DISCOVERING SCIENCE 7
TEACHER'S RESOURCE

UNIT 1: INTERACTIONS WITHIN ECOSYSTEMS

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McGraw-Hill Ryerson

UNIT 1: OVERVIEW

Understanding ecosystems is a first step to solving problems in the environment. Unit 1 provides students with a basic understanding of ecosystems and their components, as well as the interactions that occur between these components. The changes that occur within ecosystems, both naturally and as a consequence of human activities, are also a key focus.

Models of ecosystem change and interactions between various non-living and living components of ecosystems lie at the heart of the unit, as highlighted in its numerous investigations and activities. Chapter 1 introduces the basic concepts of ecosystem studies, exploring the nature of an ecosystem, as well as the biotic and abiotic factors that affect it. In chapter 2, students explore the interactions between biotic and abiotic factors in ecosystems, focussing on symbiotic relationships and matter and energy flow. Rounding the unit off in chapter 3, students delve into the sometimes-controversial topic of ecosystem change due to human and natural events, as well as methods of monitoring ecosystems and preserving habitats in the face of such change.

Chapter 1: An ecosystem is all the living and non-living things in a particular place.

Chapter 1 provides students with a basic introduction to ecosystems as the interactions of living and non-living things in specific environments. The chapter begins with a short explanation of abiotic and biotic components of an ecosystem, providing examples of each. Throughout the chapter, students are provided with examples of interactions between living and non-living things in ecosystems and are encouraged to consider how these components affect each other. They come to understand that ecosystems are defined as a consequence of the unique biotic and abiotic interactions that occur within them. Organisms have specific adaptations that help them thrive in their ecosystems. By altering the biotic or abiotic conditions in an ecosystem, some organisms may be unable to survive. The concept of ecosystem change, which is revisited throughout the unit, is introduced in this chapter. The chapter goes on to familiarize students with common ecosystems in Atlantic Canada.

The last two sections of the chapter explore the abiotic and biotic components of ecosystems in greater detail. Students are encouraged to consider how abiotic influences affect organisms within an ecosystem. The levels of organization within an ecosystem are introduced and students explore the roles of organisms in their various ecological niches.

Chapter 2: Living and non-living things interact in ecosystems.

One of the key ideas in ecology is that everything is connected to everything else. Interactions between living and non-living components of the environment are the focus of chapter 2. Students are exposed to the different types of interactions that occur in ecosystems, including abiotic-biotic, biotic-biotic, and abiotic-abiotic. From this platform, they dive into an understanding of the various symbiotic relationships of mutualism, parasitism, and commensalism, as well as the unique relationship that exists between predator and prey. The various roles organisms play in ecosystems are introduced as the chapter progresses. Students explore decomposition in greater depth, as they investigate the role decomposers play in food spoilage and learn various ways in which food is preserved.

Chapter 2 also introduces energy flow and the cycling of matter through ecosystems, two concepts essential to ecosystem sustainability. Students consider how living things obtain the energy they need to survive by determining the roles organisms play in food chains and food webs. Energy loss at each step along a food chain is explored and energy pyramids are described. Students learn that less energy is available to higher-level consumers in an ecosystem, thus limiting their population size. The chapter closes with an introduction to nutrient cycles, returning the focus again to decomposers, which play a key role in cycling matter through ecosystems.

Chapter 3: Natural events and human activities cause changes in ecosystems.

The last chapter in Unit 1 focusses on ecosystem change over time. Human activities, such as logging, farming, and urbanization, and natural events, such as landslides, fires, and floods, are all considered in terms of their effects on ecological processes. The initial focus of the chapter is on natural disturbances and succession. Primary and secondary succession are compared in depth, focussing on differences between initial conditions and later stages of succession.

The chapter then migrates toward the impacts humans have upon natural ecosystems, how these impacts can be monitored, and how conservation initiatives can help reduce their effects. Habitat loss, overharvesting, introduced species, and pollution are each examined in turn as potent examples of human activities that result in ecosystem change.

Environmental monitoring is used to detect change in ecosystems due to both human and natural events. In the concluding section of the chapter, students explore different methods of monitoring, focussing on physical, chemical, biological, and atmospheric monitoring. The importance of long-term monitoring and baseline data is highlighted. The chapter closes with an exploration of how our ability to predict ecosystem change via monitoring helps us both manage and protect sensitive ecosystems from the effects of human activity.

MULTIPLE INTELLIGENCES CORRELATION FOR UNIT 1 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 1: Interactions Within Ecosystems									
Find Out Activity: What is an Ecosystem?	■					■		■	■
Chapter 1: An ecosystem is all the living and non-living things in a particular place.									
Think About It 1-1A: What Do Living Things Need for Survival?	■					■			■
Find Out Activity 1-1B: Scrutinizing Soil	■	■			■	■			
Find Out Activity 1-1C: Creating an Ecosystem	■	■	■		■	■			■
Conduct an Investigation 1-2A: Field Trip to the Schoolyard	■	■	■		■	■		■	■
Find Out Activity 1-2B: Salty Seeds	■	■			■	■			
Think About It 1-3A: Seabirds	■	■			■	■			
Chapter 2: Living and non-living things interact in ecosystems.									
Think About It 2-1A: The Ups and Downs of Living Together	■				■	■			
Think About It 2-2A: Food Preservation	■				■				
Think About It 2-2B: Defending Against Decomposers	■	■	■		■	■			
Conduct an Investigation 2-2C: The Dirt on Decomposers	■	■	■		■	■			
Find Out Activity 2-3A: Eating at the Copepod Café	■		■		■	■			■
Think About It 2-3B: Riddle of the Pyramids	■	■	■		■	■			
Find Out Activity 2-4A: Round and Round It Goes	■	■	■		■	■			■
Chapter 3: Natural events and human activities cause changes in ecosystems.									
Find Out Activity 3-1A: Modelling Succession in a Bottle	■	■	■		■	■			
Think About It 3-1B: Secondary Succession from Beaver Pond to Bog to Forest	■	■				■			
Find Out Activity 3-2A: Mapping Your Home	■	■				■		■	■
Think About It 3-2B: The Pros and Cons of Conservations	■	■			■	■		■	■
Find Out Activity 3-2C: Checking the pH	■		■		■	■		■	■
Think About It 3-3A: Modelling an Environmental Impact Assessment	■				■	■			■
Unit 1 Project: Making a Garbage-Reduction Diary	■	■	■		■				■
Unit 1 Integrated Research Investigation: Saving Endangered Spaces	■	■			■	■	■	■	■

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 1: Interactions Within Ecosystems

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Unit 1: Interactions Within Ecosystems			
Find Out Activity: What is An Ecosystem?	None.	For each student: • large sheet of paper • pen or pencil • ruler	• 40 min
Chapter 1: An ecosystem is all the living and non-living things in a particular place.			
Think About It Activity 1-1A: What Do Living Things Need for Survival?	None.	None.	• 30 min
Find Out Activity 1-1B: Scrutinizing Soil	• 1 week before: – Ask students to collect large, wide-mouthed jars. – Assemble all other materials and apparatus. – Locate a suitable source of leaf litter or soil.	For each group: • large wide-mouthed jar • large plastic funnel • desk lamp with flexible arm • pie plate • hand lens and/or dissecting microscope • scissors • 2 damp paper towels • garden soil or leaf litter • fine mesh plastic pot scrubber • paper towel • paper for drawing	• 60–80 min – 15–20 min for steps 1–4 – 45–60 min for steps 5–8
Find Out Activity 1-1C: Creating an Ecosystem	• 2 weeks before: – Assign students into groups of 3–4. – Have students conduct research into ecosystems. – Have students begin to collect containers for their models. – Determine what plants you will have available so that students can plan their models. • 1 week before: – Review students' hypotheses submitted for approval. – Clear a space for the models in the classroom. – Gather apparatus and materials. – Obtain plants and potting soil.	For each group: • water • gravel or small rocks • twigs • seeds and/or small plants • potting soil • clear glass or plastic bowl	• 180 min – Research and planning: 60 min – Building: 60 min – Observations (ongoing until the end of the experiment): 5 min three times a week for four weeks
Core Lab Conduct an Investigation 1-2A: Field Trip to the Schoolyard	• 1 week before: – Assemble the materials and apparatus needed. – Determine the area of the schoolyard to be used for the field trip.	For each group: • notebook • drawing paper • pen or pencil • magnifying glass • binoculars • camera • thermometer • light meter • wind-speed recorder • field guides	• 90 min – steps 1–4: 30 min – steps 5–7: 60 min

