

OVERALL EXPECTATIONS

- analyze technological applications of enzymes in some industrial processes, and evaluate technological advances in the field of cellular biology
- investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions
- demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal cellular function

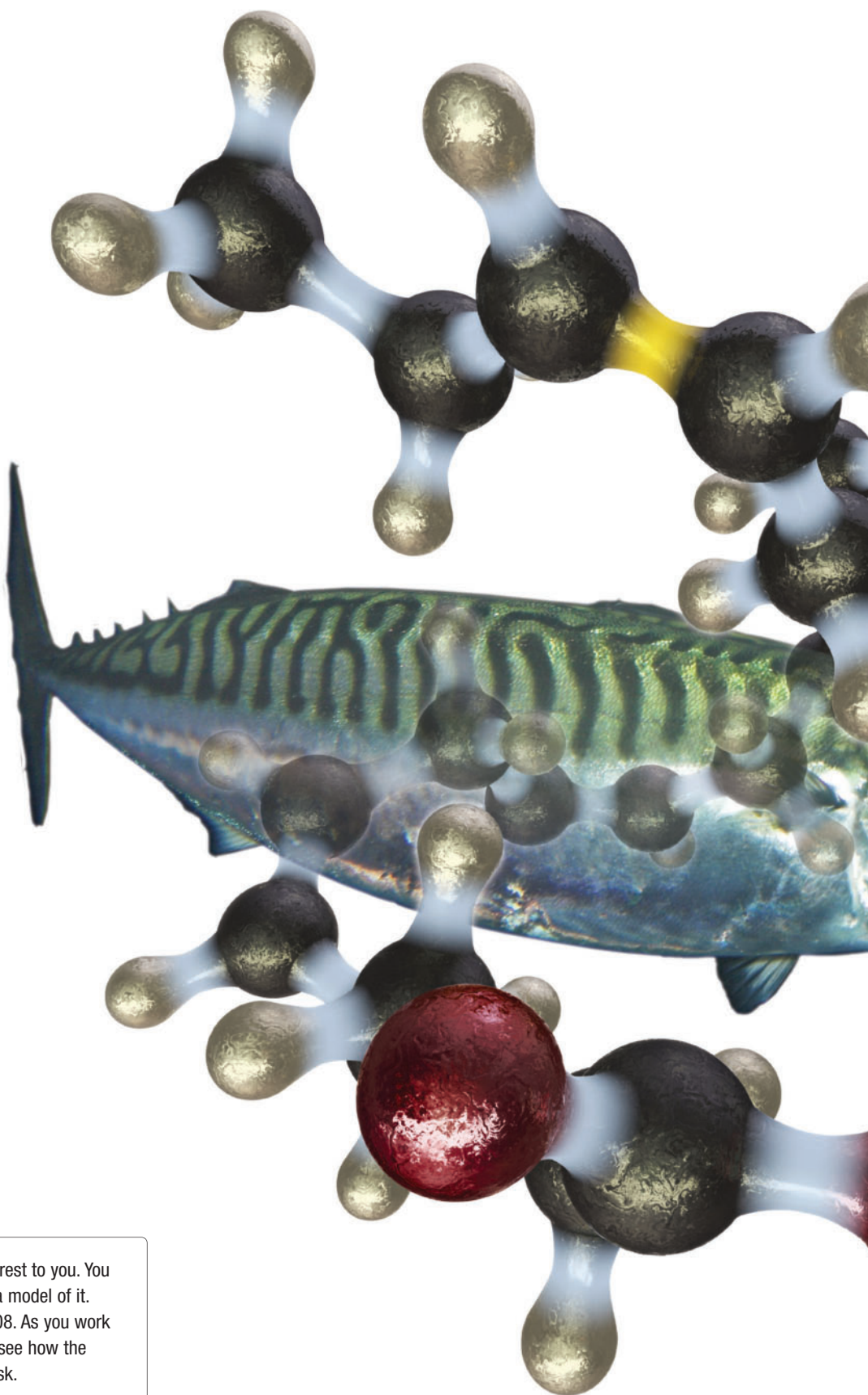
BIG IDEAS

- Technological applications that affect biological processes and cellular functions are used in the food, pharmaceutical, and medical industries.
- Biological molecules and their chemical properties affect cellular processes and biochemical reactions.
- Biochemical compounds play important structural and functional roles in the cells of all living organisms.

UNIT TASK PREVIEW

In this Unit Task, you will select a molecule of interest to you. You will research its structure and function and build a model of it.

The Unit Task is described in detail on page 108. As you work through the unit, look for Unit Task Bookmarks to see how the information you are learning relates to the Unit Task.



