Unit 2 Chemical Reactions

Chapter 4 Developing Chemical Equations

Chapter 5 Classifying Chemical Reactions

Chapter 6 Acids and Bases

Unit 2 Chemical Reactions

BIG IDEAS

- Chemicals react with each other in predictable ways.
- Chemical reactions may have a negative impact on the environment, and may be used to address environmental concerns.

Overall Expectations

- **C1** analyse a variety of safety and environmental issues associated with chemical reactions, including the ways in which chemical reactions can be applied to address environmental challenges;
- **C2** investigate, through inquiry, the characteristics of chemical reactions;
- **C3** demonstrate an understanding of the general principles of chemical reactions, and various ways to represent them.

Materials

Please see page TR-31 for a list of the materials required for this unit and other units.

In this unit, students explore chemical phenomena and reactions. The unit builds steadily on prior knowledge, having students seek patterns and organize information about substances, and having them relate such information to earlier study of the periodic table. Students are encouraged to regard the periodic table as a tool, both for predicting and explaining patterns in the behaviour of substances, as well as for summarizing the system of chemical symbols and knowledge that makes it possible to balance equations and understand the predictability inherent in chemical reactions. Students build an understanding of how the loss, gain, or sharing of electrons leads to chemical bonding, and how this relates to naming and writing formulas for compounds. Chemical equations are introduced as a symbolic representation of chemical change and as an illustration of the law of conservation of mass, reinforcing that matter is not gained or lost in a chemical reaction.

Using the Unit Opener (Student textbook pages 132 to 133)

- As students enter the classroom, play "The Elements" by Tom Lehrer. Ask students if they recognize this song. Does it make sense? What do the words mean?
- The opener shows a river that looks more like flowing lava and tells a story of how chemicals both caused and solved a pollution problem. Survey the class for attitudes toward chemicals. Ask, are chemicals harmful or helpful? Have students come up with examples. For example, while the beneficial role of fertilizers is mentioned in the opener, what are the negative effects of fertilizer use? (Answer: uncontrolled algae growth)
- Have students read the opener, then as a class, answer Get Ready question 8 on page 135.
- Check what students know and believe about the characteristics of chemicals using **BLM 4-1 Unit 2 Anticipation Guide.** When the unit is complete, have students re-evaluate the statements, reflecting on how and why their understanding and attitudes may have changed.
- Before starting this unit, you may wish to reactivate prior learning about
  - chemical and physical properties and processes
  - differences between a pure substance and a mixture, an element and a compound, and an atom and a molecule
  - internal structure of the atom using Bohr-Rutherford diagrams
  - features of the periodic table
  - Students who would benefit from remediation could complete **BLM 4-2 Unit 2 Get Ready (Extra Practice).**

Assessment OF Learning for Unit 2

Tool	Evidence of Student Understanding	Supporting Learners
Inquiry Project	Students design a procedure that chemically extracts copper from a copper(II) chloride.	Refer students to the activity series in the textbook. Students may find that **BLM G-33 Experimental Design Worksheet** helps them get started.
An Issue to Analyze	Students use facts to support a point of view on whether or not it makes sense to reclaim gold from discarded electronics.	Students may find these BLMs help them get started: **BLM G-18 How to Do a Research-Based Project, BLM G-20 Research Worksheet, BLM G-4 Analyzing Issues–Science, Technology, Society, and the Environment.**

Get Ready (Student textbook pages 134 to 135)

Prerequisite Learning

Students would benefit from understanding

- differences between elements and compounds (question 1)
- structure of the atom (question 2)
- features of the periodic table (question 3)
- covalent and ionic compounds (question 5)
- naming compounds and writing formulas (question 5)
- conservation of mass and balanced chemical reactions (question 6)

Prerequisite Skills

Students need to be able to

- communicate in writing, verbally, and using a variety of different media with different audiences for a variety of purposes (questions 2, 6, and 8)
- interpret a variety of literary, graphic, and informational texts (questions 3, 5, and 6)
- record and organize data using standard measurements in tables, graphs, or charts (question 2)
- state a conclusion based on information gathered (question 7)

Answers

Concept Check

1 a. element

b. compound

c. metal

d. valence

e. ion

2. Example:

	Electrons	Neutrons	Protons
Location	orbiting the nucleus	inside the nucleus	inside the nucleus
Charge	negative (+)	neutral/none	positive (+)
Relative size	smallest of these particles	largest	medium

3. a. Be

b. 2

c. 4

d. 4

e. 4

f. 5

4. a. physical property, qualitative

b. chemical property

c. physical property, quantitative

d. chemical property

5. **a.** 1) potassium and chlorine, 2) oxygen and hydrogen
   b. Compound 1 is ionic since an electron is transferred between atoms, and compound 2 is covalent since the atoms share electrons.
   c. 1) potassium chloride, KCl, 2) hydrogen dioxide (water), H_2O

Numeracy and Literacy Check

6. The yellow spheres need to be equal on both sides (e.g., two more yellow spheres on the right/product side).

7. Aluminum, 13
   density = mass/volume
   = 10/1.12
   = 8.93

8. Example: Three facts—red water caused by nickel tailings that contain iron; mining pollution killed vegetation around Sudbury; chemicals helped rehabilitate the area
   Two questions—How does limestone change acidity? Has mining pollution changed at all?
   One key idea—Chemicals can do both harm and good.