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Core Lab Find Out Activity 1-2B: Salty Seeds	• 1 week before: – Collect apparatus and materials.	For each group: • 2 plastic drinking cups (or similar containers) • 30 mL salt • water • stir stick • 10 bean seeds • 2 paper towels • 2 plastic self-sealing bags • masking tape • marker	• 45 min over three days: – 15 min for steps 1–3 – 15 min for step 4 – 15 min for step 5
Think About It Activity 1-3A: Seabirds!	None	None	• 20 min
Chapter 2: Living and non-living things interact in ecosystems.			
Think About It Activity 2-1A: The Ups and Downs of Living Together	• 1 week before: – Book library or computer lab, if using. • 1 day before: – Review predator–prey relationships.	For each student: • graph paper • coloured pens or pencils • ruler	• 60 min
Think About It Activity 2-2A: Food Preservation	• 1 day before: – Review food decomposition and preservation.	None.	• 30–60 min – 30 min for exercise – 30 min for extra research, if required
Think About It Activity 2-2B: Defending Against Decomposers	• 1–2 weeks before: – Schedule dates of class presentations and book computer and projector for students doing computer slideshow presentations. • 1 day before: – Review food decomposition and preservation.	For class: • Computer and projector, if required	• A number of class periods – 30 min to introduce activity – 1 week for independent research – Several hours for presentations
Conduct an Investigation 2-2C: The Dirt on Decomposers	• 1 week before: – Gather the apparatus and materials. • 1 day before: – Review decomposers and decomposition.	For each group: • 2 identical large plastic pots (approximately 750 mL) with drainage holes • saucers for under the pots • pieces of window screen or similar mesh • magnifying glass • small stones • labels for pots • garden soil (not sterilized) • sterilized soil • water • measuring cup • approximately 500 mL of waste vegetable matter such as peels from carrots, apples, or potatoes, or leaves from cabbage or lettuce	• A number of class periods – 40 min for steps 1–7 – Several weeks (a few minutes each class) to complete observations (steps 8–11)
Find Out Activity 2-3A: Eating at the Copepod Café	• 1 week before: – Gather materials. • 1 day before: – Review food chains and food webs.	For class: • 20 strips of cloth, 30 cm long (10 of one colour, 10 of a different colour) • 1 large plastic self-sealing bag per student • 4–5 L of popped popcorn or foam “peanuts” used for packing • stopwatch • whistle	• 60 min

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Think About It Activity 2-3B: Riddle of the Pyramids	• Several days before: – Gather materials. • 1 day before: – Review food chains and energy pyramids.	For each student: • pencil • ruler • scissors • large sheet of blank paper	• 30 min
Find Out Activity 2-4A: Round and Round It Goes	• Several days before: – Gather materials. • 1 day before: – Review nutrient cycles and food chains.	For each group: • one tennis ball	• 40 min
Chapter 3: Natural events and human activities cause changes in ecosystems.			
Find Out Activity 3-1A: Modelling Succession in a Bottle	• 1 week before: – Ask students to collect 2 L plastic soda bottles or large-mouthed jars. – Contact an aquarium supply store to get aquatic plants. – Collect other materials • 1 day before: – Review succession.	For each student: • 2 L clear plastic soda bottle with the top cut off, or large-mouthed jar • potting soil • ruler • water • small aquatic plant • 50 mL wild birdseed mix	• 6 weeks or longer (depending on student interest and depth of inquiry) Steps 1–3: 10-20 min Step 4: 5–10 min, the day after steps 1-3 are done Step 5: 10–20 min once a week, for as long as the activity continues Step 6: 5 min 2–3 times a week, for as long as the activity continues
Think About It Activity 3-1B: Secondary Succession From Beaver Pond to Bog to Forest	• 1 day before: – Review succession.	None.	• 60 min
Find Out Activity 3-2A: Mapping Your Home	• 1 week before: – Book library or computer resources. • 1 day before: – Gather materials.	For each student: • a large sheet of paper • coloured markers	• 40 min (longer if research is required)
Think About It Activity 3-2B: The Pros and Cons of Conservation	• 1–2 weeks before: – Schedule dates of class presentations and book computer and projector for students doing computer slideshow presentations • 1 day before: – Review habitat loss, endangered and introduced species, overharvesting, and the impact of pollution.	For class: • Computer and projector, if required	• A number of class periods – 30 min to introduce activity – 1 week for independent research – Several hours for presentations

ACTIVITY/ INVESTIGATION	ADVANCE PREPARATION	APPARATUS/MATERIALS	TIME REQUIRED
Find Out Activity 3-2C: Checking the pH	• 1 week before: – Gather materials. • 1 day before: – Review acid rain	For each group: • clean collecting jars with lids • labels • samples of rainwater • samples of pond or river water • samples of tap water • pH indicator paper	• A number of class periods – Several hours to collect samples – 20–40 minutes to complete pH testing, depending on number of samples
Think About It Activity 3-3A: Modelling an Environmental Impact Assessment	• 1–2 weeks before: – Book computer room or library for student research.	None.	• A number of class periods – 30-40 min to introduce the project, select topic, and agree on roles – 2-3 hours to complete research and create presentations – 1- 2 hours to give presentations
Project: Making a Garbage-Reduction Diary	None.	None.	• 2 class periods – 30 min to introduce the project – 1 week to complete data collection – 1 hour to complete Report Out questions
Integrated Research Investigation: Saving Endangered Spaces	• 1–2 weeks before: – Schedule dates of class presentations and book computer and projector for students doing computer slideshow presentations.	For class: • Computer and projector, if required	• A number of class periods – 20 min to introduce activity – 1–2 weeks independent work to complete research and prepare presentation – 1- 2 hours to give presentations

TALKS AND TOURS

Speaker and field trip recommendations for Unit 1:

- Invite a speaker who works in an ecology/sustainability related field, such as an ecologist, waste reduction specialist, ecosystem conservationist, environmental advocate, wildlife specialist, naturalist, municipal planner, health inspector, or expert in sustainable business, to speak with your class.
- Ask a local college or university whether they have a speakers' bureau. Determine if the ecology department is carrying out environmental monitoring and arrange to visit the site with your class if possible.
- To help students understand how environmental change can affect both themselves and others living in their region, invite local people who have been directly affected by ecosystem change to speak with your class. Consider asking a local Aboriginal elder, a person involved with the cod industry, or anyone else whose life has been affected by habitat loss, overharvesting, pollution, and so forth to share his or her experiences with students.
- Visit a local area where students can observe ecology in action, such as a logged area where secondary succession is occurring, or an ecologically sensitive area, such as the Limestone Barrens.
- Before booking a field trip or arranging a speaker, make sure the topic is interesting and appropriate for your students.

UNIT 1 BLACKLINE MASTERS

CONTENT-RELATED BLACKLINE MASTERS	ASSESSMENT-RELATED BLACKLINE MASTERS
Unit BLM 1-1, Unit 1 Summary BLM 1-2, Unit 1 Key Terms BLM 1-27, Unit 1 Review BLM 1-28, Unit 1 Answer Key	• Assessment Checklist 18, Data Table • Assessment Checklist 19, Graph from Data • Assessment Checklist 20, Assessment Record Form • Assessment Checklist 21, Project Self-Assessment • Assessment Checklist 22, Project Group Assessment • Assessment Checklist 23, Learning Skills • Assessment Checklist 24, KWL Assessment Checklist • Assessment Checklist 25, Safety Checklist • Assessment Rubric 1, Concept Rubric • Assessment Rubric 7, Scientific Research Planner Rubric • Assessment Rubric 8, Research Project Rubric • Assessment Rubric 9, Communication Rubric • Process Skills Rubric 8, Interpreting Data • Process Skills Rubric 9, Questioning
Chapter 1 BLM 1-3, Find Out Activity What Is an Ecosystem BLM 1-4, Life in a Strange Ecosystem Story BLM 1-5, Interactions in Atlantic Ecosystems BLM 1-6, Think About It 1-3A Seabirds! BLM 1-7, Studying a Pond Ecosystem BLM 1-8, Chapter 1 Review	• Assessment Checklist 1, Making Observations and Inferences • Assessment Checklist 2, Asking Questions • Assessment Checklist 3, Designing an Experiment • Assessment Checklist 4, Laboratory Report • Assessment Checklist 5, Investigating an Issue • Assessment Checklist 7, Scientific Drawing • 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 16, Science Portfolio • Assessment Rubric 2, Science Notebook Rubric • Assessment Rubric 3, Co-operative Group Work Rubric • Assessment Rubric 4, Scientific Drawing Rubric • Assessment Rubric 5, Conduct an Investigation Rubric • Assessment Rubric 6, Design an Investigation Rubric • Assessment Rubric 10, Presentation Rubric • Assessment Rubric 11, Using Tools, Equipment, and Materials Rubric • Process Skills Rubric 2, Hypothesizing

