DISCOVERING SCIENCE 8
TEACHER'S RESOURCE

UNIT 4: CELLS, TISSUES, ORGANS, AND SYSTEMS

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McGraw-Hill Ryerson

UNIT 4: OVERVIEW

In Unit 4, students learn about the structure and function of the cell, the basic unit of life. They will investigate unicellular organisms using a microscope, and also explore ways that cells work together in multicellular organisms. Students begin by identifying the characteristics of life and using those characteristics as scientific criteria to identify living and non-living things. They use this background understanding to examine the functioning of single-celled organisms, as well as single cells in larger organisms, under a microscope. They conduct experiments to explore ways that cells function together as tissues, that tissues function together as organs, and that organs function together as systems. They test their own bodies' reactions and conduct research to learn more about how systems of organs interact. They also research some technologies that have been developed to help body systems carry out their roles.

Chapter 10: The cell is the basic unit of life.
Some things are clearly alive, and others are not. It is difficult to classify many things as alive or not alive without clear scientific criteria. For example, fire moves and grows. Is it alive? In this chapter, students learn to use a set of characteristics to identify things as living or non-living. They then begin their investigations of living things by using a compound microscope to examine organisms in pond water. The skills of setting up, magnifying, focussing, preparing a wet mount, and using the field of view with a compound microscope are developed in structured, hands-on activities. Some specialized types of microscopes and the metric prefixes commonly used when working with microscopes are introduced.

Through an analogy to a space colony, students investigate the interdependent structures and functions of a cell. They learn that all living things are made up of one or more cells, and that all cells contain many of the same structures and perform many of the same functions. For example, all cells have a cell membrane or wall that controls what gets in and what gets out; all cells have a nucleus that contains chromosomes to control reproduction, growth, and other life-sustaining activities; all cells have mitochondria to break down food to produce energy; and all cells have vacuoles to store extra food and wastes. Using prepared slides and a microscope, students investigate some of the differences between plant cells and animal cells, and look for evidence of mitosis—cells dividing to produce new cells. Students also conduct an experiment with yeast, water, and sugar to observe evidence of cellular respiration.

Chapter 11: Human body cells are organized as tissues, organs, and systems.
Unlike unicellular organisms, most human cells are not in direct contact with the outside environment. To obtain oxygen and nutrients, and to eliminate waste products, they must work together in tissues, organs, and systems. Students are already familiar with the idea of systems that work together. A bicycle is a system. Each part contributes to the functioning of the whole. The human body contains many systems. For example, the respiratory system includes the nose, the trachea, and the lungs—all examples of organs. Students begin by examining slides of different types of cell tissue and describing the characteristics of each type. Cells in muscle tissue look much different than cells in nerve tissue. They need to be different because they carry out a different function. To build a foundation that will prepare them to examine interactions between the body's various systems, students conduct research to learn about the functioning of the main systems of organs and tissues in the human body.

Chapter 12: The health of the body depends on the health of its interdependent systems.
Using the example of cellular respiration, students explore how entire systems of the body work together to meet the needs of cells, and how individual cells are involved in a system's functioning. The respiratory, circulatory, digestive, and excretory systems all play roles in the process of cellular respiration. For example, there is an increased need for energy when the body is active. The heart and lungs are centrally involved in getting oxygen to cells so that they can create energy through the process of respiration. Students conduct an experiment to explore the effect of increased activity on heart rate and breathing rate. Students also explore the connection between muscle activity and heat production and learn how the muscular system and the nervous system work together to regulate the body's temperature, keeping it within an optimal range.

Many systems in the human body work to maintain a constant environment; including temperature and the concentration of glucose, water, oxygen, and waste products in the blood. This process is called homeostasis. Students build on their understanding of how human body systems interact as they learn about ways our body systems react to change to maintain this constant internal environment. They investigate different lifestyle factors, such as diet, exercise, and stress, and the effect these factors can have on homeostasis, and on the body's health. To support their understanding of the functioning of body systems, students explore how homeostasis is compromised in diabetes. They also learn about some technologies that have been developed to help acheive homeostasis in certain situations. They also investigate the ingredients of sports and energy drinks and how these drinks may or may not help the body replace glucose and other nutrients that are lost during exercise. Further, they debate the merits of conventional and alternative medicines.

MULTIPLE INTELLIGENCES CORRELATION FOR UNIT 4 ACTIVITIES AND INVESTIGATIONS

The table below identifies possible multiple intelligences that could be incorporated into activities and investigations in this unit. For more information about differentiated instruction and multiple intelligences, see the Introduction and Implementation section in this Teacher's Resource.

MULTIPLE INTELLIGENCES:	VL	VS	BK	MR	LM	N	E	IA	IE
UNIT 4: CELLS, TISSUES, ORGANS, AND SYSTEMS									
Find Out Activity: Living or Non-living?									
Chapter 10: The cell is the basic unit of life.									
Core Lab Activity Conduct an Investigation 10-1A: Setting Up and Using a Microscope		■	■						
Find Out Activity 10-1B: Observing Organisms in Pond Water		■	■			■			
Find Out Activity 10-2A: Finding Solutions for Problems in the Newo Colony					■				■
Conduct an Investigation 10-2B: Building a 3-D Cell	■	■	■						
Conduct an Investigation 10-2C: Observing Plant and Animal Cells		■	■						
Find Out Activity 10-2D: Observing Root Tip Cells		■	■						
Find Out Activity 10-2E: Observing Evidence of Cellular Respiration	■	■	■						
Chapter 11: Human body cells are organized as tissues, organs, and systems.									
Think About It Activity 11-1A: Represent the Relationship	■	■							
Find Out Activity 11-1B: Looking at Animal Tissues		■							
Find Out Activity 11-2A: Teamwork	■	■	■	■	■	■	■	■	■
Chapter 12: The health of the body depends on the health of its interdependent systems.									
Find Out Activity 12-1A: Muscle Activity and Heat	■		■		■				
Core Lab Activity Conduct an Investigation 12-1B: The Effect of Activity on Heart Rate and Breathing Rate	■		■		■				
Find Out Activity 12-2A: Health Watch	■								
Find Out Activity 12-2B: Evaluating Energy Drinks	■								
Conduct an Investigation 12-2C: Debate: Conventional versus Alternative Medicine	■								
Unit 4 Project: Building a 3-D Model of Human Body Systems			■						
Unit 4 Integrated Research Investigation: Advances in Biotechnology	■			■					■

Multiple Intelligence codes:
VL = Verbal-Linguistic Intelligence; VS = Visual-Spatial Intelligence; BK = Body-Kinesthetic Intelligence; MR = Musical-Rhythmic Intelligence; LM = Logical-Mathematical Intelligence; N = Naturalist Intelligence; E = Existential Intelligence; IA = Intrapersonal Intelligence; IE = Interpersonal Intelligence

Planning Chart for Activities and Investigations for Unit 4: Cells, Tissues, Organs, and Systems

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Unit 4: Cells, Tissues, Organs, and Systems			
Find Out Activity: Living or Non-living?	1 day before: – Prepare the samples. – Gather materials.	For each group: – 2 samples in separate containers (one yeast, the other sand) – magnifying glass – ruler – 2 bowls – warm sugar water	• 20 min
Chapter 10: The cell is the basic unit of life.			
Core Lab Activity Conduct an Investigation 10-1A: Setting Up and Using a Microscope	3 days before: – Gather materials and apparatus other than live specimens. 1 day before: – Gather live specimens. – Make copies of BLM 4-7, Compound Light Microscope, and BLM 4-11, Cell Size (optional).	For each group: – microscope – prepared microscope slides – see-through plastic ruler – lens paper – microscope slides – cover slips – medicine droppers – tweezers – water – live specimens	• 60 min
Find Out Activity 10-1B: Observing Organisms in Pond Water	1 day before: – Gather microscopes and other necessary materials. – Collect a large sample of pond water.	For each group: – microscope – microscope slide – cover slips – medicine dropper – tweezers – pond water	• 60 min
Find Out Activity 10-2A: Finding Solutions for Problems in the Newo Colony	1 day before: – Have students read the reports on page 403 of the student textbook and discuss them as a class. – Make copies of BLM 4-12, Newo Solutions (optional).	For each group: – paper – pens or markers	• 45 min
Conduct an Investigation 10-2B: Building a 3-D Cell	1 week before: – Review the purpose of using models to understand scientific concepts with students. – Gather materials, or have students bring materials from home.	For each group: – variety of materials, such as yarn, beads, toothpicks, pipe cleaners, string, straws, foam, modelling clay – clear drying glue – scissors	• 60 min
Conduct an Investigation 10-2C: Observing Plant and Animal Cells	1 day before: – Bring onions. – Gather sufficient prepared slides of human skin cells. – Make copies of BLM 4-20, Observing Plant and Animal Cells Comparison Chart (optional). 30 min before: – Prepare the onion by cutting it up into sections.	For each group: – microscope – microscope slides – cover slips – lens paper – tweezers – medicine droppers – water – onion – iodine solution – paper towel – prepared slide of human skin cells	• 40–60 min
Find Out Activity 10-2D: Observing Root Tip Cells	1 day before: – Gather materials.	For each group: – compound microscope – prepared slide of onion root tip	• 30 min

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Find Out Activity 10-2E: Observing Evidence of Cellular Respiration	Several days before: – Gather materials. 1 day before: – Review the Energy for Cells section in the student textbook. – Make copies of BLM 4-21, Observing Evidence of Cellular Respiration (optional).	For each group: – warm water – 2 beakers (500 mL) – 2 scoopulas or measuring spoons – 2 samples of white sugar (5 mL each) – 2 samples of active dry yeast (15 mL each) – 2 stirring rods – 2 plastic pop bottles (600 mL or 1 L) – 2 balloons – tape	• 20 min (steps 1 and 2) • 60–120 min (data collection at 15 min intervals)
Chapter 11: Human body cells are organized as tissues, organs, and systems.			
Think About It Activity 11-1A: Represent the Relationship	1 day before: – Review the characteristics of systems. – Make copies of BLM 4-23, Represent the Relationship (optional).	For each group: – paper – pens or markers	• 30 min
Find Out Activity 11-1B: Looking at Animal Tissues	1 day before: – If you are planning to use prepared slides of animal tissue, gather the slides and the microscopes, and reserve a flex camera.	For each group: – paper – pen – (optional) prepared slides – (optional) microscopes – (optional) flex camera	• 30 min
Find Out Activity 11-2A: Teamwork	1 week before: – Collect books, posters, diagrams, and any other materials showing different organ systems, and make them available for students. – Gather materials for student presentations.	For each group: – research materials such as books, posters, diagrams, or any other materials showing the different organ systems – materials for student group presentations, such as materials for three-dimensional models or multimedia resources	• 90–120 min (probably one class for the research and another for the presentations)
Chapter 12: The health of the body depends on the health of its interdependent systems.			
Find Out Activity 12-1A: Muscle Activity and Heat	1 week before: – Begin gathering the materials and apparatus. – Test the computer interface (optional). – Book the computer labs (if this will be done in a separate computer lab).	For each group: – dumbbell – computer – data collection interface – temperature probe – digital thermometer – liquid (alcohol) thermometer	• 60 min
Core Lab Activity Conduct an Investigation 12-1B: The Effect of Activity on Heart Rate and Breathing Rate	1 week before: – Begin gathering the materials and apparatus.	For each group: – various pieces of sports equipment – graph paper – data tables	• 60 min
Find Out Activity 12-2A: Health Watch	1 week before: – Collect print and electronic resources that provide students with information.	For each group: – print and electronic resources	• 45 min
Find Out Activity 12-2B: Evaluating Energy Drinks	2–3 days before: – Book the computers and/or library access. – Check access to energy drink websites. 1 day before: – Gather materials. – Make copies of BLM 4-34, Evaluating Energy Drinks—Investigate an Energy Drink; BLM 4-35, Evaluating Energy Drinks—Investigate a Sports Drink; BLM 4-36, Evaluating Energy Drinks—Energy Drinks PMI Chart; and BLM 4-37, Evaluating Energy Drinks—Sports Drinks PMI Chart (optional).	For each group: – labels from one or more energy drink products – labels from one or more sports drink products – library and/or computer with Internet access	• 60 min

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Conduct an Investigation 12-2C: Debate: Conventional versus Alternative Medicine	1 week before: – Collect print and electronic resources that provide students with information on this issue. 1–2 days before: – Distribute information to students to read. – Gather materials and props that may be used for the debate. – Photocopy BLM 4-38, Debating Procedures.	For each group: – print and electronic information on the issue – materials and props that may be used for the debate – BLM 4-38, Debating Procedures	• 80–100 min – 50–60 min to prepare for debate (reading and organizing arguments) – 30–40 min for the debate
Project: Building a 3-D Model of Human Body Systems	1 week before: – Gather materials students may use for their models. 3 days before: – Assign groups and have students begin thinking about their plans. Show students the materials you have gathered, as students may want to bring additional materials from home.	For each group: – large chart paper – art supplies, such as felt pens, paints, etc. – a variety of materials to represent body parts, such as rubber tubing, sponges, bean bags, vacuum hoses, etc.	• 60–120 min, depending on the expected depth of the presentation
Integrated Research Investigation: Advances in Biotechnology	1 week before: – Schedule dates of class presentations. – If possible, gather some resources for students to use as they begin their research.	For class: – computer and projector, if required	A number of class periods – 20 min to introduce the activity – 1–2 weeks of independent work to complete research and prepare presentations – 60–120 min to give presentations

TALKS AND TOURS

Speaker and field trip recommendations for Unit 4:

- Visit a local pond with students to collect pond water for Find Out Activity 10-1B, Observing Organisms in Pond Water. While there, have students identify other living things they see and explain how they know the living things are alive.
- A family physician could talk with the class about the impacts of lifestyle choices on health, and may be able to share photographs showing the effects of some lifestyle factors, for example, fatty deposits in arteries, or X rays of healthy and unhealthy lungs.
- To supplement the Career Connect in Chapter 12, invite a kinesiologist, or another health professional into the classroom to talk with students about what they do and the training they needed (and continue to need) to do their job.

UNIT 4 BLACKLINE MASTERS

CONTENT-RELATED BLACKLINE MASTERS	ASSESSMENT-RELATED BLACKLINE MASTERS
Unit BLM 4-1, Unit 4 Summary BLM 4-2, Unit 4 Key Terms BLM 4-40, Unit 4 Review—Spider Map BLM 4-41, Unit 4 Review BLM 4-42, Unit 4 BLM Answers	Assessment Checklist 5, Investigating an Issue Assessment Checklist 6, Developing Models Assessment Checklist 7, Scientific Drawing Assessment Checklist 8, Science Fair Display Assessment Checklist 9, Oral Presentation Assessment Checklist 10, Computer Slide Show Presentation Assessment Checklist 11, Poster Assessment Checklist 12, Classification System Assessment Checklist 13, Concept Map Assessment Checklist 14, Events Chain or Flowchart Assessment Checklist 15, Venn Diagram Assessment Checklist 21, Project Self-Assessment Assessment Checklist 22, Project Group Assessment Process Skills Rubric1, Developing Models Assessment Rubric 3, Co-operative Group Work Assessment Rubric 4, Scientific Drawing Assessment Rubric 7, Scientific Research Planner Assessment Rubric 8, Research Project Assessment Rubric 9, Collecting Information Assessment Rubric 10, Presentation Assessment Rubric 11, Communication
Chapter 10 BLM 4-3, Chapter 10 Key Terms BLM 4-6, Is a Candle Alive? BLM 4-7, Compound Light Microscope BLM 4-8, Parts of a Compound Light Microscope BLM 4-9, Calculate Magnification BLM 4-10, Estimating the Size of Microscopic Objects BLM 4-11, Cell Size BLM 4-12, Newo Solutions BLM 4-13, Functions of Cell Organelles BLM 4-14, Discovering Organelles: Concept Map BLM 4-15, A “Cell” Job BLM 4-16, Parts of a Plant Cell BLM 4-17, Parts of an Animal Cell BLM 4-18, Comparing a Plant and an Animal Cell BLM 4-19, Create Your Own Cell BLM 4-20, Observing Plant and Animal Cells Comparison Chart BLM 4-21, Observing Evidence of Cellular Respiration BLM 4-22, Chapter 10 Review	Assessment Checklist 1, Making Observations and Inferences Assessment Checklist 2, Asking Questions Assessment Checklist 4, Laboratory Report Assessment Checklist 6, Making Models Assessment Checklist 7, Scientific Drawing Assessment Checklist 12, Classification System Assessment Checklist 25, Safety Checklist Process Skills Rubric 1, Developing Models Process Skills Rubric 8, Interpreting Data
Chapter 11 BLM 4-4, Chapter 11 Key Terms BLM 4-23, Represent the Relationship BLM 4-24, The Eleven Human Body Systems BLM 4-25, Specialization in the Body BLM 4-26, Organization in Biology BLM 4-27, Understanding Body Tissues BLM 4-28, Chapter 11 Review	Assessment Checklist 9, Oral Presentation Assessment Checklist 10, Computer Slide Show Presentation Assessment Checklist 11, Poster Assessment Checklist 14, Events Chain or Flowchart Assessment Checklist 22, Project Group Assessment Assessment Rubric 1, Concept Assessment Rubric 3, Co-operative Group Work Assessment Rubric 9, Collecting Information Assessment Rubric 10, Presentation Assessment Rubric 11, Communication

UNIT 4 BLACKLINE MASTERS

CONTENT-RELATED BLACKLINE MASTERS	ASSESSMENT-RELATED BLACKLINE MASTERS
Chapter 12 BLM 4-5, Chapter 12 Key Terms BLM 4-29, Cellular Respiration BLM 4-30, Getting Food to Body Cells BLM 4-31, Connections Between Circulation and Respiration BLM 4-32, Organizing Organ Systems BLM 4-33, Harmful Chemicals in Tobacco Products BLM 4-34, Evaluating Energy Drinks—Investigate an Energy Drink BLM 4-35, Evaluating Energy Drinks—Investigate a Sports Drink BLM 4-36, Evaluating Energy Drinks—Energy Drink PMI Chart BLM 4-37, Evaluating Energy Drinks—Sports Drink PMI Chart BLM 4-38, Debating Procedures BLM 4-39, Chapter 12 Review	Assessment Checklist 3, Designing an Experiment Assessment Checklist 5, Investigating an Issue Assessment Checklist 9, Oral Presentation Assessment Checklist 10, Computer Slide Show Presentation Assessment Checklist 11, Poster Assessment Checklist 15, Venn Diagram Assessment Checklist 18, Data Table Assessment Checklist 19, Graph from Data Assessment Checklist 22, Project Group Assessment Process Skills Rubric 2, Hypothesizing Process Skills Rubric 3, Controlling Variables Process Skills Rubric 6, Designing Experiments Process Skills Rubric 8, Interpreting Data Assessment Rubric 3, Co-operative Group Work Assessment Rubric 6, Design Your Own Investigation Assessment Rubric 7, Scientific Research Planner Assessment Rubric 8, Research Project Assessment Rubric 9, Collecting Information Assessment Rubric 10, Presentation Assessment Rubric 11, Communication

Teaching Notes
for
Pages 384 to 467 of the Student Textbook

UNIT 4 OPENER, pp. 384–385

Unit 4 focusses on cells, tissues, organs, and systems, and how they are interrelated in a way that allows organisms to function and live. The unit progresses from looking at individual cells in isolation to looking at the tissues that cells form when they join together, and the organs and organ systems that are made from multiple types of tissues. The unit opener helps students develop and review their knowledge of cells and begin to think about how cells combine to form more complex systems.

The unit opener also encourages students to think about what organisms must be able to do in order to survive. Each organism must be able to perform basic life functions such as eating and removing wastes, and at the same time live in changing external conditions. In the Find Out Activity, Living or Non-Living?, page 387, students will determine whether similar-looking things are living or non-living. This activity opens up discussion of what defines living things, and what functions living things need to perform in order to stay alive.