PROMOTING THE GOOD FATS

Did you know that eating a tin of sardines may actually help you improve your marks in school? Sardines contain macromolecules, or large molecules, called omega-3 fatty acids. Omega-3 fatty acids are essential fatty acids. They are needed to maintain human health. Our cells, however, do not produce omega-3 fatty acids on their own, so we must obtain them through the foods we eat. Fatty fish, such as mackerel, salmon, and sardines, are rich sources of omega-3, as are nuts, oils, and other plant sources. In recent years, the popularity of omega-3 fatty acids has increased. Research has shown that omega-3 fatty acids play a significant role in brain function, cardiovascular health, and the production of healthy skin. In fact, the Heart and Stroke Foundation of Canada recommends eating fish such as sardines, mackerel, lake trout, herring, albacore tuna, and salmon at least twice a week to maintain optimal levels of omega-3 fatty acids. Foods such as eggs and orange juice may also contain omega-3 fatty acids.

Other scientific research shows that eating a diet rich in omega-3 fatty acids reduces the risk of inflammation and may help to reduce the risk of chronic diseases, such as heart disease, cancer, and arthritis. The neurons in the human brain use omega-3 fatty acids for important cognitive and behavioural functions. Babies have a greater risk of developing vision and nerve problems if their mother lacks omega-3 fatty acids in her diet during pregnancy. Omega-3 fatty acids may also be useful for treating a number of conditions in adults, such as high cholesterol, high blood pressure, diabetes, depression, skin disorders, and asthma. People who do not consume enough omega-3 in their diet may suffer from fatigue, poor memory, dry skin, heart problems, mood swings or depression, and poor circulation.

It is important to obtain a balance of all nutrients, including omega-3 fatty acids, in your diet. All organisms use and rely on thousands of different types of molecules for the proper functioning of their cells. Some of these molecules can be obtained directly in the organism's diet. Other molecules are synthesized from building blocks contained in their diet. In either case, the consumption of an appropriate mix of nutrient molecules is essential to meet the demands of cells.

Questions

1. Were you already aware of the importance of omega-3 fatty acids in your diet? Are there other essential nutrients that you have heard about? In which foods can these nutrients be found?
2. The foods we eat provide us with a balance of carbohydrates, fats, and proteins. All of these nutrients are essential for a healthy body. How do you think carbohydrates, fats, and proteins compare, in terms of their chemical and physical properties?
3. Living organisms can make many "custom" molecules. For example, spiders produce silk molecules from custom proteins, while humans use another set of proteins to grow hair. What properties might these two types of proteins share? In what ways might they be different?
4. Do you think it is better to obtain omega-3 fatty acids from foods that contain them or from a supplement? Explain your reasoning.



CONCEPTS

- understand acid, base, and neutralization reactions
- explain the laws of conservation of mass and energy
- explain the role(s) of carbohydrates, proteins, and fats in the body for cell membrane function
- differentiate between diffusion and osmosis
- understand the role of carbon in biochemical molecules
- understand the role of nucleic acids

SKILLS

- determine the number of atoms in different molecules, based on chemical formulas
- determine the atomic mass of different compounds
- balance chemical equations
- differentiate between combustion and neutralization reactions
- draw structural diagrams of the reactants and products in a reaction
- draw Lewis diagrams

Concepts Review

- Describe the difference between an atom and an ion. [K/U](#)
- What type of bond within a molecule holds the atoms of the molecule together? [K/U](#)
- Compare the following: an element, a compound, and a mixture. [K/U](#)
- Describe the difference between an ionic bond and a covalent bond. [K/U](#)
- (a) How many covalent bonds does each of the following type of atom typically form?

(i) H	(iii) C
(ii) O	(iv) N

 (b) How is the number of covalent bonds formed by an atom related to its number of valence electrons? [K/U](#) [T/I](#)
- Match each term on the left with the most appropriate description on the right. [K/U](#)

(a) pure substance	(i) two or more substances
(b) mixture	(ii) a substance made from only one kind of particle
(c) solution	(iii) substances in two different phases that do not settle out
(d) suspension	(iv) one substance dissolved in another substance
- (a) Does an acid or a base increase the concentration of H^+ ions in a solution?
 (b) Does an acid or a base increase the concentration of OH^- ions in a solution?
 (c) What is the result of a neutralization reaction between an acid and a base?
 (d) List several distinctive properties of acids and of bases.
 (e) How is acidity related to the pH value of a solution? [K/U](#)
- Electrons in a molecule will repel each other and move as far away from each other as possible. How does this explain why a water molecule has a bent shape instead of being linear (**Figure 1**)? [T/I](#)