CONTENT-RELATED BLACKLINE MASTERS	ASSESSMENT-RELATED BLACKLINE MASTERS
Chapter 2 BLM 1-9, Symbiotic Relationships BLM 1-10, Think About It 2-2A Food Preservation BLM 1-11, Find Out Activity 2-3A Eating at the Copepod Cafe BLM 1-12, Three Food Chains BLM 1-13, Food Web BLM 1-14, Energy Transfer Figures BLM 1-15, Energy Transfer Quiz BLM 1-16, Chapter 2 Review	• Process Skills Rubric 3, Controlling Variables • Process Skills Rubric 4, Problem Solving • Process Skills Rubric 5, Fair Testing • Process Skills Rubric 6, Designing Experiments • Process Skills Rubric 7, Predicting • Process Skills Rubric 10, Measuring and Reporting • Process Skills Rubric 11, Rubric Template
Chapter 3 BLM 1-17, Primary Succession BLM 1-18, Primary Succession (unlabelled figure) BLM 1-19, Think About It 3-1B Secondary Succession from Beaver Pond to Bog to Forest BLM 1-20, The Effects of Human Activities on Ecosystems BLM 1-21, The pH scale BLM 1-22, Environmental Infomercial BLM 1-23, Find Out Activity 3-2C Checking the pH BLM 1-24, Ecosystem Monitoring BLM 1-25, Chapter 3 Review	

Teaching Notes
for
Pages 2 to 103 of the Student Book

UNIT 1 OPENER, pp. 2–5

Unit 1 focusses on interactions that occur within ecosystems. The Unit Opener helps students develop or review their basic understanding of ecosystems and ecosystem change before embarking on the unit. The Unit Opener challenges students to imagine how different biotic and abiotic factors affect how living things interact with each other and with their environment. Human activities often result in negative changes to an ecosystem. Getting Started addresses this issue in a local sense by asking students to consider the impact of logging on ecosystems. The last paragraph on page 5 asks students to consider the changes that take place as a consequence of succession, briefly introducing the topic before it is discussed later in the unit.

In the Find Out Activity, What Is an Ecosystem?, students analyze a local ecosystem and build a list of terms that help describe ecosystems. This activity helps familiarize students with the process of using observations and data to distinguish between unique ecosystems and the interactions that occur within them.

USING THE UNIT OPENER

The photographs on pages 2-3 provide an opportunity to introduce students to various ecosystem interactions. Divide the class into four groups, assigning each group a different photograph. Have each group generate a list of organisms and non-living things that may be present in the ecosystem in their photograph. Next, ask group members to brainstorm a list of possible ways in which the living and non-living components of the ecosystem may be interacting. For example, in the photograph of the forest fire at the bottom of page 3, students may observe that the non-living factors of fire and high temperatures will harm living organisms in this ecosystem. After the fire, the non-living environment will be affected as silt and soil are washed away due to lack of vegetation. Alternately, you may want to complete this activity as a class discussion, writing factors on the board and interconnecting them with arrows to show interrelationships.

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

- What is an ecosystem?
- How many different types of ecosystems can you identify?
- How do the abiotic and biotic parts of an ecosystem differ?
- In what different ways do living and non-living things interact in ecosystems?
- How do food, energy, and nutrients move through an ecosystem?
- In what ways do natural events and human activities cause changes in ecosystems?

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

GETTING STARTED, pp. 4–5

USING THE TEXT

You may wish to discuss the question "How would you describe this forest?" posed in the caption for the photograph on page 4 with your class. Alternately, ask students to write a paragraph describing the scene. Remind students to consider both living and non-living aspects of the ecosystem. The questions listed in the student book at the top of page 5 also provide a springboard for discussion.

The Word Connect on page 4 provides an interesting opportunity to explore the term ecology. Explain that ecology is the study of our home planet, taking its name from the Greek roots, *eco-* (home) and *-logia* (study). Ask students to consider their own home environment. What sorts of interactions occur between the living and non-living things in their home? Draw analogies between student responses and interactions that occur in the environment.

USING THE ACTIVITY

Find Out Activity

What Is an Ecosystem?, p. 5

Purpose

- Through an analysis of a local area, students build a list of terms that help describe ecosystems.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
	None	For each student: – large sheet of paper – pen or pencil – ruler

Time Required

- 40 min

Science Background

Productivity and biodiversity vary enormously between ecosystems. Some ecosystems, such as the arctic tundra, may support only a few species in small numbers, while others, such as a tropical rainforest, will support a much greater variety of organisms in larger numbers. In general, ecosystems are limited by available sunlight, moisture, and temperature. Most ecosystems in Newfoundland and Labrador show moderate productivity and biodiversity, with mountainous and rocky regions and the Labrador tundra exhibiting less.

Activity Notes

- This exercise works well as a class, group, or individual exercise.
- If completing as a class exercise, write student ideas on the board as they are generated.
- If completing as a group exercise, students should assign one member of their group as recorder.
- Encourage students to brainstorm at least ten suggestions per list.

Supporting Diverse Student Needs

- Encourage academically weaker students to act as group recorder if completing the activity as a group exercise.
- This activity is excellent for developing naturalist intelligence, as it encourages students to consider the important influences of biotic and abiotic factors upon ecosystems early in the unit.
- For enrichment, consider taking students on a field trip to the area they are analyzing to study it first hand.

What Did You Find Out? Answers

1. Accept all reasonable answers that correctly reflect the meaning of the term.
2. Most students will be able to identify at least one living thing on their list that could also live in a different ecosystem. For example, a frog that lives by a stream could also live by a pond or estuary, while an earthworm living in a forest could also live in a field.
3. Most students will be able to identify at least one condition on their list that could also occur in a different ecosystem. For example, a pond, river, and estuary could all be described as wet, while arctic tundra and desert are both dry.
4. Accept all reasonable answers. For example, if students analyzed a forest ecosystem, they may suggest desert, ocean, or other ecosystems that are extremely different from that analyzed.

CHAPTER 1 OPENER, pp. 6–7

USING THE PHOTO AND TEXT

With students, generate a list of the living things they might see in the ocean and on the shore in the that ecosystem depicted in the photograph. Make sure that students consider some of the organisms that are less obvious (e.g., types of insects). Then, generate a list of the non-living things.
Use the description in the student book to draw a diagram on the blackboard of the ocean-coastal ecosystem. Include the features provided by students as well. Ask students to identify what differences there might be in a pond environment compared to an ocean-coastal ecosystem.

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

Review the What You Will Learn points with students defining terms as needed. You may want students to brainstorm answers to some of the following questions:

- What kinds of ecosystems would students find in their geographic area?
- What kinds of animals or plants live in these ecosystems?
- What non-living things are found there?
- What are some ways that an animal could interact with the living and non-living parts of its ecosystem?
- What are some ways a plant could interact with its ecosystem?
- What are some ways temperature could affect an ecosystem?

Read Why It Is Important aloud to students. Ask students what they already know about problems in their local environment, such as pollution and the decline in fish populations. Ask students to identify any other environmental problems they have heard about.

USING THE FOLDABLES™ FEATURE

See the Foldables™ section of this resource.

1.1 TYPES OF ECOSYSTEMS

BACKGROUND INFORMATION

With regards to the terms biotic and abiotic, bio- is a prefix meaning “life.” A- is a prefix meaning “not” or “without.” Typically, both living and dead organic matter are classified as biotic. Conversely, abiotic refers to matter that has never been living, such as atmospheric gases, inorganic salts, minerals, or water.

This expression is also used to describe chemical and physical factors that exist in an ecosystem, such as light, temperature, salinity, and humidity.

An ecosystem is any group of living and non-living things interacting with each other. Ecosystems vary in size. Within each ecosystem may be several habitats, smaller environments (living spaces) where specific organisms live. Habitats also vary in size. Adaptations are characteristics that help organisms survive in their specific habitats. They occur when a genetic change, such as being born with a longer neck or better eyesight, gives an individual organism a survival advantage in its habitat. The individual organism passes the characteristic on to its offspring, which in turn survive because of this characteristic. Over time, the majority of the organisms in the population will share this characteristic because they have a survival advantage.