USING THE UNIT OPENER

The unit opens with a picture of a pod of whales swimming in the ocean. In contrast, one of the smaller photographs shows microscopic single-celled organisms (stentors). This contrast in size shows the differences that exist between living things. A whale can easily be seen as it jumps out of the water, but observing a unicellular stentor requires a specialized tool: the microcope. Despite the difference in size between the whale and the stentor, the unit opener text emphasizes that all organisms are made up of the same basic unit: the cell. The text also states that human body cells are organized as tissues, organs, and systems, and that human health is dependent on the systems functioning well together.

Review the Key Ideas with students, defining terms as needed. Have students brainstorm answers to the following questions:

- What makes an organism alive?
- What do whales and unicellular stentors have in common? Are any of these characteristics shared by humans?
- What is a system?
- What is a healthy system, and how would healthy versus unhealthy systems interact?

They will investigate these questions further in Unit 4.

Review what students know about cells. Focus on pages 386 and 387 with questions such as:

- The stentor is a unicellular organism. What must this one cell do to stay alive?
- In what ways would the cells that make up a whale need to be different from the cells that make up a stentor?

You may wish to hand out BLM 4-1, Unit 4 Summary, and BLM 4-2, Unit 4 Key Terms to help students record their understanding of the unit and key terms.

GETTING STARTED, pp. 386–387

USING THE TEXT

The beginning of this unit and the example of the tardigrade allow for several points of discussion around the topics of cells and living things. After students have read the Getting Started section, hold a class discussion regarding the different types of environments that organisms live in, and what organisms must do to survive in these different environments. For example, desert animals need to survive extreme temperatures and, like tardigrades, they have found ways for their systems to work in these conditions so that they stay alive.

Hold a class discussion about cryptobiosis. What would an organism have to do to enter suspended animation? If a living organism was in suspended animation, how could this organism be differentiated from a dead organism?

USING THE ACTIVITY

Find Out Activity

Living or Non-living?, p. 387

Purpose

Students compare samples of water to observe possible signs of life.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Prepare the samples. Gather materials.	For each group: – 2 samples in separate containers (one yeast, the other sand) – magnifying glass – ruler – 2 bowls – warm sugar water

Time Required

- 20 min

Safety Precautions

- Remind students never to eat or drink anything in the science room.

Science Background

The purpose of this activity is to give students an opportunity to observe signs of life. Students are provided with two very similar-looking samples—sand and yeast. Sand is not alive, therefore it has no reaction with the sugar water. Yeast, on the other hand, is a unicellular fungus that is a living organism, and has the ability to metabolize, or more specifically, ferment sugar. When yeast ferments sugar, one of the products is carbon dioxide. Carbon dioxide is what makes yeast so useful for baking. Yeast makes bread dough rise as the production of carbon dioxide creates bubbles in the dough. After a short period of time, the yeast in this activity will begin to create bubbles of carbon dioxide in the sugar water.

Activity Notes

- Students can work together in small groups.
- Sand and yeast are not listed as materials in the student textbook because they would give away the secret to the activity. If possible, use light-coloured sand so that it resembles the yeast as much as possible. Be certain that the yeast you are using is fresh (check the expiry date on the container)—using old inactive yeast is the most common source of failure for this activity.
- Make sure the containers for the two samples you give to students are not labelled with their contents, so that students do not know what they are. You could label the containers "Sample A" and "Sample B."
- The water used for this activity should be lukewarm. The optimum temperature for yeast fermentation is about 35°C.
- Although bowls are specified, other containers will work for this activity. Clear containers that allow observation from the side work best.
- The action of the yeast is not instantaneous, but there should be visible activity within a couple of minutes. Students will need to be patient to wait for the yeast to reach full activity.
- An optional method of observation is to place a drop from each container onto a slide to view under the microscope. It may be possible to observe budding of the yeast under high power, but it will require an exceptionally clear preparation and optimal conditions.

What Did You Find Out? Answers

1. Students' answers may vary, but students should provide a discussion that addresses the production of gas and frothing by the yeast as opposed to the sand, which does nothing.
2. Students' answers may vary, but could include the following: One of the samples will begin to produce gas bubbles and, as a result, it will have the semblance of movement. The fact that this activity was not evident until the addition of sugar water indicates that the organism needs energy/food. Guide students to differentiate between movement, which can be caused by anything, and locomotion, which is caused by the organism itself.
3. Students' answers may vary but should note that living things react to changes in the environment (such as adding the sugar water) in various ways, such as producing gas and bubbles, whereas non-living things will not react to any changes in the environment.

CHAPTER 10 OPENER, pp. 388–389

USING THE PHOTO AND TEXT

You can use the photograph of the stentors as an introduction to microscopic life in several ways.

- If you are introducing this unit in the fall, you may be able to show some living stentors in pond water. The fall season is a time when there are lots of bacteria in the water due to the mass of decaying plant matter in the water, and hence, lots of stentors. They can be found attached to floating plants or leaves that have been in the water for a while. Stentors are considered to be one of the larger protozoans. Because stentors are so big, they were among the first unicellular organisms studied by microbiologists. Stentors also carry out all the processes necessary for life, despite their being only single celled. They eat, excrete, respire, respond to the environment, and move. An interesting side note is that they have multiple nuclei, which are needed to control each of the many processes that the stentor needs to do to survive.
- If living stentors are unavailable, ask students to take a careful look at the picture of the stentors and answer the following questions: What does their shape remind you of? (musical instrument or funnel) What purpose does this shape suggest? (to collect as much water and food as possible) What is another purpose for the cilia? (mode of transportation) What do stentors eat? (smaller microorganisms)

This chapter is an opportunity for students to learn about the characteristics of life—what differentiates

living organisms from non-living organisms—and about the cell, the building block of all living organisms. Students will learn how to use a compound microscope, which is an important tool for learning about microscopic life. They will learn about the parts that make up cells in both animal and plant cells.

USING THE WHAT YOU WILL LEARN / WHY IT IS IMPORTANT / SKILLS YOU WILL USE

Review the What You Will Learn section with students. Determine what prior knowledge students have of cells, cell organelles, and microscopes. You may want students to share and discuss answers to the following questions:

- How can you tell if something is alive?
- What is a cell?
- What does a typical cell look like?
- How big are cells?
- Where can cells be found?
- What is in a cell?
- Do all cells contain the same things?
- What does a compound light microscope do?

USING THE FOLDABLES™ FEATURE

See the Foldables section of this resource.

10.1 CHARACTERISTICS OF LIFE

BACKGROUND INFORMATION

The first concepts dealt with in this chapter help students use scientific principles to differentiate between living and non-living. Every natural environment contains both living and non-living elements. Water, air, and minerals are examples of non-living elements, while plants, animals, and microorganisms are examples of living elements. All living organisms share a set of basic needs: oxygen or carbon dioxide, water, food, and a suitable place to live.

COMMON MISCONCEPTIONS

- Students sometimes have difficulty differentiating between living and non-living. Some students may believe that seeds are not living. A fire has some of the characteristics of life—it appears to grow, eat, and even respond to a stimulus (water). Point out that a living thing does not necessarily display all of these characteristics all the time or at the same time. Creating a running chart divided into living and non-living examples may help clarify this concept.
- Keep in mind that different cultural groups may define living and non-living in different ways, and that the scientific method is only one way of defining living and non-living things. Other points of view should not be considered misconceptions. For example, many Aboriginal groups across Canada define non-living elements, such as mountains, rocks, and streams, as living things.

ADVANCE PREPARATION

- Both activities make use of microscopes, which requires that you have various samples ready ahead of time and that you book the lab you are using well in advance.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, p. 390

Using the Text

Invite students to form groups and do a "write around" about what it means for something to be "alive." Each student in the group contributes one or more ideas, then passes the paper to the next student. In this way, every student has the opportunity to make a meaningful contribution. Read to them the paragraph on page 390 about non-living things that appear to have the characteristics of living things, such as moving. Invite students to describe other non-living things that could be included in this category and explain what characteristics they have. Students may also want to consider other characteristics that could indicate life, such as taking in nutrients or getting rid of wastes, so it is best to conduct this introductory discussion before students open their books.

Using the Key Terms and Section Summary

At the beginning of each section in the student textbook are the Key Terms and section summary. Both can be used as a pre-reading strategy and a review tool. Before reading the text in the section, students should be able to define the Key Terms by scanning the text and using the Glossary. The Key Terms include terms from the curriculum outcomes and additional terms that are important for students to know and understand.

The section summary provides an overview of the key concepts being covered in the section. Students may not know all the concepts and terms described in the summary, but they can use this information to help guide them through their reading.

After reading the section, students can go back to the Key Terms and section summary to consolidate their understanding and identify areas that require clarification. At the end of the chapter or unit, students can use the Key Terms and section summary for review. BLM 4-2, Unit 4 Key Terms, and BLM 4-3, Chapter 10 Key Terms, can be used to assist students.

Using a Demonstration

A simple demonstration to introduce this section is to add a raisin or a frozen grape to some clear soda. Ask students: In what way does the grape/raisin appear to be alive? Although it will move, it will not have the other characteristics of life. It is also noteworthy that while the raisin moves, it only does so as a result of external forces. To be considered living it must meet four conditions:

- It must be able to grow.
- It must be able to move.
- It must be able to respond to stimuli in the environment.
- It must be able to reproduce.

TEACHING THE SECTION, pp. 391–397

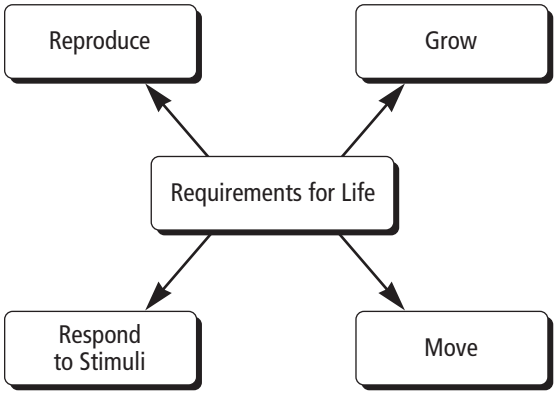
Using Reading

Divide the reading into two parts: Characteristics of Life (pp. 390–391) and Examining Very Small Living Things (pp. 391–397)

Characteristics of Life (pp. 390–391)

Pre-reading—K-W-L (Know-Want to Know-Learned)

Engage students in a discussion about what they already know about the characteristics of life. Then have them create a semantic map like the one below that will introduce them to the concepts that they will encounter as they read this section. Ask students to record their answers to the question, "What do I want to learn about the characteristics of life?" Have them review their answers and record questions they have about the characteristics of life on the relevant section of their maps. Later, students can share their questions as a class.



During Reading—Note Taking

As students read the section they can add information, examples, and new questions to their semantic map.

After Reading—Reflect and Evaluate

Students can choose an organism and describe how this organism exhibits the four characteristics of life. Students can complete BLM 4-6, Is a Candle Alive?

Examining Very Small Living Things (pp. 391–397)

Supporting Diverse Student Needs

- There are many Key Terms in this section, most of which are important to help students follow instructions about correct microscope use. After reading the section, verbal-liguistic and interpersonal learners may enjoy quizzing each other about the meaning of each term. With a microscope in front of them, one student reads one of the Key Terms. The other student touches the corresponding part on the microscope and identifies its purpose. If the pair cannot identify a part or its purpose, they can review the text together to find it.

Pre-reading—Predict-Read-Verify

Before reading, students can predict the answers to the following questions:

- In what ways might different kinds of microscopes differ from one another?
- When were the earliest microscopes developed?
- How does a light microscope work?
- How do we choose magnifying power on a microscope?
- What is resolving power, and how is it related to magnifying power?

During Reading—Note Taking

As students read the section, they can answer the questions they wrote in the pre-reading activity.

After Reading—Reflect and Evaluate

Have students create a labelled diagram of a compound light microscope or they can complete BLM 4-7, Compound Light Microscope. Students could also complete any or all of BLM 4-8, Parts of a Compound Light Microscope; BLM 4-9, Calculate Magnification; BLM 4-10, Estimating the Size of Microscopic Objects; and BLM 4-11, Cell Size. Ask students to outline the useful information they have learned in this section and rank each piece of information they include in their outline, beginning with the piece they expect will be the most useful.

Reading Check Answers, p. 393

1. The cell is the smallest, most basic functional system of any living thing.
2. The eyepiece; the objective lenses; and the light source. Students may include other parts. Accept these parts if students make a logical justification.

3. The letter "G" would appear upside down and backward.
4. The total magnification is 100×.

USING THE ACTIVITIES

- Core Lab Conduct an Investigation 10-1A on pages 394 and 395of the student textbook is best used after students have read about the compound light microscope on pages 392 and 393 of the student textbook.
- Find Out Activity 10-1B on page 397 of the student textbook is best used after Conduct an Investigation 10-1A has been completed. It is important that students have a good working knowledge of how to use the compound microscope safely and effectively before they attempt this activity.
- Detailed notes on doing the activities follow.

Core Lab Conduct an Investigation 10-1A

Setting Up and Using a Microscope, pp. 394–395

Purpose

- Students practise focussing an image with a compound light microscope, determining the field of view, and preparing a wet mount.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
3 days before	Gather materials and apparatus other than live specimens.	For each group: – microscope – prepared microscope slides – see-through plastic ruler – lens paper – microscope slides – cover slips – medicine droppers – tweezers – water – live specimens
1 day before	Gather live specimens. Make copies of BLM 4-7, Compound Light Microscope and BLM 4-11, Cell Size (optional).	

Time Required

- 60 min

Safety Precautions

- Microscopes, slides, and cover slips can break, especially when using the high-power objective lens. Remind students to handle with care.
- Sharp objects such as tweezers need to be handled carefully.
- Students should wear lab coats and wash their hands thoroughly after doing this investigation.
- Make sure that students place the microscopes well away from the edge of the desk and that the electrical cord does not get tangled up or end up in a position where someone could accidentally pull the microscope off the desk.
- Instruct students to always pull the electrical cord from the outlet by the plug, not the cord.
- Students should wash their hands thoroughly after doing this investigation.

Science Background

The compound light microscope has been continually developing for over 300 years; however, the basic principles are the same. Lenses can be used to magnify small organisms or objects. The degree of magnification depends on the three lenses in the revolving nosepiece with the low power providing the least (4×) and the high power the most (40×). Because of the way the light rays pass through the two lenses, the image produced will be inverted and reversed. This result will cause a bit of confusion for students as they will have to move the slide the opposite direction to what seems logical. The brighter the light shining on the sample is, the better the resolving power is.

The first part of the activity is learning how to focus using low and high power. Remind students how magnification power is obtained. Focussing begins with the lowest power of lens. Once the object is centred, focus using the larger coarse adjustment knob followed by the fine focussing. Once this step has been accomplished, the student can turn to the medium power objective lens. Again, coarse adjustments should be done first, then fine adjustments.

The second part of the activity is determining the field of view. This step is important, as it will give students an idea of the size of the objects that they are viewing. The third part of the activity is making a wet mount, which will be an important skill when students are looking at most cells.

Activity Notes

- This activity can be done in pairs if you have a sufficient number of microscopes; otherwise use groups of three. Ensure that each student has an opportunity to use the microscope.
- This activity may be the first time that students will have used these microscopes, so it is important to stress their proper care and use throughout the activity:
  – Always carry the microscope with two hands, one on the arm and one on the base.
  – Focus slowly and carefully so that the objective lens is not jammed into the slide, damaging both. Start by lowering the low power lens close to (but not touching) the slide. Then place your eye on the eyepiece and raise it by the coarse adjustment knob until the slide becomes some-

what focussed. Then move to the fine adjustment knob.
  – Never leave the microscope slide on the platform when you are finished. Raise the objective lenses, and leave the low powered lens in position. Clean up and put all materials away in the proper spots. Students can use BLM 4-11, Cell Size, to reinforce what they learn about field of view in Part 2.
- Part 3, step 3, requires a live specimen. You may wish to use a paramecium, an amoeba, or an euglena. These specimens can be prepared as wet mounts. As an alternative, you can obtain the much larger planarian to observe. The planarian can be placed in a well slide or a petri dish and observed under low power as it moves.
- When a particularly good specimen is found on a students' slide, make sure that the other students have an opportunity to view it so they know what to look for.
- Make sure the drawings of specimens that students do are detailed, labelled, and carry the approximate sizes.
- You may want to hand out BLM 4-7, Compound Light Microscope, to help students identify the parts of the microscope.

Supporting Diverse Student Needs

- Encourage body-kinesthetic learners to take an active role in the operation of the microscope.
- It may be easier for students with written output challenges to answer Conclude and Apply question 1 orally, using BLM 4-7, Compound Light Microscope, to help explain their answers.
- Work with individual or pairs of mathematically challenged students to model how to find the field of view and estimate the size of an object using a microscope.
- For enrichment, have students research the history of the microscope, and Leeuwenhoek's role in popularizing microbiology. More information about microscopes can be found at www.discoveringscience.ca.

Analyze Answers

1. As the power of magnification is increased you see less of the image, but in greater detail. It may be more difficult to focus on the image.
2. The letter "e" would have to be upside-down and backward under the microscope to be seen the right way up.
3. First, bring the object into focus using the course adjustment knob under low power. Centre the object under low power before switching to medium power. (If the object is in the top left corner of the view, move the slide toward the top left in order for the image to move toward the bottom right in the field of view and centre it that way.) Use the fine adjustment knob under medium power to see the object more clearly. Adjust the light coming in to get maximum viewing of the object.

Conclude and Apply Answers

1. Students' answers may vary slightly, but should include the following steps:
   - Place the slide containing the specimen on the microscope stage and secure with the stage clips.
   - Centre the cover slip over the hole in the stage through which the light will come.
   - Always begin with the lowest power. Doing so gives the largest field of view. It also reduces the chance of the lens hitting the slide.
   - Turn on the light source and adjust the diaphragm so that the specimen is getting enough light.
   - Start with the coarse adjustment knob. You may want to move the lowest power objective lens (4×) as close as possible to the slide while watching from the side of the microscope. Then move it up until the specimen is roughly in focus.
   - Make sure the specimen is in the middle of the field of view. Once the specimen is as focussed as possible, switch to the fine adjustment knob for fine tuning.
   - After the object is focussed, you can move to the next higher objective lens. Use the fine adjustment knob to see the object clearly. If you lose the object, then switch back to the low power again.

Find Out Activity 10-1B

Observing Organisms in Pond Water, p. 397

Purpose

- Students observe single-celled organisms in pond water to determine how they demonstrate the characteristics of living things.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Gather microscopes and other necessary materials. Collect a large sample of pond water.	For each group: – microscope – microscope slide – cover slips – medicine dropper – tweezers – pond water

Time Required

- 60 min

Safety Precautions

- Microscope slides and cover slips need to be handled very carefully to avoid breaking them or cutting fingers.
- Remind students that the pond organisms are alive and should be treated respectfully.
- Students should wear lab coats and wash their hands thoroughly after the activity.
- Take all necessary precautions against breakage of the high powered lens, if used. Draw students' attention to the size of the lens and whether it will hit the stage and slide when used.

Science Background

Anton van Leeuwenhoek (Lee-oo-wen-hook) built one of the first practical microscopes around 1670. He began experimenting with grinding lenses and building magnifying glasses. As his work with magnification progressed, he was able to begin observing microscopic life that surrounded him. The scientific community was very excited when he released his findings, and an entire new world was opened up for study. Until his work became public, the microscopic organisms that live on, in, and around us were largely unknown.

Activity Notes

- There are specially designed slides that contain a small well in the centre for liquid samples. These slides would be useful for this activity, but if you cannot obtain them, prepare the wet mount as described on page 395 of the student textbook.
- Pond water organisms may move too quickly for students to make detailed observations. You can buy a "quieting solution" to add to the wet mount after students have observed the organisms at their natural activity levels. The quieting solution will slow down the organisms sufficiently to allow students to make their drawings.
- You may wish to make a detailed drawing of pond water organisms yourself so that you can give students a clear expectation of what they need to draw.