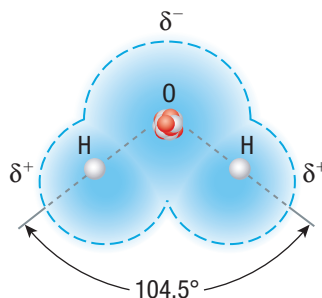


Figure 1

- (a) What is the law of conservation of mass?
 (b) How is the law of conservation of mass demonstrated in biological systems such as food chains? [K/U](#)
- (a) What is the law of conservation of energy?
 (b) How is the law of conservation of energy demonstrated in biological systems such as food chains? [K/U](#)
- (a) Name the labelled cellular structures in **Figure 2**, and describe their functions.
 (b) Does Figure 2 show an animal cell or a plant cell? Explain your reasoning. [K/U](#)

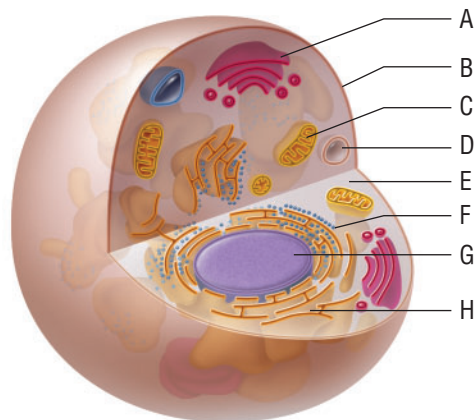


Figure 2

12. Examine the two equations below. How are they related? **T/I**
- photosynthesis: $6 \text{H}_2\text{O} + 6 \text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$
- cellular respiration: $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$
13. Match each macromolecule on the left with the most appropriate description on the right. **K/U**
- | | |
|-------------------|--|
| (a) fats | (i) directly involved with inheritance |
| (b) proteins | (ii) range from small sugar molecules to large starch molecules |
| (c) carbohydrates | (iii) responsible for long-term energy storage; also called lipids |
| (d) nucleic acids | (iv) one or more folded and coiled polypeptides; made of amino acids |
14. (a) Define osmosis and diffusion.
 (b) Make a sketch to represent each process in (a). Label your sketch.
 (c) Explain why these processes are essential for cellular function. **K/U C**
15. Draw a diagram to explain what happens to a cell in each of the following types of solutions. **K/U C**
- (a) isotonic
 (b) hypotonic
 (c) hypertonic
17. Determine the number of atoms and the atomic mass of each atom in each of the following molecules. Then calculate the total atomic mass for each molecule. **T/I**
- (a) methane, CH_4
 (b) glucose, $\text{C}_6\text{H}_{12}\text{O}_6$
 (c) cysteine, $\text{C}_3\text{H}_7\text{NO}_2\text{S}$
18. Write the balanced chemical equation for each of the following reactions. **T/I**
- (a) $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
 (b) $\text{CH}_2\text{O}_2 \rightarrow \text{C}_2\text{H}_2\text{O}_3 + \text{H}_2\text{O}$
 (c) $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow \text{C}_2\text{H}_6\text{O} + \text{CO}_2$
19. Examine the equations below. **T/I**
- (i) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 (ii) $2 \text{C}_2\text{H}_6 + 7 \text{O}_2 \rightarrow 4 \text{CO}_2 + 6 \text{H}_2\text{O}$
- (a) Which equation represents a combustion reaction? Explain your reasoning.
 (b) Which equation represents a neutralization reaction? Explain your reasoning.
20. Draw structural diagrams to represent the reactants and products in the combustion reaction between methane, CH_4 , and oxygen, O_2 . **T/A C**
21. How are cellular respiration and the combustion of methane similar? **K/U T/I**
22. Draw the Lewis diagram for each molecule. **C**
- (a) water, H_2O
 (b) carbon dioxide, CO_2
 (c) ethane, C_2H_6

Skills Review

16. Copy **Table 1** into your notebook and complete it. (For atomic mass, round to the nearest whole number.) **T/I**

Table 1

Name of element	Symbol	Number of protons	Number of neutrons	Atomic mass
neon				20
	Cl	17		
		28	31	
				52
			110	



CAREER PATHWAYS PREVIEW

Throughout this unit, you will see Career Links. Go to the Nelson Science website to find information about careers related to biochemistry. On the Chapter Summary page at the end of each chapter, you will find a Career Pathways feature that describes the educational requirements for these careers, as well as some career-related questions for you to research.