Adaptations can be structural, behavioural, or physiological. Structural adaptations refer to physical characteristics that help an organism survive in its natural habitat. Behavioural adaptations are ways in which an organism behaves that help it survive in its environment. Physiological adaptations are systems that allow an organism to carry out biochemical reactions that also help it survive. An adaptation such as the duck's webbed feet as described on page 8 of the student book is a structural adaptation. Migration from a northern to a southern climate is a behavioural adaptation that helps swallows survive in a harsh climate. The production of a special fat that bears use as food during hibernation is considered a physiological adaptation.

The green frog shown in Figure 1.1 on page 8 provides many examples of adaptations to pond life. Its webbed feet and strong, muscular back legs help it swim through the water, while adhesive discs on its fingers and toes help it climb slippery rocks and vegetation. The green colouring of the frog's skin provides excellent camouflage in its pond habitat.

Adaptations help organisms meet their basic needs. The four basic needs of most living things are food (or a source of energy to make food), water, a suitable habitat, and air, or another medium for metabolic waste exchange. Organisms living in ecosystems dominated by harsh environmental conditions often find it more difficult to meet their basic needs. For example, permafrost (see Figure 1.5 on page 11 of the student book) is soil that has been at or below the freezing point of water (0°C) for two or more years. Ice is not always present, but it frequently occurs. Permafrost is located in high latitudes (e.g., North and South Poles) or high altitudes (called alpine permafrost). Approximately 20 percent of Earth's land mass is currently covered by permafrost. A thin layer of soil, called the active layer, overlies permafrost and thaws during the summer. Plants living in an ecosystem with permafrost must be specially adapted to survive in conditions of thin soil and a short growing season, as their growth is supported only within the active layer. The active layer is typically 0.6–4 m thick, although it varies in different years and different locations. In areas of continuous permafrost and harsh winters, the depth of the permafrost can reach 1500 m. The southernmost site where permafrost has been located in the Quebec–Labrador Peninsula is in a peatland on the subalpine summit of Lac des Cygnes Mountain.

COMMON MISCONCEPTIONS

- Students may be confused between the terms *ecosystem* and *habitat*. One way to clarify the distinction is to view a habitat as an area where organisms live (a living space); an ecosystem, on the other hand, refers to the interactions between organisms and their habitat.
- Students may think an ecosystem is a certain size. Ensure that they are aware that it can vary in size from a rotting log or a pond to a mountain or ocean.

ADVANCE PREPARATION

- Purchase materials for Find Out Activity 1-1C, Creating an Ecosystem, on page 14. Determine whether you will provide containers for the models or whether students will need to gather them.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 8–9

Using the Text

Ask students to list the different types of environments they pass through on their way to school (e.g., front yard, city streets, meadows, woods, fields, parking lots, creek). Write the names of each environment along the top of the board.

Under each environment, ask students to identify at least three organisms that might live there. For each organism, have students describe its main features and determine which of the features specifically help it adapt to its environment.

Show pictures or videos of various Newfoundland and Labrador ecosystems to familiarize students with coastal ecosystems. Encourage students from different provinces or countries to share information about the types of ecosystems they are familiar with.

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

TEACHING THE SECTION, pp. 9–14

Using Reading

Pre-reading—Key Word Concept Maps

Have students prepare a concept map of the Key Terms. Before reading, new words and concepts can be pre-taught or clarified. During reading, they can be linked to the student book. After reading, students can identify word concepts they wish to learn more about.

During Reading—GIST

Have student write short summaries of the ecosystems discussed in "Ecosystems in Atlantic Canada" on pages 10-12 of the student book. Encourage students to keep their summaries to 20 words or fewer.

After Reading—Reflect and Evaluate

Students can quietly review their notes and pick out three pieces of information they have learned that they find most interesting. These interesting facts can be shared in a class discussion.

Reading Check Answers, p. 9

1. The abiotic parts are non-living, and biotic parts are living.
2. biotic
3. adaptations
4. Examples could include: flooding, avalanche, climate change, landslide, fire, prolonged drought, severe storm (hurricane, tornado), introduction of a non-native species, draining a bog, cutting down trees to build something or to plant a crop, releasing pollutants, rerouting a stream, building a dam. Accept any answer that illustrates a factor that could trigger a lasting change in an ecosystem.

Reading Check Answers, p. 12

1. These are examples of ecosystems.
2. Students' answers could include: four of temperature, wind, sunlight, salt content, currents, tides, depth of water.
3. The arctic ecosystem is called a cold desert because it has little precipitation and low temperature.
4. When dead plant material in bogs and marshes decays very slowly as a result of being covered with water, it builds up over time to produce peat.

Using the Did You Know

The Did You Know on page 11 of the student book introduces students to the fact that lakes occupy more than 8 percent of the land area of Newfoundland and Labrador (slightly more than the national average). There are 18 major lakes in the province. The largest is Lake Melville in Labrador. It has an area of 3069 square kilometers and is actually a tidal extension of Hamilton Inlet. The largest lakes on the island of Newfoundland are Red Indian Lake, Grand Lake, and Gander Lake.

USING THE ACTIVITIES

- Think About It Activity 1-1A, What Do Living Things Need for Survival?, on page 10 of the student book is best used after students have read the introduction to the section on pages 8-9.
- Find Out Activity 1-1B, Scrutinizing Soil, on page 13 of the student book is best used as a way to encourage students to think about the behaviour of organisms and their response to changes in abiotic parts of their habitat.
- Find Out Activity 1-1C, Creating an Ecosystem, on page 14 of the student book is best used as a way to help students synthesize and apply their understanding of the concepts outlined in Section 1.1.

Detailed notes on doing the activities follow.

Think About It Activity 1-1A

What Do Living Things Need for Survival?, p. 10

Purpose

- Students relate the concept of abiotic and biotic factors to the needs of an organism.

Advance Preparation

None

Time Required

- 30 min

Science Background

To survive, most living organisms need air, water, food, and a suitable habitat. Specifically, animals need air (oxygen), water, food, and a suitable habitat to protect them from predators and abiotic factors; most plants need air (carbon dioxide and oxygen), water, nutrients, and a suitable habitat with exposure to sunlight to carry out photosynthesis.

Activity Notes

- Groups of 3 or 4 should work well for this activity.
- Allow 3–5 minutes for students to do step 1. Once students appear to have exhausted their list, move on to the next step so that students will not become distracted.
- You may need to intervene with suggestions if students' lists are getting too specific; (e.g., if they start listing particular foods rather than just "food").
- Discussion may be needed to explain how items might be named differently on the lists but are the same (e.g., air and oxygen; food and nutrients).
- Some students may not realize that plants need food (nutrients) and air just as animals do.

Supporting Diverse Student Needs

- This is an excellent activity for students with good naturalist intelligence. Group work helps develop interpersonal and verbal-lingistic intelligence.
- As an extension, have students provide examples to describe how specific organisms make use of the required items.

What Did You Find Out? Answers

1. Lists should include elements related to air, water, food, and habitat (or shelter). Living things students should consider include animals (including fish and humans), plants, and fungi. Generally, to survive, animals need air, water, food, and a sheltered habitat (protection from predators and abiotic factors); most plants need air, water, nutrients, and access to light in their habitat. Some organisms may require less of one of the items than others and may be able to survive for a period of time without it.
2. Students' answers could include a variety of natural events or human interventions in an environment. Specific examples include cutting down trees, which would eliminate shelter for birds; paving a field, which would remove plants that rodents consume; and dredging the sea floor, which would destroy a lobster habitat.

Find Out Activity 1-1B

Scrutinizing Soil, p. 13

Purpose

- Students investigate abiotic and biotic parts of a soil ecosystem.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Ask students to collect large, wide-mouthed jars. Assemble all other materials and apparatus. Locate a suitable source of leaf litter or soil.	For each group: – large wide-mouthed jar – large plastic funnel – desk lamp with flexible arm – pie plate – hand lens and/or dissecting microscope – scissors – 2 damp paper towels – garden soil or leaf litter – fine mesh plastic pot scrubber – dry paper towel – paper for drawing

Time Required

- 60–80 min
  – 15–20 min for steps 1–4
  – 45–60 min for steps 5–8

Safety Precautions

- Safety eyewear, lab coats, and gloves must be worn in accordance with provincial safety standards.
- Remind students not to handle any organisms with bare hands.
- Have students return all organisms to the place where they found them.
- Remind students to handle the glass jar with care so that it does not break.
- Students should handle the scissors carefully when cutting the pot scrubber.

- Remind students to keep electrical connections for the lamp away from water or moisture. Check that they are neatly organized and do not present a tripping hazard.

Science Background

Organisms will move away from the intense light and heat of the lamp, passing through the fine mesh into the jar. They may also be attracted to the dampness of the paper towel in the jar because of the drying effect of the lamp on the soil.