Supporting Diverse Student Needs

- Prompt students who need a reminder about the procedure for focussing and viewing a slide in Activity 10-1A, Part 1 on student textbook page 394.
- Naturalist learners may want to compare the organisms they see, looking for similarities and differences among them.
- Students could add notes to their diagram to answer What Did You Find Out? question 1.
- For enrichment, consider asking students what they would expect to see in forest/marshy soil. You could then take a sample of soil, add a bit of water, and strain through cheesecloth. The resulting solution can be used to make wet mounts. Students may be able to observe some larger multicellular organisms such as nematodes.
- For enrichment, students can find Leeuwenhoek's original drawings of his "wee little beasties." Have students compare the drawings that they have made in this activity with Leeuwenhoek's drawings.

What Did You Find Out? Answers

1. Students' charts or paragraphs may vary, but could include the following evidence that the organisms in the pond water were living:

Living things grow.	Students should be able to see different sizes of the same type of pond organism, which should indicate to them that the organisms grow.
Living things move.	Students can observe the different types of movement from different organisms, such as spiral/twisting motion, flagellas in motion, amoebas shifting form, or gliding action.
Living things respond to stimuli in their environment.	Whenever the organisms in the pond water encounter obstacles, they respond by changing course or darting back.
Living things reproduce.	The fact that there are many of the same types of organisms shows that the organisms are reproducing.

USING THE FEATURES

National Geographic: Visualizing Microscopes, pp. 398–399

This feature is an excellent starting point for investigating the kinds of images of microscopic life and cellular organelles produced by the various types of microscopes. Have students read the feature or read it together as a class. Have students choose one of the microscopes and research it in more depth. They

can do a report or make a presentation to the class on their findings. Alternatively, students could consider the circumstances in which each type of microscope might be most useful.

This is also a good time to point out that our scientific understanding is always growing. Each new type of microscope that has been developed has helped us to learn new things about cells. As new technologies continue to be invented, scientists will likely continue to learn new things.

Science Math Connect: Size and Scale, p. 400

This feature provides connections to the math concepts of metric conversion, place value, exponents, and scale. Students could research the history of the metric system and the units used within it. You may wish to show a video from the National Film Board of Canada called *Cosmic Zoom*, which shows scale from outer space all the way to a strand of DNA.

Science Math Connect Answers

1. (a) 1000 × 0.2 mm = 200 mm
   (b) 100 000 × 0.2 mm = 20 000 mm
   (c) 1 000 000 × 0.2 mm = 200 000 mm
   (d) 1 000 000 000 × 0.2 mm = 200 000 000 mm

SECTION 10.1 ASSESSMENT, p. 401

Check Your Understanding Answers

Checking Concepts

1. Students' examples may vary but could include the following:
   - Living things must grow. Humans grow in size and mass until they reach maturity. Plants also grow as they age.
   - Living things move. Fish swim through water. Plants change position based on the position of sunlight.
   - Living things respond to stimuli in their environment. A cat might hiss when threatened by a dog. You might have a drink of water if you are hot and thirsty.
   - Living things reproduce. Dogs have puppies, and trees have seedlings.
2. A microscope should be carried with one hand on the arm and the other hand on the base.
3. (a) A: eye piece; B: revolving nose piece; C: objective lenses; D: stage; E: light source; F: coarse focus knob; G: fine focus knob.
   (b) – eye piece: used for viewing and contains a lens that magnifies
   – revolving nose piece: holds the three objective lenses
   – objective lenses: magnify the image
   – stage: supports the slide. Some microscopes have stage clips to hold the slide in place
   – light source: supplies the light needed to view the slide
   – coarse adjustment knob: brings an object into rough focus at all powers
   – fine adjustment knob: brings an object into fine focus at all powers
4. It is easier to focus in low power. Once you have focussed under low power, the slide will be very close to being focussed under medium and high power. Secondly if you use high power to focus, it is possible to put the lens through the slide.
5. To prepare a wet mount with a solid specimen, place a drop of water in the centre of the slide and then place your sample in the water. Next, hold the cover slip at a 45° angle to the slide and gently lower it onto the slide. If you are using a liquid such as pond water, follow the same steps but do not add the water.
6. The eye piece magnifies the image another 10× for a total magnification of 400× (40 × 10 = 400×).

Understanding Key Ideas

7. Students' answers may vary but could include the following:
   - Test to see if the organism responds to a stimulus by seeing if it responds to a light source. A chemical stimulus such as a grain of salt could be added to the slide to see if the organism responds.
   - Determine if the organism grows by looking for its presence in different sizes. This presence could indicate different stages of growth.
   - Some unicellular organisms reproduce by splitting in half. You could look through your sample to see if this process is occurring.
   - Determine if the organism moves by observing the sample and seeing if there is any movement.
8. Students' answers may vary but could include the following: The puffins respond to a number of different stimuli, such as loud noises. The puffins respond to presence of herrings and move in order to catch them. You might be able to distinguish between puffins of different maturities, showing that they grow. They may not be actively mating or laying eggs at this

time, but you could look for evidence of reproduction, for example, eggs in a nest, and then conclude that they reproduce. If the puffins do not display all of these characteristics, or evidence of them, you could say that they are alive because you know puffins are animals, or you could watch for longer to collect more evidence of the characteristics of living things.

9. It is likely that the student has tried to focus on high power without using the low power lens first.

Pause and Reflect Answer

Student's answers may vary but could include that the alien biologist observed the cars moving and responding to stimuli such as traffic lights, and concluded that the cars were alive. The students could persuade the alien biologist that cars are not alive by pointing out that there was a person behind the wheel who was manipulating the car and that cars do not grow and do not reproduce.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

10.2 FOCUSSING ON CELLS

BACKGROUND INFORMATION

All life can be classified into several levels of organization from the most basic, the cell, to the most complex, the biosphere. This section will look at the composition and the function of the parts of the cell, at cell theory, at cell division and finally, at how cells get the energy they need.

Cell Theory: The 17th century was renowned as a time of discovery. Robert Hooke, an English scientist, gave the term "cell" to the tiny "rooms" that made up the cork tissues that he observed. He made the first detailed drawings of the microscopic world. It was not until much later that the scientists Theodor Schwann and Matthias Schleiden determined (independently and not without controversy) that cells were the most important biological feature of life. From them came the cell theory, which has three basic tenets:

1. The cell is the basic unit of life.
2. All organisms are composed of one or more cells.
3. All cells come from existing cells.

The Theory of Spontaneous Generation: The last aspect of cell theory was the hardest to prove as there was a prevailing theory of "spontaneous generation" that had to be overcome. Basically that theory suggested that living things could spontaneously arise from non-living things. For example, maggots would appear on a piece of meat in storage. To the casual viewer the maggots appeared to spring up from nothing. It was Louis Pasteur who was finally able to disprove the theory of spontaneous generation through a series of scientific experiments involving sterilized broth in flasks that opened straight up or had S-curves that opened downward. The ones with the straight necks that opened upward spoiled while the ones with the S-curves that opened downward did not. In the second case, air could enter the flask, but the microorganisms in the air would be caught in the neck of the S-bend due to gravity, while the flasks that opened up had microorganisms settle in the broth.

Cell Division: In order for organisms to grow and to replace cells that are dying or need repair, cells must be able to divide and produce more cells. The cells that are produced are exact copies of the original cell, and include identical copies of the original cell's DNA. Mitosis is the process by which a cell divides and produces two identical daughter cells. There are four main stages in mitosis, although these can be further subdivided.

- First, the chromatin, which is free-floating DNA in the nucleus, condenses into chromosomes and replicates so that there are two copies of each chromosome, joined together at the middle into a double strand. The membrane surrounding the nucleus disappears.
- Second, the duplicated chromosomes align down the centre, or equator, of the cell.
- Third, the duplicated chromosomes separate into two strands, and one duplicate strand of each chromosome is pulled to the side of the cell, called the pole.
- The chromosomes cluster together at each end, a nuclear membrane appears around the chromosomes, and the cell membrane grows, pinching the parent cell into two, and creating two cells each with DNA identical to the parent cell.

These steps are not part of the Grade 8 curriculum, but will be dealt with in Grade 9 Science and Biology 3201. The process of meiosis, or cell division in sex cells, will be introduced in later grades.

Cellular Respiration: Cellular respiration is the process in which sugar and oxygen undergo a chemical reaction that produces carbon dioxide, water, and energy. It is the reverse chemical reaction of photosynthesis, which plants perform to create food, combining carbon dioxide, water, and energy from the Sun to produce sugar and oxygen.

The chemical reaction is

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy

COMMON MISCONCEPTIONS

- A common misconception is that there are only a few types of cells. In reality there are many types of cells, each having specific functions. All cells share certain features, but they also specialize.
- Cellular respiration is often confused with respiration, or breathing. Cellular respiration is the chemical reaction that occurs in the cell releasing energy for the cell to use.
- Cellular respiration is the opposite chemical reaction to photosynthesis. If students are aware of this fact, they may assume that photosynthetic organisms do not perform cellular respiration. In fact, all cells need cellular respiration for their own energy requirements, whether they can perform photosynthesis or not.

ADVANCE PREPARATION

- Start acquiring the materials for Conduct an Investigation 10-2B on page 407 of the student textbook well in advance. You could introduce this activity early on so that students can think of what materials they would like to use and bring them in to class.
- Using the microscope for Activity 10-2C on page 408 requires that you have various samples ready ahead of time and that you book the lab you are using well in advance.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 402–404

Using the Text

Discuss analogies and their use in science. Read through the analogy of the Newo colony and have students assume the roles of experts. When they have completed Find Out Activity 10-2A, have them consider what analogies are supposed to do. Based on this analogy, what do they predict they may find out about the cell? Discuss other analogies that you could use to relate the cell organelles' functions to situations in students' lives, such as a parent being the nucleus of the family, sending messages to the parts of the "cell" about what they should be doing.

Read through Table 10.3 as a class. This table will give students a good understanding of the parts of a cell and their function. Particularly important is the cell membrane, which is highlighted in its own text section.

Using the Key Terms and Section Summary

At the beginning of each section in the student textbook are the Key Terms and section summary. Both can be used as a pre-reading strategy and a review tool. Before reading the text in the section, students should be able to define the Key Terms by scanning the text and using the Glossary. The Key Terms include terms from the curriculum outcomes and additional terms that are important for students to know and understand.

The section summary provides an overview of the key concepts being covered in the section. Students may not know all the concepts and terms described in the summary, but they can use this information to help guide them through their reading.

After reading the section, students can go back to the Key Terms and section summary to consolidate their understanding and identify areas that require clarification. At the end of the chapter or unit, students can use the Key Terms and section summary for review. BLM 4-2, Unit 4 Key Terms, and BLM 4-3, Chapter 10 Key Terms, can be used to assist students.

Using the Activity

Find Out Activity 10-2A

Finding Solutions for Problems in the Newo Colony, p. 404

Purpose

- Students use an analogy to explore the parts of a cell and their roles and relationships.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Have students read the reports on page 403 of the student textbook and discuss them as a class. Make copies of BLM 4-12, Newo Solutions (optional).	For each group: – paper – pens or markers

Time Required

- 45 min

Science Background

Newo is an imaginary colony on a distant planet, made up of clusters of protection domes. The protection dome is an analogy for a typical cell and the various management groups are analogous to the various organelles that carry out the functions of the cell. Control Central is the nucleus; the Protection Dome is the cell membrane/cell wall; Food and

Nutrient Fluid Transportation comprises the vesicles, Golgi apparatus, and endoplasmic reticulum (organelles whose main function is transportation); Energy Production is the mitochondria; and Waste Control is the vacuoles and lysosomes.

Activity Notes

- Students can work in small groups to brainstorm solutions to each of the problems.
- Have students set up a chart to fill in as they brainstorm. One student in each group can record the ideas. You may wish to hand out BLM 4-12, Newo Solutions, for students to record their ideas.

Supporting Diverse Student Needs

- Encourage students with reading difficulties to take an active role in drawing and labelling the solutions for the Newo colony.
- This activity presents opportunities to build interpersonal skills. Review the rules for brainstorming and the importance of listening to and considering everyone's ideas.
- Remind students that the group will have more success if individual differences and interests are considered when assigning roles within the group.
- For enrichment, consider other specialists that the colony may have, such as the Structural Fibre Production Group (ribosomes), and the problems that they may have. Students can learn about other parts of a cell that were not discussed.

What Did You Find Out? Answers

1. & 2. Have students set up a comparison chart before looking at other students' work.
3. Students' answers may vary. Possible answers could include adding more gates to accommodate increased flow, and changing the communication plans for Control Central.
4. Students' answers may vary depending on drawings. To select solutions that will work best for solving Newo's problems, consider giving each student or group five stickers that they could use to identify the best solutions on the posted drawings for each of the problems. They can go from drawing to drawing and decide which group had the best solution to the first problem and then stick a sticker on that solution. Then they can search for the best solution to the second problem, and so on.

TEACHING THE SECTION, pp. 404–413

Using Reading

Pre-reading—Predict-Read-Verify

Break the section up into manageable chunks for students to read, based on section headings. Before reading, ask students to read headings, analyze visual aids, and read captions in each chunk. Have students predict what each chunk will be about. Upon reading the text, ask students to verify or revise their predictions.

During Reading—Note Taking

It would be a good idea for students to create a chart to use as they read the section. You may wish to hand out BLM 4-15, Functions of Cell Organelles, for students to use for support on that section.

As they read each section, they can fill in the chart. Make sure that students leave spaces after each entry so that they can add more information later from other sources.

After Reading—Reflect and Evaluate

Have students create a compare and contrast chart, a Venn diagram, or other double cell diagram comparing plant and animal cell parts. Students could complete some or all of BLM 4-14, Discovering Organelles: Concept Map; BLM 4-16, Parts of a Plant Cell; BLM 4-17, Parts of an Animal Cell; BLM 4-18, Comparing a Plant and an Animal Cell; BLM 4-19, Create Your Own Cell.

Supporting Diverse Student Needs

- Interpersonal and verbal-linguistic learners can consolidate what they learn in this section by using BLM 4-15, A "Cell" Job, to nominate an organelle of their choice for "most valuable organelle". Science Skill 10, on pages 496 – 497 of the textbook, includes information on using a spider map to facilitate brainstorming.

Reading Check Answers, p. 406

1. Organelles are the structures or components of a cell that perform a specific function.
2. The cell membrane is selectively permeable because only some, not all, substances can cross it.
3. The cell theory is valuable because it is one of the key ideas in biology and it helps scientists describe and explain their observations of living things.

Using the Activities

- Activity 10-2A on page 404 of the student textbook is best used as an introductory activity. Detailed information about this activity can be found in Introducing the Section.
- Activity 10-2B on page 407 of the student textbook is best used after reading and discussing Table 10.3 on page 405, as well as the section on the cell membrane and cell theory.
- Activity 10-2C on pages 408 and 409 of the student textbook is best used after Activity 10-2B,

once students have a stronger knowledge of the structure and function of organelles.
- Activity 10-2D on page 412 of the student textbook is best used after students have read about cell division and mitosis, as well as looked closely at Figure 10.10 on page 411.
- Activity 10-2E on page 414 of the student textbook is best used after students have read about the energy needs of cells on page 413.
- Detailed notes on doing the activities follow.

Conduct an Investigation 10-2B

Building a 3-D Cell, p. 407

Purpose
- Students design and build a model of an animal or plant cell.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Review the purpose of using models to understand scientific concepts with students. Gather materials, or have students bring materials from home.	For each group: – variety of materials, such as yarn, beads, toothpicks, pipe cleaners, string, straws, foam, modelling clay – clear drying glue – scissors

Time Required
- 60 min

Safety Precautions
- If students bring in their own materials, ensure that the materials are not hazardous in any way.
- Remind students to take care using scissors.
- If any edible substances are used in the cell construction, remind students never to eat anything in the science classroom.

Science Background
Modelling is important in science because many of the concepts in science relate to objects that cannot be seen directly. Modelling helps scientists form a physical and mental picture that they can use for further exploration of the concept. Up to this point, students have been thinking of cells in two dimensions. This activity will help students think about cells in three dimensions.

Activity Notes
- Make sure that you have some materials available to supplement students' materials.
- Remind students to draw their design before they begin to construct it. Drawing a diagram of their model will make the model-building process smoother.
- You may want to set limits on the size of their creation, such as the size of a shoebox.
- As part of your assessment, you may want to have students grade each other's models on the basis of creativity, presence of each of the cell's parts, labelling, etc.

Supporting Diverse Student Needs
- To develop vocabulary before they begin the activity, encourage students to make a checklist to show the materials they plan to use for each listed cell part.
- The summary at the end helps to build verbal-linguistic skills.
- Instead of a physical model, students could create a computer-generated model or diagram of a cell.
- For enrichment, students could research different types of specialized cells (brain, muscle, etc.) and design a model to represent one of those cell types.

Evaluate Answers
1. & 2. You may wish to use Assessment Checklist 6, Developing Models and/or Process Skills Rubric 1 Developing Models to help you assess students' models.

Conduct an Investigation 10-2C

Observing Plant and Animal Cells, pp. 408–409

Purpose
- Students examine plant and animal cells under a microscope to discover their similarities and differences and to observe some fundamental cell parts.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before 30 min before	Bring onions. Gather sufficient prepared slides of human skin cells. Make copies of BLM 4-20, Observing Plant and Animal Cells Comparison Chart (optional). Prepare the onion by cutting it up into sections.	For each group: – microscope – microscope slides – cover slips – lens paper – tweezers – medicine droppers – water – onion – iodine solution – paper towel – prepared slide of human skin cells

Time Required
- 40–60 min

Safety Precautions

- Students should wear lab coats.
- Microscopes, slides, and cover slips can break. Ensure that students handle them with care.
- Remind students to be careful when using sharp objects such as tweezers.
- Onion juice may sting eyes. Advise students to wash their hands after handling the onion. Students may wear safety glasses during Part 1 of this investigation.
- Iodine is toxic, so remind students to be especially careful and to wash any area of skin that comes in contact with it.
- Do not use freshly prepared slides of human skin cells.

Science Background

- **Plant and Animal Cells:** Although plant and animal cells share many similarities, there are fundamental differences. In addition to the structures that animal cells have, plant cells have a cell wall and chloroplasts. Animal cells possess centrioles and asters (specialized structures important during mitosis), which are absent in plant cells.

  The cell wall surrounds the cell membrane of the plant cell and is made up of a non-living material called cellulose. The cell wall is rigid, so it gives the plant its stiffness and shape. Because plants do not have a skeleton, they need the cell wall to make each cell rigid.

  The chloroplasts present in plant cells contain a green substance called chlorophyll, which is needed by plants for making food, in the process of photosynthesis. Most of the chlorophyll is found in the leaves of green plants.

  Vacuoles of plant and animal cells differ in number and size. Plant cells tend to have larger and more numerous vacuoles. Animal cells have small vacuoles.
- **Staining:** Iodine is used here as a stain. It is particularly useful in enhancing contrast of the nucleus.

Activity Notes

- Start the investigation with a brief discussion of how plants are different from animals. How do we stand upright? Do plants have an endoskeleton (internal skeleton) or an exoskeleton (external skeleton) or something else?
- Have students develop a list of organelles that they expect to see.
- Iodine solution may stain clothes. A good way to prevent spilling is to keep the iodine at the teacher's station, and have one person from each group come with the prepared slide to get a drop.
- Encourage students to follow the step-by-step instructions given in the student textbook.
- It would be useful to demonstrate step 3 of Part 1 to make sure that students are getting translucent onion skin rather than a thicker layer.
- If students are getting a lot of bubbles in their wet mount slides, they can decrease the number of bubbles by putting a drop of water on the slide, placing onion skin on top, and then adding another small drop of water.
- Cellular structures can look quite different in real cells compared to drawings of cells. This finding can be frustrating for students. If one group is able to achieve a good view of a particular structure, have the class come and take a look so they know what to look for.
- To wrap up, discuss the investigation as a class, encouraging students to talk about what they saw, what they think the function of each part of a cell they saw might be, and any difficulties they had viewing the cells.

