Give artificial respiration if not breathing. Get medical attention immediately. If swallowed, contact the Poison Control Centre. Get medical attention immediately. Do not give anything by mouth to an unconscious or convulsing person.

**ATTENTION! THIS CONTAINER IS HAZARDOUS WHEN EMPTY. ALL LABELLED HAZARD PRECAUTIONS MUST BE OBSERVED.**

**BIG**  
CHEMICAL COMPANY  
123 Nitro Avenue,  
Vapour Town,  
BC/123-4567

**ACÉTONE**

VOIR LA FICHE SIGNALÉTIQUE POUR CE PRODUIT

**DANGER! EXTRÊMEMENT INFLAMMABLE. IRRITE LES YEUX.**

**MESURES DE PRÉVENTION:** Tenir à l'écart de la chaleur, des étincelles et des flammes. Relier les récipients à la terre lors du transvasement. Éviter de respirer les vapeurs ou les brumes. Éviter le contact avec les yeux. Éviter le contact prolongé ou répété avec la peau. Porter des lunettes contre les éclaboussures de produit chimique ou une visière de protection, et des gants en caoutchouc butyle. Si l'acétone est présent en concentration de plus de 250 pour un million, porter un respirateur muni d'une cartouche à vapeur organique approuvée par NIOSH. Utiliser avec suffisamment de ventilation surtout dans les endroits clos. Entreposer dans un endroit frais, bien aéré, à l'écart des produits incompatibles.

**PREMIERS SOINS:** En cas de contact avec les yeux, rincer immédiatement et copieusement avec de l'eau courante pendant 15 minutes en soulevant les paupières inférieures et supérieures de temps en temps. Obtenir des soins médicaux immédiatement. En cas de contact avec la peau, laver immédiatement la région affectée avec beaucoup d'eau et de savon. Retirer les vêtements et les chaussures contaminées. Si l'irritation persiste après le lavage, obtenir des soins médicaux. Laver les vêtements avant de les réutiliser. En cas d'inhalation, transporter la victime à l'air frais. En cas d'arrêt respiratoire, pratiquer la respiration artificielle. Obtenir des soins médicaux immédiatement. En cas d'ingestion, contacter le Centre de Contrôle des Empoisonnements. Obtenir des soins médicaux immédiatement. Ne rien faire avaler à une victime inconsciente ou en convulsions.

**ATTENTION! CE RÉCIPIENT EST DANGEREUX LORSQU'IL EST VIDE. CHAQUE INDICATION DE DANGER SUR LES ÉTIQUETTES DOIVENT ÊTRE OBSERVÉES.**

▲ [Figure 2.4](#) An example of a supplier WHMIS label

**ACETONE**

**FLAMMABLE**

Keep away from heat, sparks, and flames

Wear butyl rubber gloves and safety goggles

Use with local exhaust ventilation

See Material Safety Data Sheet (MSDS) for more information.

▲ [Figure 2.5](#) An example of a workplace WHMIS label

### LEARNING CHECK

1. Study [Figure 2.4](#), and then decide what preventative measures you should take when working with acetone.
2. Use a Venn diagram to compare the function of the HHPS system and WHMIS in terms of their intended users.

### ACTIVITY LINK

Activity 2.2, on page 116

## Activity 2.2

### BECOMING FAMILIAR WITH AN MSDS


Products that have an MSDS range from potent firefighting substances to hair-care products. By law, certain information must appear on an MSDS, but there is no standard format. In this activity, you will examine the MSDS for a variety of products to determine the types of information that must appear on an MSDS.

#### What You Need

- MSDS for at least three products (from the Internet or supplied by your teacher)

#### What To Do

- Work in groups of three. Each group member is responsible for examining the MSDS for one product.
- In Canada, there are nine categories of information that must appear on an MSDS. Refer to the MSDS for your product. To the best of your ability, record what you think are the nine categories.
- When you are done, share your nine categories with your group members. Work together to agree on a final set of nine categories for your group.
- Compare your group's categories with those of other groups. If possible, work together to agree on a final set of nine categories for the class.
- Your teacher will tell you the nine categories that are required by law. Compare your group or class categories with the official ones.