Activity Notes

- This activity could be done in groups or as a demonstration activity if lamps are not easily available.
- You may wish to review the concepts of biotic and abiotic parts of ecosystems.
- Provide tape or stickers for students to label their jars if they are all similar.
- Review the safety precautions and rules about handling live organisms.
- If you are planning on assessing students based on their sketches, let students know ahead of time and decide as a class what the requirements will be.
- If the source of the soil was close by (e.g., on the school property), organize a short field trip to return the soil and organisms to their original location. You can use this as an opportunity to discuss the natural habitat of these organisms.

Supporting Diverse Student Needs

- Ask academically weaker students to describe the experimental set-up to you or their group, using the correct vocabulary.
- This activity provides opportunities to strengthen naturalist intelligence and visual-spatial intelligence.
- As an enrichment activity, students could identify some of the types of organisms seen in the soil samples using an identification key.

What Did You Find Out? Answers

1. Students should recognize that the organisms were trying to move away from the light. Some students may recognize that the lamp created hot, light, and dry conditions that would not be natural for soil organisms that are used to cool, dark, and damp conditions.
2. Students' answers could include moisture, cool temperatures, and lack of light. Some students may also identify that the soil contains nutrients and provides shelter.

Find Out Activity 1-1C

Creating an Ecosystem, p. 14

Purpose

- Students examine the components of an ecosystem and observe how they change over time.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
2 weeks before	Assign students into groups of 3–4. Have students conduct research into ecosystems. Have students begin to collect containers for their models. (See Activity Notes for container options.) Determine what plants you will have available so that students can plan their models.	For each group: – water – gravel or small rocks – twigs – seeds and/or small plants – potting soil – clear glass or plastic bowl
1 week before	Review students' hypotheses submitted for approval. Clear a space for the models in the classroom. Gather apparatus and materials. Obtain plants and potting soil.	

Time Required

- 180 min over a month
  - Research and planning: 60 min
  - Building: 60 min
  - Observations (ongoing until the end of the experiment): 5 min three times a week for four weeks

Safety Precautions

- Safety eyewear, lab coats, and gloves must be worn in accordance with provincial safety standards.
- Remind students not to handle any organisms with bare hands.
- Remind students to handle the glass bowl with care so that it does not break.

Science Background

Some students may observe that their plants seem to grow toward the light. This is called phototropism and is the result of a plant hormone called auxin. Auxin is present in all green plants. If light shines on a plant from one side, auxin moves to the shaded side of the stem. Here, it causes cells to elongate and the stem curves toward the light.

A model ecosystem such as this can also demonstrate the water cycle (evaporation, condensation, and precipitation). In the presence of light and heat, water evaporates from the plants (through transpiration) and soil. If students cover their ecosystem (with a lid or plastic) to make it an enclosed environment, water vapour from the air in the container will condense on the inside of the container. Once enough water accumulates or the temperature decreases, the condensation will precipitate down the sides of the container back into the soil.

Activity Notes

- Direct sunlight will cause water to evaporate too quickly and/or the plants to scorch. If possible, place models in a bright area but not in direct sunlight.
- Determine ahead of time whether you will use the labelled sketch, the observation notes, or both for assessment purposes.
- This activity works well if students can observe their model over a period of several weeks.
- Students could work in groups of 3–4 for this activity. If preferred, you could have the class create one ecosystem.
- This activity works best if students base their ecosystem on a field or forest model, rather than an aquatic one. If students wish to create an aquatic model, you will need to provide clean sand, aquatic plants to grow, and small rocks for the bottom.
- Determine whether you will discuss some of the following hints for building student ecosystems, or allow students to develop the models independently.
- The container should have a removable cover to control moisture. A piece of glass or plastic can be used if the container does not have a lid.
- Glass jars, fish bowls and tanks, clear plastic bottles, food containers, etc., can be used for the model ecosystem. Just make sure that students have enough room to reach a hand into the container for planting and maintenance.
- If glass bowls are not available, you could make containers by cutting off the tops of large, clear plastic soda bottles, leaving a container that is approximately 20 cm tall. After planting in the soda bottles, you can either tape the top back on or just cover it tightly with plastic.
- The ecosystem models designed as terrariums (i.e., non-aquatic ecosystems) will work best if a thin (1.25 cm) layer of gravel is placed on the bottom for drainage, with a thick layer of topsoil on top (fill the container to approximately one-third to one-half full with moist potting mix).
- Use a sterilized potting soil mix to avoid problems with moulds and fungi (small bags of potting soil are available at most garden centres).
- In a separate bowl, mix some soil with water until the soil is moist enough to form a ball when pressed in your hand. If water squeezes out when soil is pressed into a ball, it is too wet and more dry potting soil should be added.
- Have available an array of indoor plants that normally grow in 5–10 cm pots. Suggestions are: African violet, artillery fern, false aralia, jade plant, miniature peperomia, nerve plant, oxalis pink, polka dot plant, prayer plant, small ferns, small peace lilies, small philodendrons, spider plant, strawberry begonia, Swedish ivy, mosses. Choose plants that will not grow too quickly and that will do well in humid environments.
- Don't overcrowd the container with plants.
- Check moisture levels. A model contains the right amount of water if the sides and top get misty with water droplets when in bright light. If there is no moisture along the sides, more water is needed. If the sides are always very wet and it is hard to see the plants, there is too much water. Students can remove the top for a few hours and allow some of the excess water to evaporate.
- You may want to draw students' attention to the plant roots growing into the soil along the wall of the transparent containers.
- Water lightly only after the soil gets dry, once every few weeks. Usually only a few teaspoons of water are needed.
- To wrap up, have a class discussion about problems and successes with the models. Encourage a discussion of what parts of a typical ecosystem were not included in these classroom models (e.g., mammals, birds, insects, micro-organisms).
- Students will need to dispose of the ecosystem contents carefully. Glass containers will need to be washed out and returned to their owners, and plastic containers should be washed and recycled.

Supporting Diverse Student Needs

- This activity helps develop visual-spatial intelligence (drawing the model), naturalist intelligence, and verbal-linguistic intelligence (recording notes about the model over time).
- As an enrichment activity, students could research the water cycle and determine how it played a role in their model ecosystem.
- Students could also research the species of plants used in their ecosystem and determine their particular requirements for light, temperature, and moisture.

What Did You Find Out? Answers

1. (a) Reasons for success or failure should relate to the four basic needs of most plants — air, water, light, a place to live (habitat). Examples include: just enough/too little air circulation; just enough/too much/too little moisture; just enough/too much/too little light; too many plants; not enough soil.
   (b) Answers should clearly state the factors related to the plants' failure to thrive and how they were resolved.
2. (a) Answers should reflect an understanding of what defines a good model, (i.e., plants are surviving). For example, perhaps plants received too much or too little moisture; too little moisture could be resolved by watering the plants, while too much likely killed them and required adding new plants. Similarly with too much or too little light and too much or too little heat—students could either add the insufficient factor or replace plants that died from an excess of the specific factor.
   (b) Answers should include observations and definitions of factors that would hinder plant survival, such as those noted in the answers to question 1.
   (c) Answers should include consideration of materials and procedures, such as those noted in the answers to question 1.

SECTION 1.1 ASSESSMENT, p. 15

Check Your Understanding

Checking Concepts

1. Students' answers should reflect a clear understanding of the difference between living and non-living things and some familiarity with the elements of a forest ecosystem. Examples of abiotic parts could include rocks, soil, wind, temperature, light, or water. Examples of biotic parts could include specific names of mammals, birds, reptiles, trees, plants, insects, amphibians or fungi.
2. Abiotic factors could include sunlight, moisture, temperature, and pesticides, as well as soil type and acidity.
3. Biotic factors could include other plants (competition), consumers (hare, insects), and humans (either as consumers or agents of destruction).
4. (a) Students' answers should reflect a clear understanding of the definition of living and non-living things and name two non-living things.
   (b) Interactions could be with objects, such as clothing, furniture, or vehicles, or with abiotic factors, such as sunlight, water, temperature, or air (e.g., breathing, riding a bus, or talking a shower).
5. (a) Students' answers should reflect a clear understanding of the definition of living and non-living things and name two living things.
   (b) Interactions could be with family members, friends, pets, school staff, and plants.
6. (a) A grasshopper's habitat would be a grassy field (grasshoppers can also be found in the woods, but students may be more familiar with them in fields).
   (b) A seaweed's habitat would be a region of the ocean with access to light.
7. Students can pick any of the ecosystems discussed in class or described in the student book on pages 10–12. Adaptations should relate to the requirements for survival.
8. (a) freshwater ecosystem (river, pond)
   (b) Answers could include any three of trees, shrubs, aquatic plants, or grasses.
   (c) Answers could include any three of water, soil, air, sunlight, or temperature.