Supporting Diverse Student Needs

- Encourage English language learners to take an active role in the operation of the microscope and in the process of making the wet mount slide.
- Refer challenged learners to Table 10.3 on student textbook page 405 to find the list of required organelles.
- The comparison chart in the Conclude and Apply section can be started by one group and passed to other groups for additional information. Then students can each choose one point to share in a class discussion. In this way, all students are able to make a contribution.
- Students could place their two diagrams side by side and add notes to answer Conclude and Apply questions 1 and 2.
- Students can use BLM 4-20, Observing Plant and Animal Cells Comparison Chart to help them organize their comparison in Conclude and Apply question 1.
- As enrichment, students could cut thin (almost translucent) cross sections of carrots or celery and view them under the microscope. Emphasize that the cross sections should be cut as thin as possible to allow some light to pass through them, making them visible under the microscope. Have students compare what they see with the onion cells used in the investigation.

Analyze Answers

1. Students' answers may vary; however, the cell's nucleus, cell wall, and the vacuoles should become more visible. Depending on what students were able to see, other organelles may have become more visible as well.

2. Students' answers may vary but could include that some vacuoles are for waste storage and plant cells might need to store more waste.
3. Students' answers may vary, but could include that not all cells are the same, and so the size estimates may be different. As well, students are looking at a two-dimensional view of a three-dimensional object, so the visible structures may be different, as well as the apparent size of the cell.

Conclude and Apply Answers

1. Students' charts will vary, but may be similar to the following:

ONION SKIN CELL	HUMAN SKIN CELL
Thick wall surrounding cell	No thick wall
Regular shape	More irregular shape
Dark stained part	Dark stained part
Dark part near edge of cell	Dark part near centre of cell

2. Both onion skin cells and human skin cells have very few spaces between them. This characteristic allows the skin to form a sheath-like structure, which protects the parts it covers. The onion skin cells are shaped like bricks, or tiles and are arranged in layers. This fairly rigid shape would help the onion hold its shape. The layers with no gaps would protect the organelles in the cell.
   The human skin cells have a less regular shape, because they have to be more flexible to allow for movement.

Find Out Activity 10-2D

Observing Root Tip Cells p. 412

Purpose

- Students examine prepared slides of onion root tip cells to look for evidence of cell division.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Gather materials.	For each group: – compound microscope – prepared slide of onion root tip

Time Required

- 30 min

Safety Precautions

- Microscopes, slides, and cover slips can break. Ensure that students handle them with care.

Science Background

All cells divide during their life cycle; however, cell division occurs rapidly in areas of rapid growth. In plants, root tips are constantly growing and the process of mitosis is occurring in almost all the cells. The cells are not all dividing at the same time, so there are always multiple cells at different stages of the cell division process.

As mentioned earlier, there are four general stages of mitosis:

- First, the chromosomes become visible and the membrane surrounding the nucleus disappears.
- Second, the duplicated chromosomes align down the centre, or equator, of the cell.
- Third, the duplicated chromosomes separate into two strands, and one duplicate strand of each chromosome is pulled to the side of the cell, called the pole.
- The chromosomes cluster together at each end, a nuclear membrane appears around the chromosomes, and the cell membrane grows, pinching the parent cell into two, and creating two cells each with DNA identical to the parent cell.

Students should be able to identify the cells undergoing mitosis by looking for the solid chromosomes, or the bundles of chromosomes moving toward the poles. They should not concern themselves with naming or identifying the four stages.

Activity Notes

- Students can work in pairs or groups of three, depending on the number of microscopes.
- Refer students to the sections on Dividing Cells and Mitosis. Before beginning the activity, discuss what students might be expected to see.
- You may want to encourage students to look closely at Figure 10.10 to help identify cells that are dividing.

Supporting Diverse Student Needs

- After students have reviewed their classmates' sketches, allow students to observe the cells again and revise their sketch if they feel they were lacking detail.
- For enrichment, have students do further research on the stages of mitosis and see if they can find the correct names for the different stages of cell division occurring in their onion root tip cells.

What Did You Find Out? Answers

1. & 2. Have students set up a comparison chart before looking at other students' work. This

will help them identify the similarities and differences in the sketches. You may wish to use Assessment Checklist 7, Scientific Drawing to help assess students' sketches.

3. (a) Root tips are areas of rapid growth, so the cells in the root tip will be undergoing significant cell division to support that growth.
   (b) Students' answers may vary; however, they may suggest the edges of leaves, any new shoots or branches, or flower buds.

Find Out Activity 10-2E

Observing Evidence of Cellular Respiration, p. 414

Purpose

- Students look for evidence of cellular respiration in yeast cells.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
Several days before	Gather materials.	For each group: – warm water – 2 beakers (500 mL)
1 day before	Review the Energy for Cells section in the student textbook. Make copies of BLM 4-21, Observing Evidence of Cellular Respiration (optional).	– 2 scoopulas or measuring spoons – 2 samples of white sugar (5 mL each) – 2 samples of active dry yeast (15 mL each) – 2 stirring rods – 2 plastic pop bottles (600 mL or 1 L) – 2 balloons – tape

Time Required

- 20 min (steps 1 and 2)
- 60–120 min (data collection at 15 min intervals)

Safety Precautions

- Students may wish to wear lab coats, as they may spill some solution when pouring it into the pop bottles.

Science Background

Cellular respiration is the process used by all organisms to get the energy they need. Glucose is stored in cells, and cellular respiration releases the energy that is stored, making it available for use in life processes such as cell division. Cellular respiration is a chemical reaction that releases energy (for use by the cell) as an end product; however, during the chemical reaction, energy is also released in the form of heat.

Yeast is made of small, unicellular organisms that use organic compounds as a source of energy and do not require sunlight to grow. Yeast species are either completely aerobic (requiring oxygen for cellular respiration) or are partly anaerobic, being able to produce energy in the absence of oxygen some of the time. No known yeasts are totally anaerobic.

The anaerobic energy production occurs via the process of fermentation, and the breakdown of sugars in this process allows yeasts to be used in the making of beer and wine. The aerobic respiration of baker's yeast is used to make bread rise.

Activity Notes

- Make sure that students are careful not to spill the ingredients when preparing their solutions. For the investigation to show the proper results, the contents of each bottle must be controlled: the water temperature should be the same, and the amount of ingredients should be the same.
- Make sure that students take care labelling their bottles; otherwise, they will not be able to conclude which condition led to cellular respiration.
- The balloons must be blown up first, in order to stretch them. If they are not stretched, they will not expand as easily with the released gas.
- As well, the seal must be tight around the balloon and the bottle neck, or the gas will be lost and the balloon will not expand.
- The bottle with the yeast and the sugar should be the bottle with the evidence of cellular respiration. Gas will be given off, and the temperature of the contents should stay warm, or even get warmer (as energy is released during the reaction). The sugar is necessary as an energy source, otherwise there is no glucose to form a fundamental part of the chemical reaction.

Supporting Diverse Student Needs

- Students with reading difficulties can work with a partner to read carefully through the steps. Both partners are doing the steps at the same time, so it is an excellent opportunity to increase comprehension.
- Students with latex allergies should have another student blow up their balloon for them.
- Pairing body-kinesthetic learners with verbal-linguistic learners will ensure success in performing the experiment, and in describing the results. This will also help students to broaden their repertoire of learning styles.
- Students can use BLM 4-21 Observing Evidence of Cellular Respiration, to help them record their observations. For enrichment, have students do further research on yeast and how yeast is commonly used in baking and distilling.

What Did You Find Out? Answers

1. Partner 1's bottle, the bottle with the sugar, should show evidence of gas, as the balloon should expand.
2. Partner 1's bottle, the bottle with the sugar, should show evidence of energy being released in the form of heat. The bottle contents should stay warm, or may even become warmer as the reaction progresses.
3. (a) Partner 1's bottle should show all the evidence of cellular respiration, while Partner 2's bottle will not change. This is because there is no energy source, in the form of sugar, in Partner 2's bottle.
   (b) Partner 2's bottle acts as a control.
4. The evidence should be that gas (carbon dioxide) is given off and expands the balloon. Additionally, heat is generated and can be felt by the temperature of the bottle.

SECTION 10.2 ASSESSMENT, p. 415

Check Your Understanding Answers

Checking Concepts

1. The nucleus is the control centre of the cell.
2. The cell membrane is a protective barrier that also regulates what enters and leaves the cell.
3. The mitochondria is the organelle where cellular respiration occurs, producing energy from the breakdown of glucose.
4. The vacuole acts like the cell's storage container.
5. Plant cells would eventually die once their supply of glucose has been used up. Without chloroplasts, they would not be able to make any more food.
6. A: cell membrane; B: cytoplasm; C: nucleus; D: mitochondria; E: chloroplast; F: nucleus; G: cell wall.
7. The bottom green cell is a plant cell. It has chloroplasts and a cell wall, neither of which is found in animal cells.
8. Cytoplasm contains organelles, water, and other life-supporting materials.
9. Cell theory states that the cell is the basic unit of life, and makes up all organisms. It also states that all cells come from other cells.
10. Students' answers may vary but could include the following: Scientists consider cell theory to be a main idea of modern biology because cell theory explains the observations that have been made about cells and presents a logical framework that is testable. For example, if we observed cells being made from non-living materials, we would have to reject the cell theory.

Understanding Key Ideas

11. The cell membrane must allow the exchange of nutrients and wastes to occur all over its surface. One opening would not allow this.
12. • Plant organelles: chloroplasts, cell wall
    • Plant and animal organelles: cell membrane, nucleus, mitochondria, vacuoles
    • Animal organelles: none
13. Onion roots do not contain chloroplasts because the roots are covered with soil and therefore do not receive sunlight.
14. Animals obtain their food by eating other organisms and not through photosynthesis.
15. Plant cells need cell walls for support and therefore tend to have a regular shape. Animal cells do not have cell walls and can assume a variety of shapes because they are not providing rigid support.
16. (a) The cell theory states that all cells come from other cells. This process is cell division.
    (b) Students' answers will vary but may include the following: Unicellular organisms such as bacteria and some pond microorganisms reproduce by dividing the cell into two cells. Growing organisms, like onion root tips, add new tissue and cells by cell division.
    Red blood cells and all other body cells, such as skin, replace dead or damaged cells by cell division.

Pause and Reflect Answer

Students' answers may vary but should include that air, fire, water, and earth are not basic units of life and they do not exist in each cell. The ancient Greeks did not have the ability to see microscopically, so they were not able to identify cells and the organelles within them.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

CHAPTER 10 ASSESSMENT, pp. 416–417

PREPARE YOUR OWN SUMMARY

Students' summaries should incorporate the following main ideas:

1. Characteristics of Living Things
   - All living things are made up of one or more cells.
   - Living things respond to their environment, grow, reproduce, and move.
2. The Microscope
   - The image you see through a compound light microscope is magnified, inverted, and reversed.
   - The magnification power is found by multiplying the power of the objective lens by the power of the eyepiece lens.
   - The resolving power is the ability to distinguish between two objects that are very close together.
3. Cell Theory
   - Cell theory was based on observations over several hundred years.
   - Cell theory states that the cell is the basic unit of life; all organisms are composed of one or more cells; and all cells come from other living cells.
4. Cell Organelles
   - You can use an analogy to help understand new ideas by making a comparison.
   - Organelles are cell structures in which functions are carried out to ensure the cell's survival.
   - There are similarities and differences between plant and animal cells.

CHAPTER REVIEW ANSWERS

Checking Concepts

1. Living things respond to stimuli, grow, move, and reproduce.
2. Unicellular and multicellular organisms are both made up of the basic unit, the cell.
3. Living organisms grow, move, reproduce, and respond to stimuli in their environment.
4. All organisms must eventually die. Living things must reproduce in order to replace themselves.
5. The coarse adjustment knob should be used only on low or medium power.
6. As the slide moves toward you, the object that you are viewing will appear to move away from you.
7. The objective lens could crack the slide when adjusted. Also, there is a chance of some debris from the sample getting on the lens.
8. A wet mount slide is made by adding a drop of water to the sample before putting on the cover slip.
9. Plant cells have chloroplasts and cell walls, which animal cells do not have.
10. The vacuoles store food and waste material.
11. The cell membrane controls the movement of substances in and out of the cell.
12. The genetic material in a cell would be found in chromosomes in the nucleus.

Understanding Key Ideas

13. The cell wall is a tough rigid structure that surrounds the cell membrane and gives plant cells a regular, box-like shape. The cell membrane surrounds and protects the contents of the cell and helps to control the movement of materials into and out of the cell.
14. Students' answers will vary but may include the following: Cells need to stay fairly small in order to effectively distribute materials, such as food and wastes, into and out of the cell. If cells just kept growing, they would not survive because they would get too big. Living things grow larger by dividing existing cells into two new cells, through the process of cell division, or mitosis.
15. The cells would continue to reproduce to replace dead, dying, and damaged cells.
16. You can tell if a cell is undergoing mitosis by looking at it and seeing if it is in an intermediate stage, such as the chromosomes being pulled apart.
17. You could determine the field of view using a length of ruler, and then divide that field of view by 40. The field of view at low power is usually 4.2 mm, so the cells would be approximately 0.1 mm.
18. (a) Carry the microscope using both hands, one on the base, and one on the arm.
    (b) Begin preparing a wet mount slide by placing a drop of water on the slide. Then use a pair of tweezers to place your specimen in the drop of water. Next, hold a cover slip at a 45° angle and gently lower it onto the slide, over the drop of water and the specimen. There should be no air bubbles under the cover slip. If there is any excess water on the slide, dab a piece of tissue paper on the side.

(c) To view the slide under low power, place the slide on the stage of the microscope. Turn the coarse adjustment knob carefully to bring the object into focus. Next, turn the lens to the medium power and focus the image. You may need to turn the fine adjustment knob to make minor adjustments to the focus.

19. (a) The cells are animal cells. Plant cells have a regular box-like shape because of the rigid cell walls.

(b) Students' answers will vary but may include the following: the cell membrane, the nucleus, or the chromosomes.

Pause and Reflect Answer

Students should be able to come up with the following points as they describe possible reasons for seeing only darkness through the eyepiece:

- The light may be off.
- The lens may not be fully engaged, so they are not looking at the stage.
- The slide may be out of position, and light is not getting through.
- There may be something else on the stage, blocking the light from passing through.

You may wish to have students answer this Pause and Reflect using a write around, in which one student begins a response, then others in the group take turns adding to it. In this way, all students have opportunities to contribute in a non-threatening way and all have the benefits of seeing a complete answer. Students can each choose one point from their group's response to share in a class discussion.

CHAPTER 11 OPENER, pp. 418–419

USING THE PHOTO AND TEXT

This chapter is an opportunity to talk with students about the various organ systems that make up the human body. After an overview of systems, tissues, organs, and organ systems, the text introduces the 11 human body systems. You can use the photograph of acrobats to illustrate the idea of a circus troupe being analogous to the parts of the body. Each member of the circus troupe has a particular role to play in the overall acrobatic performance. What makes the performance exciting to watch is how one member's specialty seamlessly flows into another's, leading to an experience that is greater than the sum of its parts. You can relate this seamless co-operation to the cell and the various organelles that carry out their tasks, or to their various organ systems working together in order for an organism to exist.

Another example that can show the importance of parts working together to ensure a smooth running whole would be a typical city. Have students brainstorm what these parts would be and their role. Some ideas may be the transportation system, garbage disposal, water and sewage systems, etc.

USING THE WHAT YOU WILL LEARN / WHY IT IS IMPORTANT / SKILLS YOU WILL USE

Encourage students to read the What You Will Learn and Why It Is Important sections. Refer back to Chapter 10 and the requirements of life. Have students determine the functions that the human body needs in order to survive. Their answers may include the body's need to acquire nutrients, fight disease, and excrete wastes. Students can use their answers to suggest other points that could be included in the Why It Is Important section.

USING THE FOLDABLES™ FEATURE

Use the Foldables section of this resource.

11.1 CELL ORGANIZATION

BACKGROUND INFORMATION

The simplest level in living things is the cell, the basic building block of life. Groups of cells having the same task are called a tissue. Tissues working together to carry out a common task are called an organ. Groups of organs working together for a particular function are called an organ system. This section of the chapter begins with a review of what a system is, and to the functions of various systems that we work with every day. This is followed by an introduction to the organizational relationship of tissues, organs, and organ systems.

Tissues: A tissue, which is a grouping of cells having a similar set of limited functions, can be considered as the second level (after the cell) into which structures are organized in an organism. Tissues allow the organism to function effectively.

Animal Tissues: Animal tissues can be subdivided into the following four main types:

– Epithelial tissues form "linings" that cover every exposed body surface including the lining of internal cavities in the body (such as the chest cavity, the cavity of the heart and stomach, and the inner linings of blood vessels). An epithelium therefore always has one surface exposed, either externally or toward an internal space. In general epithelial tissues provide physical protection and control permeability. One characteristic of epithelia is that they lack blood vessels, so that they must obtain nutrients by diffusion or absorption.
– Muscle tissue is made up of muscle cells, which are distinct from other cells. The special properties and organelles of muscle cells allow them to contract, producing shortening. There are three main types of muscle tissue: skeletal (causes the movement of bones), smooth (in the walls of the digestive system and in blood vessels for example), and cardiac (only in the heart).
– Nerve tissue conducts electrical impulses from one part of the body to another. Nerve tissue contains two basic cell types: the neurons that carry the electrical signals and the cells collectively termed "neuroglia", which provide a support system for the neurons.
– Connective tissue includes all sorts of seemingly unrelated but vital parts of the body. The main characteristic of connective tissue is that the cells, mainly, secrete an extracellular matrix in which the cells then reside. For example, bone cells secrete a mineral matrix of mainly calcium phosphate. The property of the connective tissue depends on the kind of matrix. Examples include bone, cartilage, blood, tendons, and ligaments.

Plant Tissues: Plant tissues include xylem and phloem (conductive tissues) and epidermal tissues (protective tissues).

COMMON MISCONCEPTIONS

- Students can probably name a number of organs in the human body. What they may have difficulty doing is telling you where those organs are and what function those organs have. Students

may also have difficulty coming up with relationships between the various organs that make up the organ systems.
- Students may not think of skin and bones as being made up of cells, or even being "alive." Remind them that cuts and scrapes heal, and that broken bones regrow.

ADVANCE PREPARATION

- If you will be showing prepared slides of other body tissues for Activity 11-1B, you will need to arrange for a flex camera and a series of slides.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, p. 420

Using the Text

You may wish to begin by having students name all the systems they can (stereo system, solar system, ecosystem, public address system, etc.) and then have them consider what these systems have in common. This activity could be done as a class brainstorming session or with students working in small groups.

Together, develop a flow chart showing how the parts of some of the systems that students mention are organized to form the system, and how the parts of a bicycle, as listed on page 420, are organized to form systems. This will help prepare students for Think About It Activity 11-1A.

From their study of Chapter 10, students have learned that all living organisms are made of fundamental units—cells. Students are now ready to appreciate the need for specialization and the different levels of organization required by multi-cellular organisms. The hierarchical relationship between cells, tissues, organs, and organ systems needs to be clearly realized. Having different levels of organization (including specialized cells, tissues, and organs) is the way that a multicellular organism ensures that all the primary life requirements of each of its cells are met. Explain to students that not all the cells can perform all of the functions required by, for example, the human body. Instead, through differentiation, each cell develops characteristic features and a limited number of functions to carry out tasks that contribute to the overall functioning of the organism.