**MATERIAL SAFETY DATA SHEET**

# CHLORINE

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**1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**

<p>ABC Gases Division of The ABC Group, Inc. 313 Oxygen Road North Bay, Ontario</p> <p>TELEPHONE NUMBER: (705) 555-5555 24-HOUR EMERGENCY TELEPHONE NUMBER: (408) 444-4444 Emergency Response Plan NO: <b>20101</b></p>	<p><b>PRODUCT NAME:</b> CHLORINE <b>CHEMICAL NAME:</b> Chlorine <b>COMMON NAMES/SYNONYMS:</b> Bertholite, Molecular Chlorine <b>TDG (Canada) CLASSIFICATION:</b> A, DIA, D2A, D2B, E, C <b>PREPARED BY:</b> ABC GASES 97050 555-5555 <b>PREPARATION DATE:</b> 3/1/00 <b>REVIEW DATES:</b> 3/7/01</p>
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**2. COMPOSITION, INFORMATION ON INGREDIENTS**

INGREDIENT	% VOLUME	PEL-OSHA <sup>1</sup>	TLV-ACGIH <sup>2</sup>	LD <sub>50</sub> or LC <sub>50</sub> Route/Species
Chlorine FORMULA: Cl <sub>2</sub> CAS: 7782-50-5 RTECS #: FO2100000	100.0	1 ppm Ceiling	0.5 ppm TWA 1 ppm STEL	LC <sub>50</sub> 293 ppm/1H (rat)

<sup>1</sup>As stated in 24 CFR 1910, Subpart Z (revised July 1, 1993)  
<sup>2</sup>As stated in the ACGIH 1994-95 Threshold Limit Values for Chemical Substances and Physical Agents

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**3. HAZARDS IDENTIFICATION**

**EMERGENCY OVERVIEW**  
 Corrosive and irritating to the eyes, skin and mucous membranes. Inhalation may result in chemical pneumonitis and pulmonary edema. Nonflammable oxidizer, may explode or accelerate combustion if contacting reducing agents.

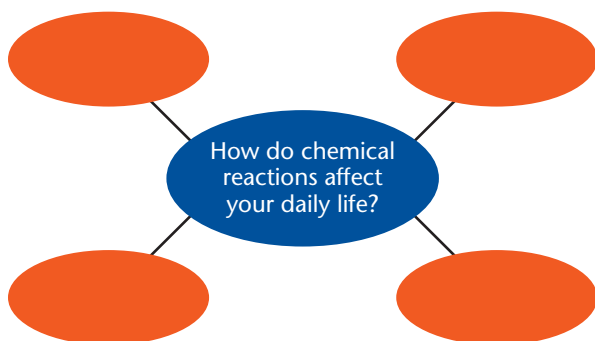
# Topic 2.1 Review

## Key Concept Summary

- Chemical reactions support our lives and assist us at home and at work.
- Chemical compounds require safe handling to minimize their hazards.

## 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. **K/U** Acetic acid (vinegar) and sodium hydrogen carbonate (baking soda) react in a chemical reaction to form carbon dioxide gas, water, and a solid substance called sodium acetate.
- Explain why this is an example of a chemical reaction and not a physical change.
  - Identify the reactants in this chemical reaction.
  - Identify the products in this chemical reaction.
3. **A** Name three substances or products in each of the following workplaces that you think have, or should have, a WHMIS label or hazard warnings on their labels.
- a hair salon
  - an automotive repair shop
  - a construction site
  - a school

4. **A** Explain why it would be important for workers in the following workplaces to understand WHMIS.
- a restaurant
  - a hair salon
  - a construction site
  - an automotive repair shop
5. **C** **a)** What do the letters MSDS represent?  
**b)** Name three places where you would expect to find files containing MSDS forms.
6. **C** Examine the product label below.



- Name a place in which you would expect to see a product with this label.
- Identify the three types of information on this label.
- Does this label give you all the information you need to handle the product safely? Explain your answer.