Understanding Key Ideas

9. Students' answers should reflect the fact that an ecosystem can be very small (e.g., a rotting log, a pond) or very large (a mountain, an ocean) or in between.
10. Students should remember that the needs are food, air, water, and a suitable habitat. Accept all reasonable answers. A polar bear hunts seal and fish for food, is able to breathe the cold air, drinks fresh water from snow melt, swims in the ocean to find food, travels on ice floes

to get to feeding grounds, and finds shelter from the weather in snow dens.

11. The dandelion habitat is an open area exposed to the wind. The seeds are light and have feathery or hair-like structures that the wind can carry for long distances.

Pause and Reflect Answer

Students' answers should reflect the fact that observations of an aquarium-based ecosystem containing plants and animals will illustrate the importance of the basic needs of life, the role of biotic and abiotic parts of an ecosystem, and the types of interactions that occur in an ecosystem. Specific examples illustrating these points should include the assumptions of what would be contained in the hypothetical aquarium-based ecosystem.

Other Assessment Opportunities

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

1.2 ABIOTIC PARTS OF AN ECOSYSTEM

BACKGROUND INFORMATION

Range of tolerance is a key concept in understanding the impact of global warming and climate change. Changes in abiotic conditions (temperature, moisture, acidity, salinity) can have a significant impact on the ability of organisms to survive in their usual habitats, and the range of conditions that allow survival can be quite narrow. Changes in this range may quickly lead to extinction if a suitable habitat can no longer be found.

A treeline is a boundary that marks the limit of trees' range of tolerance. Although it appears well defined from a distance, a treeline is actually an area of gradual transition. Trees become fewer and shorter as the conditions become less hospitable (called the struggle zone). This zone may give way to a region of low, densely matted bushes that extends to an area that cannot support either type of plant. Together, the two zones constitute a transition zone, which ends at the treeline. Treelines are found in increasingly harsh environments at high altitudes but can also occur at high latitudes. As one goes farther north, it becomes too cold and dry to sustain trees. In addition, nutrient-poor soil conditions dominate. Permafrost may also prevent trees from growing a deep enough root system for the necessary structural support.

Section 1.2 overviews the various abiotic components found in ecosystems, including light, temperature, soil, air, and water. All green plants use the energy in sunlight to produce carbohydrates and other organic molecules via photosynthesis. Students will be interested to learn, however, that not all plants carry out photosynthesis or possess chlorophyll. Such plants must rely on other plants or organisms to provide the nutrients they require for life. For example, Indian pipe (*Monotropa uniflora*) is a white, waxy plant that usually grows to be about 10–30 cm tall. Indian pipe is also often called ghost plant or corpse plant due to its unusual appearance. During the summer months, it grows in shady, temperate forests in North and South America, as well as Asia. The plant is a parasite. It absorbs nutrients from the root-like threads of fungi (known as mycelia) growing on trees. The fungus is in a mycorrhizal relationship with a tree as well, providing nitrogen to the tree and receiving sugars in return. When Indian pipe absorbs nutrients from a fungus, it is stealing nutrients from the tree in a round about way as well. This way it relies on another plant's ability to photosynthesize to receive the nutrients it needs.

Regulation of body temperature is key to the survival of ectotherms, reptiles and other organisms that control their body temperature via external factors. The northern alligator lizard in Figure 1.10 on page 18 of the student book is using the Sun to warm itself. This method of maintaining body temperature is different from that of mammals and birds, homeotherms that generate internal heat to maintain their body temperature. Students may have heard the term "cold-blooded," used to describe the way reptiles such as lizards and snakes (as well as invertebrates, fish, and amphibians) use the temperature of the environment to regulate their body temperature. The term "cold-blooded" is now considered outdated, as cold-blooded creatures were thought to be incapable of maintaining their body temperatures on their own. However, it is now known that these organisms have a variety of mechanisms for controlling body temperature.

Soil, particularly the upper layer, known as topsoil, is a mixture of mineral particles of various sizes, living organisms, and humus (partly decayed organic material). Plant roots grow mainly in topsoil. The particles that form soil determine its texture. For example, coarse sand is made up of particles that are 200–2000 μm (micrometres) in diameter. Clay, on the other hand, is made up of particles that are less than 2 μm in diameter. The earthworms depicted in Figure 1.9 on page 18 have adapted to living in dark conditions found in soil in that they have a streamlined body and claw-like bristles (called setae) that help them to move easily through their environment. The slimy mucous that covers their body also helps earthworms burrow through the soil. They have no eyes but they do have light sensitive cells to give them the ability to detect light and changes in light intensity.

The can also sense changes in heat and are highly responsive to touch, two more adaptations that help them sense the environment around them.

Air and water are two of the main factors that influence weather and climate. Weather is the state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity, and barometric pressure. Climate is determined by averaging weather patterns, such as temperature, precipitation, air pressure, humidity, and annual number of days of sunshine, over a long period of time. Factors directly affecting climate are latitude, topography, ocean currents, location of large bodies of water, and locations of air masses.

COMMON MISCONCEPTIONS

- Students may know the terms cold-blooded and warm-blooded, which have fallen out of favour with the scientific community. Cold-blooded does not mean the organism's blood is cold.
- Students may be confused to learn that dead organic matter is also considered biotic. Explain to students that abiotic matter is non-living in the sense that it was never living at any time, while biotic matter refers to all matter that is currently or was once alive.
- Most students will know that plants take up carbon dioxide, but few will realize that they require oxygen as well. Make sure students are clear on the point that plants require oxygen for respiration, just as humans and most other organisms do.

ADVANCE PREPARATION

- If you plan to do the optional activity (see under Using a Demonstration), you may want to expose the plants to the various conditions a week before beginning this unit, so that effects of changes in abiotic conditions will be visible.
- Make arrangements as needed for Conduct an Activity 1-2A, Field Trip to the Schoolyard, on pages 20-21. Choose a suitable location to carry out this Core Lab well in advance. Gather all apparatus and materials.
- Gather the materials necessary to do the Core Lab, Find Out Activity 1-2B, Salty Seeds, on student book page 22.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 16–17

Using the Text

Draw students' attention to Figure 1.7 on page 16. Ask students how they think changes in abiotic factors could affect the plant in the figure. Write student suggestions on the board. Use this activity as a springboard for to a discussion of how different organisms are adapted to different abiotic conditions. Have students name several ecosystems with extreme conditions (e.g., desert, arctic, mountaintop). As a class, come up with examples of organisms that would live in each ecosystem. Ask students to generate a list of characteristics that would make animals suited to living in their particular ecosystem. Then, discuss what would happen if an organism from one ecosystem (e.g., a polar bear) tried to live in another ecosystem (e.g., the desert). This will encourage students to think about interactions that take place between an organism and the abiotic parts of its environment. Students should realize that most animals could not survive in ecosystems with extremely different abiotic conditions. This discussion can be used as an excellent segue to the introduction of range of tolerance.

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

Using a Demonstration

Optional Activity: Abiotic Conditions and Range of Tolerance. Purchase a set of five plants of the same variety or grow them from seed. Demonstrate the concept of range of tolerance by varying the conditions for each plant. Place a plant where it will get too much light, and one where it will get too little light. Water another plant too much and don't water another enough. Present another with suitable conditions (indirect sunlight, regular watering so that soil is damp but not soaked). With students, observe what happens over time to each of the plants, and use the

results as a basis for discussing suitable abiotic conditions and range of tolerance.

TEACHING THE SECTION, pp. 17–22

Using Reading

Pre-Reading—Predict-Read-Verify

Chunk the text into manageable sections by headings. Before reading, ask students to read the headings, analyze the visuals, and read the captions. Encourage students to use their background knowledge of abiotic conditions to predict what "range of tolerance" means. After reading the section, students can verify or revise their predictions.

During Reading—GIST

As students read this section, have them write short summaries of the sections on abiotic influences. Encourage students to keep their summaries to 20 words or fewer.

After Reading—Reflect and Evaluate

Students can quietly review their notes and pick out three pieces of information they have learned that they find most interesting. These interesting facts can be shared in a class discussion.

Reading Check Answers, p. 17

1. The example in the student book is the altitude at which tree growth is impossible. Students may also know that northern latitudes also have a treeline.
2. range of tolerance

Reading Check Answers, p. 19

1. abiotic factors
2. Any three of: small particles of rock, water, air, temperature, and acidity.