Using the Key Terms and Section Summary

At the beginning of each section in the student textbook are the Key Terms and section summary. Both can be used as a pre-reading strategy and a review tool. Before reading the text in the section, students should be able to define the Key Terms by scanning the text and using the Glossary. The Key Terms include terms from the curriculum outcomes and additional terms that are important for students to know and understand.

The section summary provides an overview of the key concepts being covered in the section. Students may not know all the concepts and terms described in the summary, but they can use this information to help guide them through their reading.

After reading the section, students can go back to the Key Terms and section summary to consolidate their understanding and identify areas that require clarification. At the end of the chapter or unit, students can use the Key Terms and section summary for review. BLM 4-2, Unit 4 Key Terms, and BLM 4-4, Chapter 11 Key Terms, can be used to assist students.

Using the Activity

Think About It Activity 11-1A

Represent the Relationship, p. 421

Purpose

- Students create a flowchart to represent relationships among the components of human organisms.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Review the characteristics of systems. Make copies of BLM 4-23, Represent the Relationship (optional).	For each group: – paper – pens or markers

Time Required

- 30 min

Activity Notes

- Students can work individually or in groups.
- Before developing a flowchart for the human body, you may wish to have students develop other flowcharts representing other systems similar to the examples in the activity. This process can be done as a class and the results can be displayed at the front of the class. If this activity was already done as an introduction to the section, review the results.

Supporting Diverse Student Needs

- Students whose first language is not English can write their first-language term for the components of the human organism beside the English term.

- Give challenged students the words "organ," "cell," "organism," and "tissue" to arrange, in order, in their flowchart.
- Students could answer What Did You Find Out? question 1 orally.
- Students can use BLM 4-23, Represent the Relationship to record their flowcharts.
- As enrichment, consider having students do more research on the identified components, such as finding more detail about one or more of the organ systems, and adding it to the flowchart.

What Did You Find Out? Answers

1. Students answers' will vary but should summarize the relationship from cell to tissue to organ to organ system. They should make the connection to even larger layers made up of the smaller components in the layer below. You may wish to use Assessment Checklist 14, Events Chain or Flowchart to assess students' interpretation of their flowcharts.

TEACHING THE SECTION, pp. 420–423

Using Reading

Pre-reading—Predict-Read-Verify

Have students list groups of tissues and organs that they think work together. Ask them to predict the unifying function for each of the groups that they identify. Upon reading the text, ask students to verify or revise their predictions.

During Reading—Note Taking

Have students add specific information for one or more systems to the flowchart they made in Activity 11-1A or to their lists. They could use different colours in the chart for each of the component systems.

Supporting Diverse Student Needs

- Remind students that they can use the Reading Check questions to help them be sure they have extracted the key points from the reading. Students can use a think-pair-share format to develop their own answers to the Reading Check questions, then refine those responses by discussing with a classmate. In their discussion instruct students to always show their partner where in the text they found the information that helped them develop their response.

After Reading—Reflect and Evaluate

Students could make connections between tissues, organs, and organ systems. Students could complete BLM 4-24, The Eleven Human Body Systems; BLM 4-25, Specialization in the Body; BLM 4-26, Organization in Biology; and/or BLM 4-27, Understanding Body Tissues; and outline interesting information they discovered in the section. They could write a statement explaining why they found the information interesting, and these could be shared in class discussion.

Reading Check Answers, p. 423

1. A system is made up of individual parts that work together as a whole.
2. If any part of the system is missing or damaged, the system will not function as it should.
3. Tissues are groups of similar cells.
4. Organs are made up of one or more types of tissues.

USING THE ACTIVITIES

- Activity 11-1A on page 421 of the student textbook is best used as an introductory activity. Detailed information about this activity can be found in Introducing the Section.
- Activity 11-1B on page 423 of the student textbook is best used after reading the section on tissues.
- Detailed notes on doing the activities follow.

Find Out Activity 11-1B

Looking at Animal Tissues, p. 423

Purpose

- Students observe photographs and distinguish different animal tissues.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	If you are planning to use prepared slides of animal tissue, gather the slides and the microscopes, and reserve a flex camera.	For each group: – paper – pen – (optional) prepared slides – (optional) microscopes – (optional) flex camera

Time Required

- 30 min

Safety Precautions

- If students will be using microscopes, remind them of proper safety procedures using the microscopes.
- Remind students to use caution with the slides as they are sharp and may break.

Science Background

Animal tissues can be subdivided into the following four main types:

– Epithelial tissues form "linings" that cover every exposed body surface including the lining of internal cavities in the body (such as the chest cavity, the cavity of the heart and stomach, and the inner linings of blood vessels). Epithelial cells often appear as a row on top of other tissue cells.
– Muscle tissue is made up of muscle cells, which are able to contract and shorten, moving the bones they are attached to. There are three main types of muscle tissue: skeletal (causes the movement of bones), smooth (in the walls of the digestive system and in blood vessels for example), and cardiac (only in the heart). Much muscle tissue is made up of densely packed elongated cells.
– Nervous tissue conducts electrical impulses from one part of the body to another. Nervous tissue contains two basic cell types: the neurons (with long appendages) that carry the electrical signals and the cells collectively termed neuroglia that provide a support system for the neurons.
– Connective tissue is made up of cells that secrete an extracellular matrix in which the cells then reside. For example, bone cells secrete a mineral matrix of mainly calcium phosphate. Examples include bone, cartilage, blood, tendons, and ligaments. Cells of connective tissue can have a variety of shapes, depending on their function. Bone cells are densely packed for stability. Blood cells can appear to have a lot of space between them.

Activity Notes

- This activity can be extended so that students examine prepared slides of animal tissue under the microscope or with the aid of a flex camera.
- If you do not have access to a flex camera, set up a few microscopes in advance as "stations," each station having a different slide. The slides should be pre-focussed for students.
- As a wrap-up, have students complete labelled sketches in their notebooks of the three tissues. If students used the flex camera or a microscope, they may have already completed labelled sketches. In this case, have them review and then display their work.

Supporting Diverse Student Needs

- This is an excellent activity for English language learners. Pair them with a fluent English speaker and encourage them to either dictate their answers in English, or record their partner's answers.
- Some students may need one or more intermediate steps in which they use words and phrases to describe each tissue (e.g., stringy, tightly packed). They can then use the photos on student textbook page 422 to decide which type of tissue each of their descriptions matches the most closely.
- You could set this up as a matching activity, in which you provide the names of four or five tissue types and four or five slide samples and challenge students to correctly match them up.
- For enrichment, have students look at other examples of tissues, including plant tissues. They can make up a tissue comparison chart for their own reference.

What Did You Find Out? Answers

1. A is skeletal muscle, B is bone, and C is nerve tissue. Students may answer that skeletal muscle tissue is the easiest to identify because it is in a shape that will stretch out. Students may answer that bone is easiest to identify because the sample contains many cells packed tightly together and that would make it strong. Students may answer that the nerve tissue is the easiest to identify based on its fibrous appearance. Accept any answer that seems reasonable.
2. The muscle tissue is relatively long and thin with parallel cells, making it possible to elongate and then shorten in contractions and so move muscles. The bone tissue contains many cells that are tightly packed together. This would make it hold its shape as bone. The nerve tissue is fibrous and looks like a web. This relates to its function of making a network of pathways for electrical signals.

USING THE FEATURE

Science Watch: Pig Parts for People?, p. 424

This feature is an excellent starting point for discussion regarding the propriety of using animal parts for human transplantation. Have students read the feature or read it together as a class.

Be prepared for students to express ethical concerns with transplanting organs and tissues between different species, in addition to the concerns expressed in the article. There is no need to support or refute students' concerns, but acknowledge them and help students understand that making difficult ethical decisions based on scientific information and our own world views is a part of being human.

Science Watch Answers

1. Scientists are considering pigs for human transplants because there is a long waiting list for organs and too often patients die before receiving one. Human organs are in short supply because there are few organ donors and

these donors, in most cases, must die before their organs become available. Also, an organ must be compatible with the patient or the patient's immune system will attack it. Pigs reproduce quickly, have organs of a similar size to human organs, and these organs can be genetically engineered so that human immune systems do not reject them.

2. Scientists are afraid that xenotransplantation might result in animal disease being transferred to humans. This disease may then gain the ability to attack other people who would have no natural immunity to it.
3. Students' answers may vary but could be similar to the following:
   - I think that the doctor should recommend the xenotransplantation of the pig kidney. Although there is some risk of the kidney harbouring a disease that could attack a human, it is a small risk. And, even if it were successful in crossing the species barrier, it would still need a mode of transmission that would place human populations at risk.
   - I think that the doctor should not recommend the xenotransplantation. Although the risks are small that any disease can cross the species barrier, we do have examples of that happening, such as the bird flu. However slight the risk, the consequences could be catastrophic. The human population would never have been exposed to the disease and would likely have no defence against it. There is a possibility that the world would have a pandemic.

SECTION 11.1 ASSESSMENT, p. 425

Check Your Understanding Answers

Checking Concepts

1. The parts of a system must work together and be able to interact with other systems. If part of the system operates incorrectly, the system may operate incorrectly or fail.
2. Students' answers may vary but could include the following points: A bike is made up of a number of different parts that must work together in order for the bike to function properly. For example, the gear system of a bike must work with the wheels and pedals, which in turn must work with the brakes. Or, if you view the entire bike as a system, it must be able to work with a person. If any part of the bike breaks down, such as the wheels, the bike will work poorly or not at all.
3. A (c) (muscle tissue)
   B (b) (nerve tissue)
4. Tissues are composed of cells that have the same structure and function. Organs are made up of different types of tissues working together.

Understanding Key Ideas

5. Students' answers may vary but could be similar to the following examples:
   – A car engine is composed of a number of parts that must work together. The engine must work with the transmission system and if one part of the engine fails, the engine will not work properly.
   – The combustion system in a gas furnace has different parts that work together, such as valves. The combustion system must work with other systems, such as the thermostat and fan in order to heat the house. A broken valve may result in the entire system shutting down.
6. Students' answers may vary but could be similar to the following examples:
   – A coral reef is a natural system that has many different interacting parts, including the coral and the different organisms that live in the coral. All the parts of the reef, including the movement of the water, must work together or the whole system will fail and the reef will die.
   – Plants have root systems, where all the different tissues work together to grow and expand through the ground in order to obtain water and food and to anchor the plant. They also have a shoot system made up of the stem and the leaves, which all work together to make food for the plant. If any part of the system fails, the plant will die as it will not be able to make food or obtain water or other nutrients.
7. Students' answers will vary; however, they may include the following:
   – muscle tissue: elastic bands or other stretchy material that is able to expand and contract
   – epithelial tissue: some smooth fabric or material that could be used to line a cavity. The smooth surface faces out into the cavity.
   – connective tissue: some hard, solid material that holds its shape, such as clay or Plasticine.

– nerve tissue: a webbed material or cotton that is pulled apart. The tissue should be able to hold the shape of a web or a net.

8. B, D, C, E, A. The heart cell (B) is organized into cardiac tissue (D), then into an organ (the heart) (C), then into an organ system (the circulatory system) (E), then finally into a human (A).

Pause and Reflect Answer

Students' answers should reflect the fact that the skin serves a purpose as protection from the environment including protection from sharp objects and dirt, and protection from dehydration. It is the first line of defense against micro-organisms and the elements. As well, it is constantly growing and replacing itself as skin cells die or are damaged.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

11.2 INTRODUCING HUMAN BODY SYSTEMS

BACKGROUND INFORMATION

The main functions of the organ systems in humans are provided below:

– Digestive system: Processes food and absorbs nutrients such as vitamins, minerals, and water. Also eliminates solid wastes from the body.
– Circulatory system: Transports materials within the body, including nutrients and wastes, as well as hormones for communication. This system is technically referred to as a bulk transport system, and one of its main functions is clearly reflected by the form of the system. It is a series of tubes or "pipes" that carry materials from one part of the body to another. It takes the oxygen delivered by the respiratory system to all of the body's cells and takes away the cell's wastes to where they can be removed from the body.
– Nervous system: Responds to stimuli and coordinates activities in the body such as the functioning of the other organ systems.
– Respiratory System: Brings air to where gas exchange with the circulatory system occurs.
– Excretory system: Eliminates salts, excess water, and other waste products.
– Muscular system: Allows movement, allows heart and stomach to contract, provides support, and produces heat.
– Skeletal system: Supports and protects soft tissues, produces blood, and serves as a site of mineral storage. Works with muscles to move the body.
– Immune system: Defends the body against infectious micro-organisms and other foreign bodies.
– Endocrine system: Influences the activities of the other organ systems through the production of hormones. Hormones are factors in numerous bodily functions such as growth.
– Integumentary system: Provides protection from the outside environment and helps in temperature control.
– Reproductive system: Produces sex cells and hormones, and allows for the development and delivery of offspring.

COMMON MISCONCEPTIONS

- Students may not realize that body systems are not independent of each other, and that many of the functions of each system overlap with the functions of other systems. For example, the respiratory system is responsible for gas exchange, but the circulatory system carries the gases to and from the site of gas exchange in the lungs.

ADVANCE PREPARATION

- Gather any required materials to help students present the results of their research in Activity 11-2A.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 426–427

Using the Text

Many students will have experience with robots, either from playing with robotic toys or from movies. Have them discuss the reality of robots, with all of their complex machinery, being able to perform the list of functions given on page 422. Connect the bulleted points in the text with their own bodies. Many will not have considered their bodies as a machine with requirements to function, so this may be an eye-opener.

Organs that cooperate and function closely with each other to perform a common purpose are considered to be part of an organ system. For example, the heart and blood vessels are the main organs that make up the circulatory system. They work together to ensure that all of the body's cells receive oxygen and other vital nutrients and have their wastes taken away. The number and kinds of systems differ among organisms. Plants generally have two main systems—the shoot and the root systems—as well as

a reproductive system. Less complex animals, such as sponges, do not have organ systems; in fact, they lack organs. Commonly, however, more complex animals have numerous organ systems.

Using the Key Terms and Section Summary

At the beginning of each section in the student textbook are the Key Terms and section summary. Both can be used as a pre-reading strategy and a review tool. Before reading the text in the section, students should be able to define the Key Terms by scanning the text and using the Glossary. The Key Terms include terms from the curriculum outcomes and additional terms that are important for students to know and understand.

The section summary provides an overview of the key concepts being covered in the section. Students may not know all the concepts and terms described in the summary, but they can use this information to help guide them through their reading.

After reading the section, students can go back to the Key Terms and section summary to consolidate their understanding and identify areas that require clarification. At the end of the chapter or unit, students can use the Key Terms and section summary for review. BLM 4-2, Unit 4 Key Terms, and BLM 4-4, Chapter 11 Key Terms, can be used to assist students.

TEACHING THE SECTION, pp. 428–430

Using Reading

Pre-reading— (K-W-L) (Know-Want to Know-Learned)

Ask students to record their answers to the question, "What do I know about human body systems?" Then have them review their answer and record questions they have about human systems. Later, students can share their questions as a class.

During Reading—Think-Pair-Share

Have students confirm, expand, and refine their ideas about this section by sharing ideas with a partner. Ask students to read each section of Table 11.1 independently, record their thoughts, and then pair up with another student to discuss their ideas. They can add to their notes after each group's presentation in Find Out Activity 11-2A.

After Reading—Reflect and Evaluate

When students have finished reading and presenting, have them choose three facts that they find interesting about human systems. Students can write a statement explaining why they find the information interesting. Have students reread the questions they had about human body systems, and reflect on which ones have now been answered.

Supporting diverse student needs

- Musical-rhythmic learners may enjoy creating a short rap or poem about one or more of the organ systems covered and presenting it to the class. Have them include the main organs, and functions of the system.

USING THE ACTIVITY

- Activity 11-2A on page 427 of the student textbook is best used after the different human organ systems have been introduced. Review Table 11.1 as a starting point for students' research.
- Detailed notes on doing the activities follow.

Find Out Activity 11-2A

Teamwork, p. 427

Purpose

- Students work in teams to research and present information about human body systems.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Collect books, posters, diagrams, and any other materials showing different organ systems, and make them available for students. Gather materials for student presentations.	For each group: – research materials such as books, posters, diagrams, or any other materials showing the different organ systems – materials for student group presentations, such as materials for three-dimensional models or multimedia resources

Time Required

- 90–120 min (probably one class for the research and another for the presentations)

Science Background

Circulatory System: Consists of the heart, blood, and blood vessels. Arteries are blood vessels that carry blood away from the heart to the capillaries, where oxygen, nutrients, and glucose diffuse out of the capillaries into the fluid surrounding tissue cells. At the same time, carbon dioxide and other wastes diffuse out of the cell tissues and into the capillaries. The deoxygenated blood flows from the capillaries to veins leading to the heart and then into the lungs, where gas exchange occurs and it becomes oxygenated again.

Digestive System: Consists of the mouth, salivary glands, esophagus, stomach, gall bladder, liver, spleen, pancreas, small intestine, large intestine, rectum, and anus. Digestion takes place in four stages: ingestion,

digestion, absorption, and elimination. Ingestion occurs through the mouth. Digestion begins in the mouth, as the food is chewed (mechanical digestion) and glands secrete saliva (chemical digestion). Next, food passes through the esophagus and stomach, where chemical digestion continues with the stomach's gastric juices. Absorption takes place in the small intestine and the large intestine. Any undigested materials at the end of the large intestine are turned into feces and eliminated through the rectum and anus.

The liver carries out over 500 functions. Many of these are related to digestion and therefore the liver is considered part of the digestive system (the liver develops embryonically from the gut). The liver stores and reassembles nutrients and releases specific nutrients when they are required. However, the liver also serves important roles in the circulatory system, including breaking down and "recycling" worn out red blood cells. This organ is of vital importance and its malfunctioning usually leads to the death of the individual.

Excretory System: Consists of the kidneys, the ureters (two tubes that carry urine), the bladder, and the urethra. The kidneys filter blood and remove any wastes. Urine is formed during filtration and stored in the bladder. When the bladder is full, the urine is flushed from the body through the urethra.

Muscular System: Provides movement for the body and enables organs like the stomach and the heart to contract. There are over 650 muscles attached to the skeleton, and their contractions move the bones in the body. There are three types of muscle tissue: skeletal, cardiac, and smooth. Some muscles are voluntary (the ones that we can consciously control, such as our arm and leg muscles) and others are involuntary (one we cannot consciously control, such as the smooth muscle in the intestines).

Nervous System: Receives stimuli, transmits stimuli to nerve centres, and initiates responses of the body to the stimuli. The brain and spinal cord make up the central nervous system (CNS). All other nerves connecting parts of the body to the CNS make up the peripheral nervous system. The peripheral system will receive stimuli (hand touching stove), send them to the central system, which interprets them and sends the message about response (move your hand away) back through the peripheral system to the muscles.

Respiratory System: Consists of the pharynx, trachea, bronchi, and lungs. Breathing begins when air is inhaled through your nose or mouth into the pharynx. The air is warmed and filtered by tiny hairs called cilia. As the air continues, it passes the larynx (voicebox) that contain the vocal cords and into the trachea. The trachea splits into two large tubes called the bronchi (singular: bronchus) that lead to the right and left lungs. The bronchi branch into smaller tubes in the lungs called bronchioles, and finally reach tiny air-filled sacs called alveoli. Gas exchange occurs in the alveoli, where gas moves back and forth between each alveolus and the surrounding capillaries.

Activity Notes

- Before students finalize their presentations, have the class come together to develop a rubric or assessment tool for the presentations. Have students look at Assessment Rubric 10, Presentation Rubric, to get an idea of what may be assessed.
- You may decide to limit the presentation methods to assure more standardized assessment.
- Provide students with Assessment Checklist 22, Project Group Assessment; Assessment Rubric 3, Co-operative Group Work and Assessment Rubric 9, Collecting Information, to help them with their group work skills and research skills.
- As a wrap-up, summarize what was learned about each organ that was researched as a class. Students could make their own notes during the discussion.
- Have the class evaluate each of the presentations based on the evaluation criteria agreed on in step 2.