Assessment FOR Learning		
Tool	**Evidence of Student Understanding**	**Supporting Learners**
Concept Check	Students identify key ideas about atoms and elements	Explore the features of the periodic table.
Inquiry Check	Students link Bohr-Rutherford diagrams to components of elements and types of bonds formed.	Model drawing Bohr-Rutherford diagrams for several elements. Lead students to analyze how many electrons belong to each element in order to decipher whether electrons are "leant" or shared.
Numeracy and Literacy Check	Students identify key points from the unit opener.	Use a think-pair-share strategy to have students check and support each other's understanding.

Introducing the Unit 2 Projects (Student textbook pages 256 and 257)

Introduce the unit projects and have students read the instructions to get a sense of what is required. Have them begin a project folder in which to store ideas as they complete the unit. Both projects focus on mining, one traditional, the other recycling. In both cases, chemistry is used to extract a valuable metal.

Preview the Unit 2 chapter headings as a class. Have students predict which sections may provide information to complete the projects. As students work in Unit 2, draw their attention to concepts that may be helpful in completing the projects. For example, displacement reactions in section 5.2 and mining analogies in section 5.3.

Using Making a Difference (Student textbook pages 166, 205, and 242)

Throughout the unit, students encounter teens who examined properties to find new uses for common substances: sodium bicarbonate makes an effective non-toxic fire retardant; hydrophilic properties reduce harmful runoff by 90%; and the possibility of using paraffin wax to reduce acid erosion on historic limestone buildings.

Encourage students to recognize that, in each case, a chemical is both the problem and the solution. Discuss science fairs in your school and district, explaining how and when students might enter. Encourage students to consider projects they could contribute.

These stories also present an opportunity to illustrate that it doesn't take an advanced degree to come up with useful applications of scientific knowledge. A fresh perspective and creative thinking can lead to significant contributions. Following through on an idea can make the difference alone.

Using Science at Work (Student textbook pages 254 to 255)

This feature introduces Dalia Bagby who chemically tests forensic evidence at the Ontario Centre of Forensic Sciences. As an introduction to this feature, have students examine the concept web of careers that use chemistry. Ask, "In what way do each of these careers use chemistry? What level of chemical knowledge is required for the various careers?"

As an alternative to researching a career relating to chemistry, students may opt to interview such a worker, or arrange to shadow them at their job. Encourage students to think creatively about other careers that use chemistry, such as a health inspector.

An extension to the career study is suggested in the questions on page 255.

Using the Case Studies

Chapter 4 (Student textbook pages 166 to 167)

Read the case study aloud as a class. Clarify that the waste caused in manufacturing medicine is not because matter is created by the reaction (matter cannot be created or destroyed) but is because the *products* side of the equation contains the desired medicine as well as other, unwanted products. Show a sample equation containing desired and waste products. Compare the before-and-after bar graphs depicting the savings green chemistry has made in producing Emend.

You may wish to introduce the idea that medicines do not necessarily break down when they are used by the body. In fact, many are eliminated (unchanged) by the body with other waste. Water filtration systems often cannot remove the substances, resulting in waterways that contain a wide range of pharmaceuticals. (This is #10 in the EPA's 12 Principles of Green Chemistry.)

Discuss examples of Green Chemistry and introduce the research required to complete the case study. You may wish to provide the list of 12 principles, dividing them among research pairs (or threes) for a jigsaw approach to steps 1 and 2 of the assignment. Letters could then be completed by each home group cooperatively on a principle of their choice, or individually on the principle in which each student is an expert.

Chapter 5 (Student textbook pages 182 to 183)

Open with a video clip of the Hindenburg exploding. Discuss the physical properties of hydrogen gas and relate these to why hydrogen would be used as a gas in zeppelins. Ask students what gas is currently used in party balloons. Ask what chemical and physical properties make helium a wise choice. Then lead into the discussion of hydrogen as a future fuel source. Have students complete a 3, 2, 1 organizer to summarize three facts, two questions, and one key idea.

Chapter 6 (Student textbook pages 240 to 241)

Throughout the chapter, acid rain is presented as a neutralization problem. This Case Study delves more into the long history and varied factors affecting acid deposition. It links acid rain to two key historical points: the industrial revolution and the 1991 international air quality agreement. It also touches on landscape and prevailing winds as contributing to the spread of pollution. Show the class a map of prevailing winds around the globe to draw links between places pollution is emitted and where its related problems may be experienced.