USING THE ACTIVITIES

- Core Lab Conduct an Investigation 1-2A, Field Trip to the Schoolyard, on pages 20–21 of the student book is best used after students have read the section and are familiar with the various abiotic components of ecosystems.
- Core Lab Find Out Activity 1-2B, Salty Seeds, on page 22, will give students experience working with controlled and manipulated variables.

Detailed notes on doing the activities follow.

Conduct an Investigation 1-2A

Field Trip to the Schoolyard, pp. 20–21

Purpose

- Students investigate abiotic and biotic factors in a schoolyard ecosystem. They will observe, analyze, and record collected information.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Assemble the materials and apparatus needed. Determine the area of the schoolyard to be used for the field trip.	For each group: – notebook – drawing paper – pen or pencil – magnifying glass – binoculars – camera (optional) – thermometer – light meter – wind-speed recorder – field guides

Time Required

- 90 minutes
  – steps 1–4: 30 min
  – steps 5–7: 60 min

Safety Precautions

- Remind students not to handle any organisms with bare hands.
- Remind students to handle the magnifying glass and thermometer carefully so that they do not break.
- If students disturb the habitat, ensure that they return it to its original condition.
- Remind students not to harm organisms in the study site.
- Make sure that students do not focus the Sun's light through the magnifying glass to burn items in the schoolyard.

Science Background

The abiotic factors that students should be encouraged to investigate include (a) intensity of sunlight; (b) air, soil, and water temperature; (c) wind direction and speed; (d) level of moisture; and (e) type of soil.

Activity Notes

- You may wish to discuss or demonstrate the use of the binoculars, camera, thermometer, light meter, wind-speed recorder, and/or field guides.
- Students could work individually or in pairs.
- In the brainstorming session, students could first identify two specific questions they would like to investigate related to the local ecosystem. Then, the class could compare questions to compile a list. Ensure that students' questions address intensity

of sunlight; air, soil, or water temperature; wind direction and speed; moisture level; soil type; and the different species that inhabit the ecosystem.
- Discuss the possible ways of recording observations (anecdotal, drawings, tables/charts, photographs). This provides an opportunity to discuss the strengths and weaknesses of the different methods.
- If there are not enough measuring devices for all students, a few students could be made responsible for taking measurements and providing the data to the class.
- If there are several different types of ecosystems in the schoolyard, determine whether the class could be divided to work in different areas. Ensure that there is adequate adult supervision.
- Discuss which of the devices will be used to collect information about the abiotic versus biotic parts of the ecosystem (e.g., magnifying glass, binoculars, camera for the biotic; thermometer, light meter, and wind-speed recorder for the abiotic).
- Upon return to class, students could attempt to identify the species observed. Field guides or pictures/posters of local flora and fauna can be used.

Supporting Diverse Student Needs

- This is an excellent activity for students with logical-mathematical intelligence and with naturalist intelligence.
- As an enrichment activity, students could research which of the organisms would be able to inhabit the schoolyard ecosystem during another season of the year.

Analyze Answers

1. A list of organisms could be compiled on the blackboard and then added to by each group.
2. Students should recognize that some animals and plants may have a limited range of tolerance for the abiotic conditions in the schoolyard. If possible, identify the most sensitive organisms found in the chosen area.

Conclude and Apply Answers

1. Students' answers should include reference to abiotic conditions, such as daytime and nighttime temperatures, amount of light and angle of the Sun, and moisture levels, that will change. They should be aware that some abiotic conditions such as type of soil and acidity of soil will not vary with the season. If your field trip took place when the leaves were no longer on the trees, students should recognize that the amount of shade will not vary much in the summer.
2. Students' answers should cite plants or animals that require conditions not found in the schoolyard, (e.g., a wolf would not be able to find food in the schoolyard; an ocean organism, such as seaweed, requires a marine habitat not found in a schoolyard).
3. Students should be able to list the kinds of organisms that would now be able to live in the schoolyard (heron, fish, frogs, snails, water plants). Students might also recognize that some organisms may no longer be able to live there (e.g., those that may require drier conditions, or those that would be prey for the new organisms introduced).

Find Out Activity 1-2B

Salty Seeds, p. 22

Purpose

- Students explore an interaction between an abiotic and biotic component of an ecosystem.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Collect apparatus and materials.	For each group: – 2 plastic drinking cups (or similar containers) – 30 mL salt – water – stir stick – 10 bean seeds – 2 paper towels – 2 plastic self-sealing bags – masking tape – marker

Time Required

- 45 min over three days:
  –15 min for steps 1–3
  –15 min for step 4
  –15 min for step 5

Science Background

The uptake of salt overnight will have caused some damage to the cells, so that most of the seeds will not have germinated.

Activity Notes

- You may wish to review the concept of biotic and abiotic interactions.
- Have students record the number of sprouting seeds carefully. Make sure that they record which bag (salt or fresh water) the sprouting seeds have come from.

- Collect class results on a chart on the blackboard. These can be helpful if there are any germination failures due to other factors.

Supporting Diverse Student Needs

- Academically weaker students will enjoy this activity as the results are visible and there is not a strong emphasis on vocabulary.
- This activity emphasizes visual-spacial intelligence and naturalist intelligence.
- For enrichment, students could design an experiment to test other abiotic influences on plant growth. Plant the seeds that are sprouting and have students vary different abiotic factors: temperature, water, air, etc. They can record their observations and draw more conclusions about biotic and abiotic interactions.

What Did You Find Out? Answers

1. The seeds soaked in salt water should not sprout as often, if at all, compared to the seeds soaked in fresh water. Descriptions can note size, colour, condition of seed coat, or appearance of sprouts.
2. The amount of salt (or level of mineral) in the water was the abiotic factor.
3. Controlled variables were amount of water, light, number of bean seeds, use of a moist paper towel, being sealed in a self-sealing bag, temperature, and the amount of time for soaking and sprouting.
4. Salt or mineral level in the water was the manipulated variable.
5. Different plants will respond to salt levels differently. (For example, northern bayberry is a salt-tolerant plant that is native from Newfoundland to North Carolina and grows mostly along the ocean. Samphire is a salt-tolerant herbaceous plant of the intertidal mud flats of Gros Morne National Park.) The experiment could be repeated using seeds of other plants to test their tolerance for salt.

SECTION 1.2 ASSESSMENT, p. 23

Check Your Understanding Answers

Checking Concepts

1. Reptiles draw their warmth from the air around them. A reptile will have a warmer body temperature when the outside air temperature is warmer and a colder body temperature when the air temperature is cooler.
2. A dandelion's seeds are designed to be carried on the wind; the plant has a flexible stem that will bend in the wind.
3. Students' answers could include two of the following: temperature, moisture, type of soil (sandy, clay, rocky), soil acidity, or air.
4. Students' answers could include
   - the birds and caribou breathe air
   - the birds and caribou drink water
   - the plants use the Sun's energy for photosynthesis
   - the plants absorb minerals from the soil
   - the worms require the cool, moist conditions in the soil
5. Students may cite water temperature, the pH level, or the amount of oxygen in the water as important for the survival of tropical fish in an aquarium.
6. Swallows have a limited range of tolerance for temperature, so that when temperatures decrease in Newfoundland they move to an area with a temperature range they can tolerate.

Understanding Key Ideas

7. The variety of trees and plants in a forest cast different levels of shade depending upon the size of the organism and the size and density of its leaves. At the edge of the ecosystem, light will be more intense, but in the depths of the forest with heavy tree canopies, light will be less available.
8. There is not enough light at the bottom of a deep lake for plants to photosynthesize.
9. The fence may cast too much shade and change the light conditions under which roses can grow (if it's an opaque fence it will definitely cut off the light the roses need to grow).
10. You could find a treeline wherever the conditions are not suitable for growing trees. Examples are at high latitudes in the Arctic, near a desert, and near conditions that aren't suitable for growth (soil that has a high acidity or salinity).

Pause and Reflect Answer

Students should name a specific organism and give examples of changes that would affect one or more of its basic needs: the availability of food, air, suitable habitat, or water. Answers should reflect an understanding of the interactions between organisms and abiotic parts of their ecosystem.

Other Assessment Opportunities

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

1.3 BIOTIC PARTS OF AN ECOSYSTEM

BACKGROUND INFORMATION

Species is one of the basic units of biological classification. A species is defined as a group of organisms capable of interbreeding and producing fertile offspring. However, the presence of unique, locally adapted traits and similarities in DNA sequencing are now used to define species as well. The commonly used names for plants and animals sometimes correspond to species names, but they often do not. For example, "earthworm" refers to more than 5500 different species.