Supporting Diverse Student Needs

- English language learners should be placed in a group with more fluent English speakers so that both the purpose and the group-assigned tasks are understood. To accommodate students with different reading abilities, have research materials at a variety of reading levels available.
- Work with any groups that include students with special needs to be sure that their plans in steps 3 and 5 provide opportunities for meaningful and appropriate involvement by all group members.
- The range of presentation methods gives this activity the potential to be a good activity for all styles of learners. Ensure that the presentation method chosen matches the dominant learning styles of group members.
- The breadth of this activity makes it an excellent opportunity for enrichment. Students can either dig deeper into the material, or create a more complex and detailed presentation.

SECTION 11.2 ASSESSMENT, p. 431

Check Your Understanding Answers

Checking Concepts

1. Students' answers may vary but will need to include six of the following: digestive system; circulatory system; nervous system; respiratory system; excretory system; muscular system;

skeletal system; immune system; endocrine system; integumentary system; and reproductive system.
2. (a) circulatory system
   (b) digestive system
   (c) excretory system
   (d) respiratory system
   (e) respiratory system/digestive system
3. The digestive system provides the body with all the matter and energy it needs to live.
4. From left to right: circulatory system; muscular system; nervous system.

Understanding Key Ideas

5. The excretory system filters wastes from the blood and flushes it from the body. The circulatory system carries gaseous wastes from the cells and takes them to the lungs where they are exchanged for nutrients and oxygen.
6. (a) the digestive system
   (b) No, the respiratory system also connects the internal and external environment. It is responsible for exchanging gases and wastes from cells inside the body with oxygen from outside the body.
   (c) The digestive system fits inside the body because the intestines (particularly the small intestine) are tightly folded many times into a small area.

Pause and Reflect Answer

Students may find it difficult to combine systems into only three or four groups. Advise them that five groups are also acceptable. Students' answers may vary; however, they may choose the following groupings:

- Supplying nutrients to cells/removing wastes from cells: digestive, circulatory, excretory, and respiratory systems. All of these systems work to transport and eliminate wastes from inside the body and intake nutrients and other critical factors from outside the body.
- Movement: muscular and skeletal systems. Both of the systems are responsible for movement and supporting movement, both inside the body and also moving the body through the environment.
- Control of body systems: nervous and endocrine systems. The nervous system organizes all the internal and external stimuli and controls the body activities. The endocrine system triggers body activities through the secretion of glands.
- Protection: immune and integumentary systems. The integumentary system serves as a barrier from the external environment, while the immune system serves to eliminate threats that make it through the integument.
- Reproduction: reproductive system

Note that students may have different groupings, which is acceptable as long as their rationale for grouping systems is appropriate.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

CHAPTER 11 ASSESSMENT, pp. 432–433

PREPARE YOUR OWN SUMMARY

Students' summaries should incorporate the following main ideas:

1. Systems
   - Systems are made up of individual parts that work together as a whole.
   - Systems are often connected to one or more other systems.
   - If one part of a system is missing or damaged, the system will not function well or may not function at all.
2. Organization of Cells of the Human Body
   - Tissues are groups of similar cells.
   - Organs are groups of tissues.
   - Organ systems are groups of organs.
3. Survey of Human Body Systems
   - There are 11 systems in the human body.
   - Human body systems work together and also independently.

CHAPTER REVIEW ANSWERS

Checking Concepts

1. A microscope is made up of individual parts working together as a whole. If one part of the system is missing or damaged, the system will not function well, or will not function at all.
2. The order of the flowchart will be cells, tissues, organs, organ systems, organism.
3. Muscle cell (cell), smooth muscle (tissue), intestine (organ), digestive system (organ system), human (organism).
4. (a) The circulatory system transports blood, nutrients, oxygen, and liquid and gaseous wastes. (b) The digestive system takes in food, absorbs nutrients, and eliminates solid wastes. (c) The excretory system removes liquid and gaseous wastes and maintains the volume and composition of body fluids. (d) The muscular system

enables certain organs to contract and relax and works with the skeletal system to move parts of the body. (e) The nervous system senses and responds to changes and controls and coordinates body activities. (f) The respiratory system exchanges carbon dioxide and oxygen in lungs and tissues.

Understanding Key Ideas

5. Yes, as a multicellular organism, the tree will need specialized tissues in order to perform all the functions needed for life. The systems will be different, but the functions will be the same: getting nutrients in, getting wastes out, reproducing, etc. For example, the plant's roots will grow through the ground and will absorb nutrients from the ground. The leaves will be part of the system that makes food for the plant by capturing sunlight and turning it into sugar.
6. Students' answers will vary but may include the following: the cell needs to move materials, into and out of the cell, just as an organism needs to move materials into and out of the body. Body systems such as the digestive system and the circulatory system act to carry waste away from cells and to bring nutrients and oxygen to the cells.
7. (a) No, it is unlikely that they are made from exactly the same tissue. Each is specialized for a different function. While they may have some of the same tissues in them, the roles they perform means that they must behave differently, so the combinations of tissue types, or the distributions of the tissues within the structures, will be different.
   (b) Students' answers may vary but should include the following: muscle tissue (as each organ moves) or nerve tissue (as each organ is controlled by the central nervous system). Students may come up with other tissues as well, so look for a solid rationale.
   (c) Muscle tissue would be necessary in order for the stomach to move and churn food.
8. Students should not be surprised by this fact because muscles need energy in order to move, so it would make sense that muscle cells have lots of energy-producing organelles.

Pause and Reflect Answer

Students should connect the digestive and circulatory systems together as a means of getting the nutrients from food to the cells where they are needed. Similarly, the circulatory and respiratory systems work together to remove waste gases and supply oxygen to cells. The digestive and respiratory systems have common openings via the mouth and pharynx (which splits into the trachea and the esophagus).

CHAPTER 12 OPENER, pp. 434–435

USING THE PHOTO AND TEXT

Discuss why Sarah, or any other amputee, would be at a disadvantage in terms of acquiring oxygen and energy (because she has significantly fewer cells to perform cellular respiration and thus supply her body with energy, and also because she requires more energy to accomplish basic tasks). With students, generate a list of what systems are found in the legs. Draw students' attention to the fact that the muscular, skeletal, and circulatory systems are reduced in size, due to the loss of her limb, but all systems exist in her body. Have students discuss whether or not an entire organ system could be replaced. They should realize that organisms cannot live if they are missing organ systems. In some cases, pieces of organ systems can be compensated for, as when someone donates a kidney and is able to function with only one remaining kidney. As with Sarah, the remaining systems must work harder to make up for the missing parts.

USING THE WHAT YOU WILL LEARN / WHY IT IS IMPORTANT / SKILLS YOU WILL USE

Review the What You Will Learn points with students, discussing how their previous knowledge from the earlier two chapters is associated with these topics. You may wish to brainstorm and create a class list of factors students think can affect the body in positive ways and factors students think can affect the body in negative ways.

Read the Why It Is Important section out loud. Have a discussion about different ways students work to maintain their health (eating well, exercising, getting enough sleep, etc.), and see if students can tie that back to the different systems they learned about earlier.

USING THE FOLDABLES™ FEATURE

See the Foldables section of this resource.

12.1 HOW BODY SYSTEMS ARE CONNECTED

BACKGROUND INFORMATION

As students learn about these systems, they will realize how much our body systems depend on one another in order to carry out the functions necessary for life.

Circulatory and Respiratory Systems: We need oxygen to be able to use the energy in our foods. We breathe it in thousands of times a day, and millions of times over our lifetime. It is exchanged between the air and the red blood cells by diffusion through our lungs' alveoli. The oxygenated red blood cells are pumped by our heart throughout the body in the arterial blood vessels. These arteries get progressively smaller until they connect with the multi-branching, hair-like capillaries that allow the oxygen to be delivered to the cells that need it, such as our muscle fibres. The depleted red blood cells, along with the waste carbon dioxide, then pass into the veins, which take them back through the heart and to the lungs. Carbon dioxide is released into the lungs, oxygen is picked up, and the whole cycle begins again.

Nearly all animals have oxygen-carrying molecules, known as respiratory pigments, which increase the capacity of the blood to transport oxygen. Humans, along with all vertebrates, have hemoglobin as their respiratory pigment, which becomes red when combined with oxygen. Hemoglobin is carried in the red blood cells in vertebrates. Hemoglobin has a strong affinity for oxygen, but its affinity for carbon monoxide is even stronger. When carbon monoxide attaches to hemoglobin, it does not dissociate easily, so the oxygen does not have a chance to combine. This is why carbon monoxide is so dangerous.

Circulatory and Digestive Systems: Digestion involves the breakdown of food into its smaller molecular components, so they can be absorbed through the intestine walls, distributed by the circulatory system, and used by cells in the body for their own purposes. Digestion involves compounds collectively referred to as gastric juices (basically enzymes produced mainly by glands in the lining of the digestive system). In addition to producing saliva that moistens food and helps it to be swallowed, the salivary glands produce an enzyme that begins the breakdown of starch.

Once digestion is complete, nutrients are absorbed into the capillaries of the small intestine. Nutrients are either distributed to the cells of the body for immediate use or are taken to the liver for storage and re-synthesizing.

The villi in the small intestine greatly increase the area for absorption. In addition to villi, there are also microvilli, which are tiny projections on the surface of the individual cells of the stomach lining. The villi and microvilli combined provide nearly 300 m^2 of surface area for absorption. The thin walls of the villi allow for passage of nutrients from the inside (lumen) of the small intestine into the capillaries.

Circulatory and Excretory Systems: Kidneys remove wastes from the blood, such as urea, uric acid, water, and salts that are produced by cells of the

body. Some of these substances can cause body systems to fail if concentrations become too high. The filtering of these wastes takes place inside the kidneys, in little filtering units called nephrons. There are about 1 million nephrons in each kidney. The glomerulus is a tiny blood vessel (a capillary) that is inside each nephron. As the blood passes through the glomerulus, the wastes are filtered out of the blood in circulatory system and either circulated back into the body (if they can be reused) or sent to the bladder in urine.

Nervous and Muscular System—Shivering: Shivering is an automatic function performed by the body to regulate temperature and keep the body at an even 37°C. It is a late stage effort by the body to keep warm when the temperature drops. Technically, shivering is heat production caused by rapid contractions, and therefore respiration, deep within the skeletal muscles. Goosebumps are an involuntary reflex of the body to being cold. It is a reflex started by the nervous system where tiny muscles at the base of each hair contract, causing the goosebumps. Mammals with fur have this reaction to cold because as the hairs go erect, they form an insulating layer, trapping air between hairs and insulating the body.

COMMON MISCONCEPTIONS

- Some students may have the misconception that oxygenated blood is bright red while deoxygenated blood is blue in colour. This misconception arises from two sources. One source is that diagrams of the circulatory system always show the venous system as blue in colour (used to differentiate the two systems). Another source is that students looking at the veins in their arms see them as being blue. All blood is red. Oxygenated blood is a bit brighter. The blue colour we see in veins has to do with the way light is reflected and absorbed by our skin, not with the blood itself.

ADVANCE PREPARATION

- Gather the materials for Find Out Activity 12-1A in advance. Test the data collection interface to make sure it will work properly and to ensure that you can troubleshoot if students need help.
- Gather the materials for Core Lab Conduct an Investigation 12-1B. Review the data tables and ensure that students will be able to record the appropriate data for their investigations. Consider which types of sports equipment to bring to class and see if they will be available from the athletic department.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 436–437

Using the Text

This section is a very logical progression from the material in the last chapter. In many ways, this chapter is about one more level of organization: cells form tissues that form organs that form organ systems, and then organ systems form multiple interacting organ systems. Discuss how none of the systems that students are familiar with would be able to survive independently. It is the successful connections between all systems that make an organism survive. See if students can come up with analogies for connected body systems. For example, one earlier analogy of systems was a city (with different departments working to carry out separate functions). Use the analogy of a province (made up of different types and sizes of towns and cities) or even the entire country. Canada could not exist without all of the provinces and territories working together within it.

Cellular respiration was explored in Chapter 10. Have students look at Figure 12.1 on page 436 and also review the work they did for Find Out Activity 10-2E. The information can be summarized on the board as a review of the process of cellular respiration. BLM 4-29, Cellular Respiration also summarizes the process of cellular respiration.

Using the Key Terms and Section Summary

At the beginning of each section in the student textbook are the Key Terms and section summary. Both can be used as a pre-reading strategy and a review tool. Before reading the text in the section, students should be able to define the Key Terms by scanning the text and using the Glossary. The Key Terms include terms from the curriculum outcomes and additional terms that are important for students to know and understand.

The section summary provides an overview of the key concepts being covered in the section. Students may not know all the concepts and terms described in the summary, but they can use this information to help guide them through their reading.

After reading the section, students can go back to the Key Terms and section summary to consolidate their understanding and identify areas that require clarification. At the end of the chapter or unit, students can use the Key Terms and section summary for review. BLM 4-2, Unit 4 Key Terms, and BLM 4-5, Chapter 12 Key Terms, can be used to assist students.

Using a Demonstration

Consider capturing students' attention at the beginning of this chapter by bringing in a pig heart. Pig hearts closely match the human heart and are large enough for students to observe the structures. The heart acts as a pump, and as such, is connected to the respiratory, digestive, and excretory systems. Students can observe the heart and brainstorm a list of questions about how it pumps, moving blood through the body. These questions can be researched on the Internet or in the library.

TEACHING THE SECTION, pp. 438–441

Using Reading

Pre-reading—Predict-Read-Verify

Break up the section into chunks for students to read based on section subheadings. Before reading, ask students to read the headings, analyze the visual aids, and read the captions in each chunk. Have students predict what connections each chunk will describe. Upon reading the text, ask students to verify or revise their predictions.

During Reading—Note Taking

Encourage students to take notes as they read through each chunk. They can use the subheadings to generate questions and then take notes as a means of answering the questions.

After Reading—Reflect and Evaluate

Have students review their notes and select three facts they find the most interesting. They can then write a statement as to why they find the information interesting. Alternatively, facts can be shared in class discussion. You may wish to use BLM 4-30, Getting Food to Body Cells; and BLM 4-31, Connections Between Circulation and Respiration, to help students summarize the functions of the circulatory and respiratory systems; and BLM 4-32, Organizing Organ Systems, to help students review the components of five major organ systems.

Supporting Diverse Student Needs

- After students have completed BLM 4-30, Getting Food to Body Cells, and BLM 4-31, Connections Between Circulation and Respiration, have them identify any responses that they are unsure about. With a classmate, have them review the textbook for 2 min, looking for information to help compete or clarify each response. If they have not found the information in 2 min, they can flag the question, then ask the rest of the class, or you, to identify the information that will help them. As well as helping students find the responses, this will model the process of extracting key information from texts.

Reading Check Answers, p. 441

1. Cellular respiration is the process that releases energy needed by the cell for its life functions.
2. The circulatory system moves blood through the body.
3. The digestive system moves food and nutrients through the body.
4. The respiratory system moves carbon dioxide and oxygen through the body.

Using the Activities

- Activity 12-1A on page 441 of the student textbook is best used after reading about the connections between the Nervous and Muscular Systems on page 440.
- Activity 12-1B on pages 442 and 443 of the student textbook is best used after reading the entire section; however, it relates specifically to the circulatory and respiratory system, so it can be done after reading the relevant text.
- Detailed notes on doing the activities follow.

Find Out Activity 12-1A

Muscle Activity and Heat, p. 441

Purpose

- Students use a computer interface and a probe to explore the link between muscle activity and heat production.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Begin gathering the materials and apparatus. Test the computer interface (optional). Book the computer labs (if this will be done in a separate computer lab).	For each group: – dumbbell – computer – data collection interface – temperature probe – digital thermometer – liquid (alcohol) thermometer

Time Required

- 60 min

Safety Precautions

- Have students take care with the temperature probes, digital thermometer, and the liquid thermometer. These items may break if handled roughly.

- Students need to take care with the dumbbells so that the dumbbells do not get dropped or fall off a desk and hurt anyone.

Science Background

One of the products of cellular respiration is energy, which is used by the cell to perform life functions (the other products are carbon dioxide and water). The chemical reaction that occurs during cellular respiration produces a molecule called ATP, short for adenosine triphosphate. The breakdown of this molecule frees the energy needed by the cell. When the cell is doing work, such as lifting dumbbells, the energy requirements increase and more cellular respiration will take place. As the ATP molecule is broken down, heat is released, as well as usable energy. The greater the work being done by the cell, the more energy is needed. This result means that the rate of cellular respiration will increase and more heat will be produced.

Activity Notes

- Make sure that students choose a dumbbell sufficiently heavy so that they can just do 10 curls. Doing so will ensure that the bicep muscle gets enough of a workout to increase its temperature measurably. This process might take a bit of trial and error.
- Get students to attach the temperature probe to the bicep muscle using masking tape. Doing so may help keep the temperature probe firmly pressed against the muscle.
- Allow time so that everyone can have a turn measuring the heat generated by their working biceps.

Supporting Diverse Student Needs

- Have English language learners be responsible for recording the data into a table. This process will help develop their comprehension and their writing skills.
- Provide a sample data table template for students who have trouble organizing their thoughts in writing. They can build onto the table if they extend the investigation. For example,

	TEMPERATURE PROBE	DIGITAL THERMOMETER	LIQUID THERMOMETER
Base temperature			
Temperature after 10 curls			

- This activity requires body-kinesthetic learning as well as logical-mathematical and verbal-linguistic learning. Ensure each group includes students with strength in these areas.
- For enrichment, have students use their results to determine if there are any trends in amount of muscle activity and temperature when more repetitions are performed. For example, is there a point past which temperature does not increase further?

What Did You Find Out? Answers

1. As muscles are worked, the temperature should increase. This will take some trial and error.
2. Students will probably find that the probe and the digital thermometer will be more effective than the liquid thermometer. You can use this result to initiate a discussion about the importance of using the most appropriate tools in any experiment.

Core Lab Conduct an Investigation 12-1B

The Effect of Activity on Heart Rate and Breathing Rate, pp. 442–443

Purpose

- Students look for a relationship between activity and heart and breathing rates.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Begin gathering the materials and apparatus.	For each group: – various pieces of sports equipment – graph paper – data tables

Time Required

- 60 min

Safety Precautions

- Advise students to always take a pulse at the wrist, never at the neck. The procedure is outlined in Part 1, instruction 2.
- Make sure that students do not overexert themselves. Review their plans to ensure the amount of activity they plan to do is reasonable.
- Ask students to disclose any health conditions that may prevent them from participating in physical exercise.

Science Background

Every time the heart beats, the muscles of the heart contract. This contraction forces blood through the arteries in a wave of pressure called a pulse. Every heartbeat has a pulse, and these pulses can be felt throughout the body. The most common places to feel a pulse are at the temples, on the neck, at the crook of the elbow, on the wrist, in the groin, and on the back of the knee. Pulse rates vary with age and with fitness. When the heart rate increases due

to physical activity, more blood is sent through the body to supply the cells with oxygen. There are two ways that the heart can respond to an increased need for oxygen during activity: pump faster (increase your pulse) or pump more per heartbeat. Pumping more per heartbeat requires strengthening the heart muscle, and is a goal of athletes when they train.

The body has the ability to store nutrients and water; however, oxygen cannot be stored. This means the lungs must be working all the time to make sure there is enough oxygen getting to the cells. Breathing is a function that cannot be voluntarily controlled for long. If you hold your breath, you will faint and the involuntary control of the brain and respiratory system takes control and you will start breathing again. The lungs are able to respond to an increase in the need for oxygen: they can breathe faster, or they can take in more oxygen per breath (breathing deeply and increasing volume).

Activity Notes

- Review the definition of hypothesis with students. Have them record their hypotheses and get your approval of them before beginning to design the procedure they will use to prove or disprove it.
- Approve students' procedures and data tables before they begin testing their hypotheses.
- Review Assessment Checklist 18, Data Table; and Assessment Checklist 19, Graph from Data with students so that they understand what will be expected of them.

Supporting Diverse Student Needs

- The instructions for this activity are lengthy. If some students have trouble reading instructions, have one group member read each part of the procedure aloud to the group.
- This activity requires body-kinesthetic learning as well as logical-mathematical and verbal-linguistic learning. Ensure each group includes students with strength in these areas.
- All students would benefit from discussing answers to Conclude and Apply questions with a classmate before writing them. Mathematically challenged students or those who have difficulty interpreting graphs might also benefit from discussing answers to the Analyze questions with a classmate before writing their answers.
- For enrichment, have students develop hypotheses about body temperature and performing light, moderate, and intense activity. Have them design a procedure to test their hypotheses. If there is enough time, they could perform the experiment.

Analyze Answers

1. Students' answers will vary; however, assuming they took regular measurements and recorded data correctly, the relationship should be that both breathing rate and heart rate return to resting rates most quickly after light exercise and slowest after intense exercise.
2. Students' answers may vary but the control variables should include: having the same person perform the activity for all the trials (or using an average of both partners' results), using the same interval rate between measurements, and using the same procedure for measurements at each trial.
3. (a) The average heart rate and average breathing rate will not show the extremes seen in the individual measurements. The averages would fall in between the individual measurements.
   (b) Breathing rates and heart rates are variable, so they may change from minute to minute due to tiny adjustments by the body as it responds to stimuli. As well, anxiety or stress may affect the rates. Using an average rate represents the best estimate of a standard breathing or heart rate for the individual.

Conclude and Apply Answers

1. Students' answers may vary, but on the whole, if they followed their approved procedure, their results should support the hypothesis that breathing rate and heart rate return to normal most quickly after light exercise. If the results did not support such a hypothesis, they likely had an error in their procedure, such as a measurement or control error.
2. Students' answers may vary; however, other variables that were not controlled could include the level of stress or anxiety of the participants, the temperature in the room, or the state of the equipment being used.

USING THE FEATURE

Science Watch: Too Much Sugar—Not So Sweet, p. 444

This feature is an excellent starting point for raising awareness of the explosion in the number of diabetes cases in Canada and elsewhere in North America. More and more children are being diagnosed with type 2 diabetes, a largely preventable disease. This increase is due to the increasingly sedentary lifestyle

of our youth and the rising intake of nutritionally bereft foods. Students might be interested in becoming involved in raising funds to fight childhood diabetes or raise awareness of this illness in the school community.

Science Watch Answers

1. In order for glucose to enter cells, the cells must have receptors for the glucose and there must be insulin in the blood. The insulin signals the glucose receptors to transport the glucose into the cell.
2. In type 1 diabetes (juvenile onset or insulin-dependent diabetes), the pancreas can no longer manufacture insulin. Individuals suffering from type 2 diabetes can manufacture insulin. However, their cells do not have enough receptors for the insulin and therefore cannot absorb the correct amount of glucose.
3. Individuals who are at risk, but do not have diabetes, would benefit from regular exercise and a healthy diet.

SECTION 12.1 ASSESSMENT, p. 445

Check Your Understanding Answers

Checking Concepts

1. Cells need oxygen in order to perform cellular respiration, which is a chemical reaction that provides the cell with energy.
2. Students' answers may vary but should include one of the following: The blood (circulatory system) picks up oxygen from the lungs (respiratory system) and delivers it to the body cells. Also the blood (circulatory system) picks up carbon dioxide from the body cells and delivers it to the lungs (respiratory system).
3. Students' answers may vary but should include one of the following: The blood (circulatory system) picks up nutrients from the small intestine (digestive system) and delivers them to the body cells. The blood supplies oxygen and carries away carbon dioxide to enable cellular respiration to take place in the stomach muscles, so that they have the energy they need to function.
4. If the body gets too cold, the nervous system instructs muscle cells to contract and relax repeatedly, causing shivering.

Understanding Key Ideas

5. (a) The blood vessels of the circulatory system near the surface of the skin expand. This increases blood flow near the body surface so heat can be lost to the outside, cooling the body.
   (b) The nervous system is the key system working with the circulatory system to cool the body.
6. The wastes that need to be filtered by the kidneys are carried in the blood in the circulatory system. Blood vessels must enter and leave the kidneys so that the wastes come in contact with the filtering units.
7. (a)

SUBSTANCE IN BLOOD	AMOUNT IN URINE
chloride	6 g
glucose	0 g
urea	20 g
uric acid	0.5 g
calcium	0.15 g

   (b) Glucose should not be found in urine because the chart indicates that all of it is returned to the bloodstream. Glucose is used by cells. It is not a waste product.
   (c) One benefit is that individuals do not have to keep eating to maintain the glucose in their bodies. By returning it to the body for use by the cells, the body is reducing the amount that needs to be consumed.

Pause and Reflect Answer

Carbon dioxide from all cells in the body leaves the same way: The carbon dioxide crosses the cell membrane and enters into the blood in the capillaries of the circulatory system. The blood is carried through veins to capillaries in the lungs. The capillaries encase the alveoli of the lungs, and gas exchange occurs here. The carbon dioxide leaves the blood in the capillaries and is exhaled when you breathe out.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

12.2 BODY SYSTEMS AND HEALTH

BACKGROUND INFORMATION

Blood Pressure: Normal adult blood pressure is about 120/80. The numbers, measured in units of mm Hg (i.e., mercury), indicate the pressure in the arteries. The upper number is the systolic pressure. It is a measure of the pressure of the contraction of the left

ventricle. The lower number is the diastolic pressure, which is a measure of the pressure in the relaxed left ventricle as it is filling with blood.

A sphygmomanometer is the instrument used to measure blood pressure. As the cuff of the sphygmomanometer is filled with air by squeezing the rubber bulb, the air pressure in the cuff builds until the pressure is greater than the blood pressure in the artery. When this process happens, the walls of the artery collapse and the flow of blood through the artery is temporarily interrupted. Gradually deflating the cuff allows the air pressure to decrease slowly. Blood can surge through the artery again as the air pressure in the cuff becomes less than the blood pressure. The systolic pressure is the pressure at which blood flow resumes. The sound of the blood pulsing through the artery again is detected with a stethoscope. The diastolic pressure is the pressure at which blood can move freely through the artery.

Homeostasis:
Most of the energy released by body cells from food is used to help maintain a constant body temperature. Essentially, in humans, one of the main functions of eating food is simply to keep the internal body temperature at 37°C.

The endocrine system and the nervous system are the body's main points of control for coordinating systems and maintaining homeostasis. In general, the endocrine system affects long term changes, from over a few minutes to a few months, whereas the nervous system is much more rapid. Endocrine glands secrete their products into the bloodstream (or the intercellular spaces) where they diffuse into the circulatory system. The endocrine system includes glands that release various hormones that direct many of the body's functions.

The excretory system is a key system of homeostasis. In addition to getting rid of wastes, the system controls the concentration of important substances in the blood, such as sodium, calcium, chloride, and potassium, by regulating how much of these substances are lost in the urine. For example, if a person drinks one litre of fluid, then one litre of fluid must be excreted in order to maintain the proper water concentration in the blood and maintain a stable internal environment.

COMMON MISCONCEPTIONS

- Students may be familiar with the terms "warm-blooded" and "cold-blooded," although these terms are not used scientifically anymore. The terms do not refer to the temperature of the blood, but rather to the need for a constant internal temperature. Warm-blooded animals have a constant internal temperature, whereas cold-blooded animals, such as reptiles, can have variable internal temperatures. These variable internal temperatures are why cold-blooded animals are so slow-moving in the cold.
- Students may not realize that lifestyle choices can be made at any time. The body will respond to positive changes very quickly, including changes in diet and reductions in activities such as smoking or alcohol consumption. Regardless of how long a person has been smoking, for example, there will be a benefit to stopping.

ADVANCE PREPARATION

- Collect print and electronic resources that provide students with information for Find Out Activity 12-2A on page 452.
- Collect labels from energy and sports drinks, and ensure students have access to Internet sites for Find Out Activity 12-2B on page 453.
- Collect print and electronic resources that provide students with information, and determine student groupings for Debate 12-2C on pages 454 and 455.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 446–447

Using the Text

Page 446 provides one example of how the circulatory system interacts with other systems. Have students recall the functions of other systems and explain how the systems interact with one another.

Using the Key Terms and Section Summary

At the beginning of each section in the student textbook are the Key Terms and section summary. Both can be used as a pre-reading strategy and a review tool. Before reading the text in the section, students should be able to define the Key Terms by scanning the text and using the Glossary. The Key Terms include terms from the curriculum outcomes and additional terms that are important for students to know and understand.

The section summary provides an overview of the key concepts being covered in the section. Students may not know all the concepts and terms described in the summary, but they can use this information to help guide them through their reading.

After reading the section, students can go back to the Key Terms and section summary to consolidate their understanding and identify areas that require clarification. At the end of the chapter or unit, stu-

dents can use the Key Terms and section summary for review. BLM 4-2, Unit 4 Key Terms, and BLM 4-5, Chapter 12 Key Terms, can be used to assist students.

TEACHING THE SECTION, pp. 448–451

Using Reading

Pre-reading—Key Word Concept Maps

Have students prepare a concept map centred around the idea of maintaining good health. They should include any Key Terms and body systems they think are appropriate for this concept. Before reading, new words and concepts—such as sphygmomanometer, brachial artery, artery elasticity, and dialysis—can be pre-taught or clarified. During reading, these new words and concepts can be linked to the student textbook. After reading, students can identify word concepts they wish to learn more about, or they can name the most important point they learned in their reading.

Supporting Diverse Student Needs

- Remind students to look up any unfamiliar words in the textbook's glossary.
- Concept maps could be created in a write-around format, in which a student creates part of the map, then passes it to another student in the group to add to, until everyone has had a chance to contribute, and the group feels the map is complete. Students could each choose a part of the group's map to share with the class, and in this way contribute to a large class concept map about maintaining good health.

During Reading—Think, Pair, Share

Assign students to read a section of the student textbook independently, record their thoughts, and then pair up with another student to discuss and share their thoughts. You may want to provide questions to focus on such as, "What is new to me about this passage?" Partners can collaborate to come up with one shared response and can also add ideas to their concept maps. Additional information about the effects of smoking are available on BLM 4-33, Harmful Chemicals in Tobacco Products.

After Reading—Reflect and Evaluate

When students have finished reading, have them quietly review their notes and choose three facts that they can use to maintain their own good health. Students can write a statement explaining why they find the information useful.

Reading Check Answers, p. 451

1. Genetic factors are factors that can affect the balance of body systems that are inherited from one or both birth parents.
2. Lifestyle factors are factors that can affect the balance of body systems that are within your control.
3. Students' answers may vary but should include two of the following: An artificial pacemaker releases electrical charges to stimulate the heart to beat with a steady rhythm; an insulin pump is programmed to deliver insulin; an artificial heart can replace a damaged heart until a donor is found; kidney dialysis removes wastes from the blood.

USING THE ACTIVITIES

- Activity 12-2A on page 452 of the student textbook is best used after students have read the section and have considered more of the interactions between body systems.
- Activity 12-2B on page 453 of the student textbook can be connected directly with lifestyle choices, and should be performed after students have considered Table 12.1 on page 449.
- Activity 12-2C on pages 454 and 455 of the student textbook is best used at the end of the chapter after students have fully considered the relationship between the balance of all systems in the body, and health.
- Detailed notes on doing the activities follow.

Find Out Activity 12-2A

Health Watch p. 452

Purpose

- Students explore ways that diet, exercise, or stress can affect a body system.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Collect print and electronic resources that provide students with information.	For each group: – print and electronic resources

Time Required

- 45 min

Science Background

The relationship between diet, exercise, and stress, and body systems is relatively clear. The more nutritious the foods that are eaten, the better raw mate-

rials the cell has to work with. One of the major problems for many individuals is eating a balanced diet and acquiring all of the nutrients necessary for the body to grow and perform well. Exercise acts not only to train the heart and strengthen it, but it also plays a key role in reducing the negative effects of stress and anxiety.

Stress is a normal response to hostile external conditions. The body responds in the short term with a "fight or flight" reaction, where the heart rate, blood pressure, and breathing rate all increase in order to supply the body with more oxygen. As well, blood is diverted from the extremities to the core of the body. Some of the symptoms a person may feel include chest pain or palpitations, cold and clammy skin, and muscle pain or headaches. If the stress factor is persistent, the body stays in fight or flight, which is an unnatural long term condition. Damage to systems can occur, and significant symptoms may show up, including chronic headaches and pain, mood swings, substance abuse (to reduce anxiety or block the stressors), heart attack or stroke, weight loss, and sleep disorders.

Activity Notes

- You may wish to have a class discussion about the meaning of the terms "diet," "exercise," and "stress."
- For some students, the term "diet" may represent the act of restricting food in order to lose weight; however, in the context of this activity, diet should be interpreted as the more general term describing what students eat.
- Students may interpret the term "stress" to mean tension or anxiety; however, there are other meanings, such as carrying a physical load. Ensure that the class agrees on how "stress" is to be interpreted.
- Discuss the format for presenting results before students begin their research. You may wish to present Assessment Checklist 9, Oral Presentation; Assessment Checklist 10, Computer Slide Show Presentation; and/or Assessment Rubric 10, Presentation, so that students have an idea of how their presentations will be assessed. Alternatively, you may wish to create guidelines as a class.

Supporting Diverse Student Needs

- English language learners can benefit from the opportunities to be involved with interviewing, both asking and recording questions. Some English language learners may be able to interview individuals who speak their own language or who share their own background. For example, it may be possible to interview a practitioner of Eastern medicine.
- To accommodate students with different reading abilities, have research materials at a variety of reading levels available.
- Work with any groups that include students with special needs to be sure that their plans in steps 5 and 6 provide opportunities for meaningful and appropriate involvement by all group members.
- This is an excellent activity for enrichment opportunities, because it is so open-ended. Students may investigate multiple topics, or you may wish to encourage creative and comprehensive presentations.

Find Out Activity 12-2B

Evaluating Energy Drinks, p. 453

Purpose

- Students research energy drinks to learn more about why people use them and how safe they are.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
2–3 days before	Book the computers and/or library access. Check access to energy drink websites.	For each group: – labels from one or more energy drink products – labels from one or more sports drink products – library and/or computer with Internet access
1 day before	Gather materials. Make copies of BLM 4-34, Evaluating Energy Drinks—Investigate an Energy Drink; BLM 4-35, Evaluating Energy Drinks—Investigate a Sports Drink; BLM 4-36, Evaluating Energy Drinks—Energy Drinks PMI Chart; and BLM 4-37, Evaluating Energy Drinks—Sports Drinks PMI Chart (optional).	

Time Required

- 60 min

Science Background

Energy drinks are different from sports drinks that rehydrate the body. Sports drinks provide sugars, which the body burns to create energy, and electro-

lytes, which maintain salt and potassium balances in the body.

Energy drinks provide mental and physical stimulation for a short period of time. Problems arise when people consume too many energy drinks or mix them with alcohol. For example, energy drinks have become popular at all-night dance bars and clubs. People drink them to sustain their energy during periods of intense physical activity, or after exercise, to quench their thirst. Energy drinks may, however, actually lead to dehydration because they usually contain caffeine, which is a diuretic and removes water from the body.

Sports drinks vary in the levels of carbohydrates and electrolytes that they contain. Sports drinks with high levels of carbohydrates and electrolytes are designed for athletes, such as distance runners, who sweat a lot and need to quickly replace sugars. Other sports drinks are nothing but water with flavour and colour added.

Activity Notes

- Check that the computers can access the commercial websites for each brand of energy and sports drink in order to find the advertising claims about it.
- Use Assessment Rubric 3, Co-operative Group Work and Assessment Rubric 9, Collecting Information to inform students of expectations for their work.
- Most energy drinks contain the same ingredients, although the proportions vary. This may create problems when students are creating their table or Venn diagrams for comparison. Try to find labels that show different ingredients in the different drinks to make this step easier.

Supporting Diverse Student Needs

- Place students with weak research skills in groups with students who have strong research skills. They can share the Internet research or choose to perform tasks such as recording their research results.
- The comparisons and explanations in this activity will help verbal-linguistic learners organize their learning.
- For students who have trouble organizing written responses, use BLM 4-34, Find Evaluating Energy Drinks—Investigate an Energy Drink; BLM 4-35, Evaluating Energy Drinks—Investigate a Sports Drink; BLM 4-36, Evaluating Energy Drinks—Energy Drinks PMI Chart; and BLM 4-37, Evaluating Energy Drinks—Sports Drinks PMI Chart.
- For students who have trouble analyzing and evaluating information, choose one website that provides appropriate information about energy drinks and one that provides appropriate information about sports drinks, and direct them to those sites.
- Instead of providing written answers to What Did You Find Out? questions 3 and 4, some students might enjoy creating short print, television, or radio advertisements either promoting or discouraging the use of sports or energy drinks in the circumstances given. Students should include evidence for their viewpoints.
- The research about energy drinks can be extended for enrichment. Have students research the different ingredients and find out where they come from.

What Did You Find Out? Answers

1. Students' answers will vary depending on which energy and sports drinks they were assigned. Some sports drinks are only flavoured, sweetened, and coloured water, and in fact contain no electrolytes. Others will have varying amounts of carbohydrates and electrolytes. Energy drinks vary in the key ingredients, such as caffeine, taurine, and guarana. (Note: Guarana is also a source of caffeine.)
2. Students' answers will vary but may include the following:

	PLUS (P)	MINUS (M)	INTERESTING (I)
Energy drink	– Boosts energy in the short term. – Ingredients are usually harmless in low doses.	– Negative side effects include headaches, dehydration, and nausea, when over consumed. – Common ingredients are dangerous for diabetics and individuals with low or high blood sugar.	– Accept any reasonable or interesting facts.

Sports drink	– Replenishes lost water. – Replenishes sugar stores.	– May contain only sugar and flavour, adding no value other than as a source of water. – May be over-consumed due to the good taste, and provide no value to the athlete.	– Accept any reasonable or interesting facts.

3. No, students should not recommend using energy drinks to prepare for an exam. People can become dehydrated, get a headache, or experience nausea and vomiting. All of these side effects could affect performance on an exam.
4. No, students should not recommend using sports drinks to prepare for a sports activity. Sports drinks can help athletes to rehydrate and replace lost electolytes after intense activity; however, there would be no value to using the drinks before an activity unless the athlete was already dehydrated (in which case, they probably should not be performing the activity).

Conduct an Investigation 12-2C

Debate: Conventional versus Alternative Medicine pp. 454–455

Purpose

- Students consider the value of using alternative medicine in the treatment of illness by conducting a debate on this issue.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Collect print and electronic resources that provide students with information on this issue.	For each group: – print and electronic information on the issue – materials and props that may be used for the debate
1–2 days before	Distribute information to students to read. Gather materials and props that may be used for the debate. Photocopy BLM 4-38, Debating Procedures.	– BLM 4-38, Debating Procedures

Time Required

- 80–100 min
  - 50–60 min to prepare for debate (reading and organizing arguments)
  - 30–40 min for the debate

Science Background

During the past century, scientific, or conventional, medicine has developed vaccines, antibiotics, and surgical techniques that have almost eliminated some diseases, for example, smallpox and polio. Scientific medicine has also reduced the risk of death from other disorders, such as heart attacks and cancer. As a result of medical advances, together with improved nutrition and sanitation, Canadians born today have a much higher life expectancy than people did who were born 100 years ago.

Many medical advances are based on better understanding of how cells and organs function in the body to help maintain normal health. For example, analysis of cells in the immune system helped researchers develop methods of controlling AIDS. The value of new techniques in scientific medicine is measured by quantitative results, for example, improved rates of recovery and increased survival rates.

Despite the great success of medical treatments based on scientific understanding, many types of alternative medicines have become popular in Canada. Some of these alternative medicines, such as herbal remedies, which are based on the uses of various plants, have been used by most cultures around the world since prehistoric times. Other alternative practices, such as homeopathy, chiropractic, and faith healing, were developed in the nineteenth century to compete with scientific medicine. More recent alternative practices include aromatherapy, therapeutic touch, magnet therapy, reflexology, and various dietary supplements.

Alternative treatments are not taught in most medical schools in Canada. People using these techniques vary in their training and knowledge. In general, alternative techniques have not been tested according to the same standards used to establish the value of scientific therapies.

Activity Notes

- Read through the activity with students. Assign groups and roles within the group (debating for, debating against, researchers).
- Set up a small stage or podium where the speakers will stand. If possible, include beverages or snacks.
- Establish standards or expectation for the audience, emphasizing the importance of constructive criticism.

Supporting Diverse Student Needs

- Read the Background Information aloud to English language learners, if necessary. Provide simpler words or analogies for the complex medical terminology included in the background information and that may be used during the debate.
- Verbal-linguistic learners may enjoy, and will benefit from, playing an active role in the debates.
- You might want to ask students to find out if any of their family members have, at some point, supported alternative medicine. If any have, ask students to consider the reasons for this choice. Was the course of action taken as a last resort? Did someone turn to alternative medicine because of disillusionment with traditional treatments or the side effects of strong drugs? Have students plan and conduct interviews and present them after the debates are completed.

Evaluate

1. & 2. Students' answers will vary and will be highly personal. They are likely to be influenced by their family experience and beliefs as well as their home environment. Accept any thoughtful answers to these questions, as long as students include a justification that makes sense.

USING THE FEATURE

Career Connect: Robyn Bagley, p. 456

In Canada, a certified Kinesiologist has to obtain a four-year Bachelor of Science degree in Kinesiology or obtain a Human Kinetics degree or an equivalent. There are several service areas for certified Kinesiologists to work in, including the following:

- Health Promotion: enhancing the health, fitness, and well-being of individuals
- Clinical/Rehabilitation: working to assist individuals with disabling conditions to regain optimal physical function
- Ergonomics: assessing and modifying the design of workplaces and assistive devices
- Health and Safety: consulting with industry to identify hazards and to optimize the health and safety of workers
- Disability Management/Case Coordination: designing strategies and plans to return injured individuals to their optimal function in all aspects of life
- Management/Research/Administration/Health and Safety: fulfilling roles in all of the other areas listed above, as well as performing research and managing businesses

Career Connect Answers

1. Technology has had positive and negative impacts on athletes. While athletes have fewer injuries due to some technologies (such as improved helmets and visors), there are also increases in injuries due to the ability to hit harder, push physical limits further, and play in a longer sports season.
2. Robyn's advice on maintaining life balance is relevant to all individuals. As well, core training to strengthen the muscles located in the trunk of the body will increase overall fitness and health for everyone.

SECTION 12.2 ASSESSMENT, p. 457

Check Your Understanding Answers

Checking Concepts

1. Students' answers will vary but may include the following:
   - Positive: diets low in fats and cholesterol; regular exercise
   - Negative: smoking and consuming drugs and alcohol
2. Fluids that are more viscous are more resistant to flowing. They require more energy to keep them moving. Since the heart provides that energy, it must work harder.
3. (a) Technology can be used to support or even replace the function of an organ or organ system.
   (b) Students should describe two of the following:
   artificial pacemaker: releases electrical charges that stimulate heart muscle cells to beat with a steady rhythm
   insulin pump: delivers a specific dose of insulin at specific times of the day to help cells absorb glucose from the blood
   artificial heart: pumps blood in the circulatory system while a person is waiting for a real heart to become available for a transplant
   kidney dialysis machine: filters waste products from the blood in a person whose kidneys are not able to do that
4. Smoking is a double threat because the nicotine in cigarettes causes the blood vessels to constrict, increasing heart rate and raising blood pressure. As well, the carbon dioxide in smoke competes with oxygen in the lungs, reducing the ability of the blood to carry oxygen.

5. Homeostasis is the ability of the body to maintain an internal balance.
6. Genetic factors are out of the control of the individual, whereas lifestyle factors are choices that can be adjusted.

Understanding Key Ideas

7. A high-fat diet can cause fatty deposits that clog blood vessels, reducing the flow of blood through blood vessels.
8. Drugs and alcohol can either be classified as stimulants, which temporarily increase the rate of life functions, or as depressants, which decrease the rate of life functions.
9. A: the respiratory system, which exchanges oxygen and carbon dioxide in the lungs, and works with the circulatory system to carry the oxygen and carbon dioxide to and from the site of gas exchange
   B: the heart (circulatory system), which is the pump that moves the blood through the circulatory system
   C: the digestive system, which breaks down food and releases nutrients into the circulatory system where they are carried to the cells
   D: the excretory system, which takes wastes carried in the circulatory system and filters them out into the urine

Pause and Reflect Answer

Answers will vary. Students should mention that stress can make it difficult for the body to obtain its essential needs, such as nutrients, adequate sleep, and exercise, because the body systems are responding to the stress and may not perform well.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

CHAPTER 12 ASSESSMENT, pp. 458–459

PREPARE YOUR OWN SUMMARY

Students' summaries should incorporate the following main ideas:

1. How Body Systems are Connected
   - The circulatory and respiratory systems are connected. The respiratory system exchanges gases and the circulatory system transports these gases and supplies them to cells.
   - The circulatory and digestive systems are connected. The digestive system provides nutrients and the circulatory system transports these nutrients and supplies them to cells.
   - The circulatory and excretory systems are connected. The excretory system filters wastes out of the circulatory system and moves them out of the body in urine.
   - The nervous system and the muscular system are connected. They work together to maintain a constant body temperature and to respond to other stimuli in the external environment.
2. Body Systems in Balance
   - The body maintains an internal balance, called homeostasis.
   - Genetic factors, inherited from one or both birth parents, can affect the balance of body systems.
   - Lifestyle factors are within a person's control and can affect the balance of body systems.
3. How Technology can Help Body Systems
   - Technology is used to diagnose and treat illnesses and diseases.
   - Technology can support or even replace the function of an organ or body system.
4. Healthy Choices Support Healthy Body Systems
   - Everyone has the same essential needs of clean air and water, a nutritious diet, exercise, and restful sleep.
   - Lifestyle choices have a significant impact on whether the body's essential needs are met.

CHAPTER REVIEW ANSWERS

Checking Concepts

1. Students who have written output difficulties may benefit from recording their answer on BLM 4-40, Unit 4 Review—Spider Map. Students' concept maps will vary. Check the linkages they have made to ensure that the relationships are correct. Encourage them to add more terms if necessary.
2. Infants might have a faster breathing rate because they are growing faster and so they need more oxygen and they need to get rid of more carbon dioxide. Also, their bodies might not process and use oxygen as efficiently as an older person's would.
3. Answers will vary and may include:
   (a) Blood in the circulatory system carries nutrients from the intestines to the cells of the body, and the circulatory system brings oxygen to the stomach muscles so that they can contract and digest food.
   (b) Both systems extract wastes from the blood—the respiratory system extracts gaseous wastes and the excretory system extracts liquid wastes.

(c) The circulatory system sends needed oxygen to the brain, enabling it to function. Nerves communicate a rise in temperature to the circulatory system, which can send more blood close to the skin, to increase heat transfer to the environment.
(d) The digestive system provides nutrients that enable muscles to function. Muscles in the jaws help to begin the process of breaking down food.
(e) The digestive system provides nutrients that allow the muscles to function that cause the lungs to expand. The respiratory system provides oxygen and removes carbon dioxide for the cells in the stomach and intestines.
(f) The circulatory system brings needed oxygen and nutrients to the muscles. The heart will beat at an increased rate, when necessary, to send more oxygen to muscles that are working hard.

Understanding Key Ideas

4. Sweating on a hot day is a response of the body to overheating. The body needs to cool itself down, and does this by evaporating sweat off the body. Thirst is a response to the loss of water by sweating.
5. Homeostasis is important because the human body systems are designed to function within fairly inflexible limits of characteristics such as temperature. The internal systems cannot function outside of these boundaries, so homeostasis works to maintain this balance.
6. (a) The obesity rate is increasing in all groups. While the number of obese people in the 25–34-year age group increased the most, the rate of obesity tripled for 12–17-year-olds, and more than doubled for the other two groups.
   (b) The three most common reasons for the changes are likely higher ingestion of prepared and fatty foods now than in 1978, lower levels of regular activity, and more sedentary activities such as television watching. Young people may be more likely to adopt these new lifestyle trends than older people are.
7. Yes, the graph does show an example of homeostasis. At the end of the graph the amount of glucose in the blood is the same as at the beginning. This result indicates that the body has regulated the amount of glucose. After the fruit juice, the amount of glucose went up, but the body brought it down again. The amount of glucose decreased quickly, then more slowly, until it reached the pre-juice amount.
8. The vegetarian diet will provide long-term health and support of the body because it provides whole grains and fibres, is high in good fats, and low in bad fats. Fad diets usually restrict the intake of many foods, so the body is starved of certain nutrients.

Pause and Reflect Answer

Students' answers may vary but may include the following: eating a well balanced diet, getting regular exercise, and not smoking. These things are important because cells need a good mix of nutrients in order to properly function, the body needs exercise to keep the voluntary and involuntary muscles strong and functioning, and the body needs to be able to efficiently exchange gases through the lungs.

UNIT 4 ASSESSMENT, pp. 460–467

PROJECT

Building a 3-D Model of Human Body Systems, p. 462

Purpose

- Students create a life-sized, three-dimensional model of four human body systems.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Gather materials students may use for their models.	For each group: – large chart paper – art supplies, such as felt pens, paints, etc.
3 days before	Assign groups and have students begin thinking about their plans. Show students the materials you have gathered, as students may want to bring additional materials from home.	– a variety of materials to represent body parts, such as rubber tubing, sponges, bean bags, vacuum hoses, etc.

Time Required

- 60–120 min, depending on the expected depth of the presentation

Safety Precautions

- Remind students to take care with sharp objects such as scissors or pins so that they do not poke or cut themselves.
- If students bring materials from home, ensure that the materials are safe and unbreakable.

Science Background

Students will be constructing a 3-D model of four human body systems.

Activity Notes

- This activity works very well as a group activity. However, it could also be assigned as an individual project for extra credit if class time is short.
- Students may require some guidance when choosing materials. Steer students toward easily obtainable, inexpensive household materials.
- To shorten the preparation time, consider collecting a large number of sample items (perhaps with help from a trip to a discount store) for students to use with their models.

Supporting Diverse Student Needs

- Be flexible in presentation format to accommodate students' strengths. It may be advisable to allow English language learners to present their final model in written or poster form.
- This is an excellent activity for students with good tactile skills. Students who can realize subtle design problems and features will excel at this activity. Consider allowing students with strong design skills to help other students who are having difficulty with construction.
- For enrichment, consider having students research and describe one disorder in the body system models they have constructed. Their models should indicate the disorder and how it affects the function of their system.

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

INTEGRATED RESEARCH INVESTIGATION

Advances in Biotechnology, p. 463

Purpose

- Students develop research skills as they broaden their understanding of the role of biotechnology.

Activity Notes

- Before students begin their research, have them show you the topic they have chosen and tell you some ways they plan on looking for information. If you think it will be difficult for them to find relevant information at an appropriate level, discuss a modification of topic, or some additional research strategies with them.

Supporting Diverse Student Needs

- Be flexible in presentation format to accommodate students' strengths. Other report formats should be allowed, such as oral reports (verbal-linguistic); interpretative dance, poem, or song (musical-rhythmic); or mock debate (interpersonal).

Other Assessment Opportunities

- Consult the Unit front matter for a list of applicable Assessment BLMs.

UNIT 4 REVIEW ANSWERS, pp. 464–467

Visualizing Key Ideas

1. Students' spider maps may vary, and could include more than a dozen terms for each heading.

Using Key Terms

2. Students' quiz questions will vary. You may wish to have students exchange quizzes with a partner.

Checking Concepts

3. To determine if the object is alive, it would have to move, grow, respond to stimuli in its environment, and reproduce.
4. Students' answers for (a) and (b) may vary, but could include the following:
   (a) Multicellular living things generally have cells that have become specialized to perform particular functions, such as nerve cells or red blood cells. Unicellular living things are made up of only one cell, and so cannot show such specialization.
   (b) All living things possess genetic material, a cell membrane, and cytoplasm.
5. (a) eye piece: used for viewing and contains a lens that magnifies
   (b) revolving nosepiece: holds the three objective lenses
   (c) coarse adjustment knob: brings an object into rough focus at low or medium power
   (d) light source: supplies the light needed to view the slide
   (e) stage: supports the slide. Some microscopes have stage clips to hold the slide in place
   (f) diaphragm: controls the amount of light reaching the specimen
   (g) objective lenses: magnify the image

6. (a) stage clips
   (b) fine adjustment knob
   (c) iris diaphragm
   (d) base
7. The object will be inverted (upside down and backward).
8. One millimeter is equal to 1000 microns.
9. The mitochondria produce energy for cellular activities.
10. The vacuole acts like a storage container for the cell.
11. (a) Plant cells have a cell wall and chloroplasts, which animal cells do not have.
    (b) Cell walls give the plant support and protection, as the plant does not have a skeleton. Chloroplasts produce food (glucose) for the plant cell through the process of photosynthesis.
12. The nucleus directs the process of mitosis.
13. The cell theory has three basic tenets:
    – The cell is the basic unit of life.
    – All organisms are composed of one or more cells.
    – All cells come from existing cells.
14. (a) This number is the product of the magnification of the low-power lens (4×) and the eyepiece lens (10×).
    (b) 100×
    (c) 400×
    (d) Students' sketches should be progressively more detailed. The edges of the eyelash will be visible under the low, may be visible under the medium, and will probably not be visible under the high power.
15. Students' answers may vary but could include the following:
    • Systems are made up of individual parts that work together. In the circulatory system, veins, arteries, and capillaries transport the blood and the red blood cells transport oxygen. The heart pumps to move blood through the system.
    • A system is connected to one or more other systems. The circulatory system picks up oxygen from the respiratory system and nutrients from the digestive system. It delivers these to every other system in the body. In addition, it delivers waste to the excretory system.
    • If one part of the system is missing or damaged, the system will not function well. Without the heart, red blood cells will not be able to carry oxygen to the tissues and the body will die.
16. Students' examples may vary.
    • Nerve tissue: nerves, brain
    • Connective tissue: tendons, bone
    • Epithelial tissue: skin, lining of systems
    • Muscle tissue: biceps, stomach
17. A tissue describes a group of similar cells working together.
18. Students' diagrams should show cells forming a tissue, tissues forming an organ, organs forming an organ system, and finally, organ systems joining to form an organism.
19. The arteries are filled with blood that contains red blood cells. The oxygen is transferred to the red blood cells in the capillaries in the lungs during gas exchange, and the capillaries lead into arteries.
20. A lack of air means that no oxygen is being supplied to the cells. Water and food are both stored; however, oxygen is used immediately in cellular respiration. Without cellular respiration, the organism dies very quickly.
21. (a) – circulatory system: transports blood, nutrients, oxygen, and liquid and gaseous wastes throughout the body
    – digestive system: takes in food and breaks it down into nutrients; absorbs nutrients; eliminates solid wastes
    – excretory system: removes liquid and gaseous wastes from the body; maintains the volume and composition of body fluids
    – muscular system: moves the body and some internal systems (digestive system, etc.)
    – nervous system: controls and coordinates body activities; senses and responds to internal and external changes
    (b) –(d) Students' answers will vary, but may include the following:
    (b) The circulatory system moves nutrients from the digestive system through the body.
    (c) The circulatory system moves oxygen from the respiratory system through the body.
    (d) The circulatory system removes wastes filtered from the blood by the excretory system.
22. Cellular respiration is the chemical reaction that takes place inside cells and that releases the energy the cell needs for its life functions.
23. If the blood vessels are damaged, the kidneys may not be able to properly filter the blood. Toxic substances may build up and cause illness or even death.

24. (a) Homeostasis is the ability of the body to maintain a constant balance internally.
    (b) Students' answers will vary but may include the following:
    - All body systems work together to achieve homeostasis, in order to maintain the proper internal conditions for all of its cells. The role of homeostasis is to allow the body to return to a resting balanced state after responding to external stimuli. For example, during a stressful situation, the body responds by increasing the heart rate and the breathing rate. Doing so provides more oxygen to muscle tissues and allows the body to perform well in an emergency. Once the emergency is over, the heart rate and breathing rate return to normal, achieving homeostasis.

Understanding Key Ideas

25. Students' answers will vary; however, the drawing at medium power should fill the entire field of view (the object will be magnified 10× rather than 4×) and there should be more detail, as the resolving power at medium power will be greater than at low power.
26. No, you would not expect to find chloroplasts in the root tip. Chloroplasts are organelles used during photosynthesis, so they are only present in parts of the plant that would be exposed to sunlight. The root tips are underground.
27. In the Plant Cell portion, students' diagrams should list cell wall and chloroplasts. In the shared portion of the Venn diagram, students should list cell membrane, cytoplasm, nucleus, vacuole, and mitochondria. In the Animal Cell portion, there should be nothing listed. If students have done additional research, they may know that animal cells have centrioles and asters, which plant cells do not contain.

Thinking Critically

28. This carbon dioxide is a waste product of cellular respiration that occurs in mitochondria in cells.
29. Blood flow in a healthy artery is even and unobstructed. In an artery with a buildup of fatty deposits, the artery is narrow and can become blocked. Blood pressure will be higher, as the heart works to pump the blood through the narrow artery.
30. (a) The circulatory system and the respiratory system are involved in this response.
    (b) The nervous system controls the functioning of these systems.
    (c) Homeostasis is the term used to describe the return to normal functioning.
31. Students' answers will vary, but should definitely include the point that cells, like factories, take materials in and let products and wastes out. There are specialized organelles, like pieces of equipment, which perform different functions within the cell in order to keep the cell functioning.

Developing Skills

32. The steps to preparing a wet mount slide are: place a drop of water on the slide; use tweezers to place the specimen in the drop of water; hold the cover at a 45° angle and gently lower it onto the slide. There should be no air bubbles. If there is excess water on the slide, it can be absorbed with a piece of tissue paper. Refer students to the procedure of Investigation 10-1A on page 394 if they need a guide for their labelled diagrams.
33. Microscopes must be carried with one hand on the arm and one hand on the base. Before being plugged in, check for any standing water in the work area.
34. One day: 100 800 beats
    One month: 3 024 000
    One year (365 days): 36 792 000
    80 years: 2 943 360 000, or 2 945 376 000 if you include 20 leap years
35.

RANGE OF HEART RATES	TOTAL NUMBER OF NON-ATHLETES IN THE RANGE
119–122	0
123–126	0
127–130	1
131–134	2
135–138	5
139–142	4
143–146	3

The data indicate that physical training decreases the exercising heart rate, as there were no athletes with heart rates over 138 beats per minute, while there were seven non-

athletes. There were no non-athletes with heart rates lower than 127 beats per minute, but there were five athletes.
The data would be easier to analyze if they were presented in a bar graph.

Pause and Reflect Answer

The titles of the three chapters are: The cell is the basic unit of life; Human body cells are organized as tissues, organs, and systems; and The health of the body depends on the health of its interdependent systems. The three titles show the hierarchy between body cells, tissues, organs, and organ systems, as well as the need for the interdependent systems to be healthy in order for the whole organism to be healthy.