When studying ecosystems, there are four levels of organization relating to biotic elements: ecosystems, communities, populations, and individuals. Each level includes the levels below it. An individual is one member of a species. A population refers to multiple individuals of one species living together in an ecosystem. A community is made up of interacting populations. An ecosystem is made up of a community together with the various abiotic factors that affect this community.

Scientific study of the pond ecosystem shown in Figure 1.12 on page 24 can be made at the ecosystem, community, population, or individual level. Organisms can also be studied in terms of their biological niche. Both ecosystems and communities will contain various different organisms. For example, in Figure 1.13 on page 25, populations of wolves, hare, grasshoppers, grasses, frogs, hawks, earthworms, mosquitoes, and a variety of other species may share the ecosystem inhabited by caribou.

COMMON MISCONCEPTIONS

- Students may think that a population refers to all of the organisms in an ecosystem. Make sure that they understand the difference between a population and a community.

ADVANCE PREPARATION

- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 24–25

Using the Text

As a class, discuss the answer to the question in Figure 1.12. You can use the discussion as a basis to review scientific inquiry and explore Science Skill 2: Designing and Conducting Experiments. Students may identify stages such as asking questions, observing, inferring, predicting answers, measuring, hypothesizing, classifying what they see, designing experiments, collecting data, analyzing data, and interpreting data as a means of studying an ecosystem.

Students could generate a list of all of the things they see in the picture, including biotic and abiotic parts. By now they should be able to classify them as abiotic or biotic. Use the description in the student textbook to make a list, but have them try to add to it. If they have trouble visualizing a pond ecosystem from the illustration, consider finding other images or videos of similar ecosystems.

The previous sections in this unit introduced interactions in an ecosystem. Students could make a list of all of the interactions they can imagine happening in Figure 1.12, including biotic–biotic, abiotic–abiotic, and biotic–abiotic. Encourage them to consider not only interactions involving the food chain (animals eating animals and plants), but also interactions such as sunlight evaporating the water (abiotic–abiotic), a duck making a nest in the grass (biotic–biotic), and wind or water dispersing the seeds (abiotic–biotic), and plants preventing erosion of the soil (biotic–abiotic).

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

Using a Demonstration

Optional Activity: What Part of the Ecosystem Am I? The names of various biotic and abiotic parts (compiled during the Using the Text activities highlighted above) could be written on individual cards, and pinned or taped to the back of students' clothing. Students could circulate in the classroom and try to guess what element of the ecosystem they are by asking yes/no questions about their interactions. For example, a student with "frog" on his/her card, could ask another student "Would I interact with water?" "Would I interact with an insect?" Once a student has guessed what is on his or her card, the card can be transferred to the board, and then other students who are still guessing can add another question, "How would I interact with you as a frog?"

TEACHING THE SECTION, pp. 25–28

Using Reading

Pre-reading—Key Word Concept Maps

Have students prepare a concept map of the key terms. Before reading, new words and concepts can be pre-taught or clarified. During reading, they can be linked to student book. After reading, students can identify word concepts they wish to learn more abou, or they can name the most important point they learned in their reading.

During Reading—Think–Pair–Share

Assign students to read a section of the student book independently, record their thoughts, and then pair up with another student to discuss and share their thoughts. You may want to provide focus such as "What is new to me in this passage?". Partners can collaborate to come up with one shared response.

After Reading—Reflect and Evaluate

When students have finished the reading, have them quietly review their notes and choose three facts that they find interesting. Students can write a statement explaining why they find the information interesting.

Reading Check Answers, p. 25

1. A species is a group of organisms that can reproduce among themselves to produce offspring that can also reproduce successfully.
2. Three levels of biological organization that can be studied in an ecosystem are individual, population, and community.
3. Interacting populations of organisms form a community.

USING THE ACTIVITY

- Think About It Activity 1-3A Seabirds!, on pages 26–27 of the student book is best used after students understand the concept of niche introduced on page 25.

Detailed notes on doing the activity follow.

Think About It Activity 1-3A

Seabirds!, pp. 26–27

Purpose

- Students have an opportunity to use a dichotomous key to identify species of seabirds.

Advance Preparation

none

Time Required

- 20 min

Science Background

Also known as a **dichotomous key** (meaning that it is divided into two parts or classifications), an identification key is a method of identifying a species based on offering two alternatives at each step. The choice of one of those alternatives determines the next step.

All of the illustrated bird species are in the key, and no final description should apply to more than one bird.

Answers: A-Pomarine Jaegar; B-Parasitic Jaegar; C-Common Tern; D-Iceland Gull; E-Herring Gull; F-Ring-billed Gull; G-Black-legged Kittiwake; H-Great Black-backed Gull.

Activity Notes

- Students could work in pairs for this activity.
- You may want to show the class how to use the key by working through one identification as a demonstration.
- For each bird, students should start with pair number 1 on the identification chart.

Supporting Diverse Student Needs

- An academically weaker student would benefit by being paired with a student with good reading skills. Some of the names for body parts as well as their descriptions as used in the identification key will be unfamiliar. You may want to illustrate some of the terms on the blackboard ahead of time to make sure that the class understands the vocabulary (e.g., forked tail, robust, cap, bill.)
- This activity helps build visual-spatial, verbal-linguistic, and logical-mathematical intelligence.
- For enrichment, students could use Internet resources to find out more information about some of the seabird species illustrated. They could

determine which species can be found around Newfoundland and Labrador. (Note: A, B, and D are not.). A useful web site can be found at www.discoveringscience.ca.

What Did You Find Out? Answers

1. Students' answers could include any three of tails, bills, wings, colour of feathers, or body size.
2. Answers could include specialized web sites, bird reference books, museums specializing in biology, information centres for bird sanctuaries, university or government departments, or naturalist groups.

USING THE FEATURE

www science: Wild, Weird, Wonderful, p. 28

If possible, bring in a sample of a couple of types of coral to show students.

The Gully is an underwater canyon 260 km off the coast of Halifax and 40 km east of Sable Island. It is up to 1.5 km deep in spots, has steep slopes, and has an extension far onto the continental shelf (which geologists call the Scotian Shelf). This ocean abyss is larger than the Grand Canyon.

Organisms that live in The Gully include deep-sea coral, sperm whales, seals, and a population of northern bottlenose whales that have lived in this area for the last 30 years. The next closest habitat of this whale is off northern Labrador, 1400 km to the north. They are currently classified as "vulnerable" on Canada's Species at Risk list. Scientists theorize that the whales have stayed in The Gully for so long because the ecosystem on the slope is suitable for the northern bottlenose whale, and that they're eating a type of squid called *Gonatus* found at the bottom of deep North Atlantic waters.

This gully also is a lucrative source of oil and natural gas. Although The Gully is now protected, other areas around The Gully are under exploration and development. Dangers posed by the oil industry to the endangered whale population as well as other organisms in The Gully include acoustic (noise) pollution, which could potentially disrupt the whales' communication system for feeding and mating; floating debris (such as plastic packaging), in which many marine animals get entangled; and chemical pollution.

As a class, discuss The Gully as an example of the problems that occur when environmental concerns clash with economic opportunities.

SECTION 1.3 ASSESSMENT, p. 29

Check Your Understanding

Checking Concepts

1. Students may not be familiar with common names for animals or plants that represent a single species. Encourage them to name plants or animals with as specific a name as possible (e.g., green frog or leopard frog rather than frog, balsam fir or Douglas fir rather than fir tree).
2. Students could count the number of students in their classroom, and you could provide them with the number of classes in the school. They could then estimate the population of the school.
3. Students' answers could include:
   (a) What does the frog eat? What kind of habitat does the frog live in?
   (b) Has the population of the frogs in the pond changed from year to year? Is the population of frogs larger or smaller than the population of dragonflies?
   (c) What interactions take place among different populations in the pond community? How would the introduction of a new population affect the community?
4. Possible answers:

DIFFERENCES/ SIMILARITIES	POPULATION OF HERRING GULLS	COMMUNITY OF SEABIRDS
number of species	one	several
interaction with food	all individuals eat the same food and will compete	individuals eat many different types of food
interaction with predators	individuals face the same predators	members of different species face different predators
interaction with air	breathe air	breathe air
interaction with water	drink water	drink water
interaction with land	compete for habitat	occupy different niches in the habitat

5. Pictures should illustrate an individual organism, a population of the organism, and a community and an ecosystem in which the organism would be found.
6. Students should be able to explain that two organisms could live in the same habitat but have different niches because their resource needs (food, shelter) and behaviours (daytime versus nighttime) can be very different.

Understanding Key Ideas

7. Students should describe their niches in terms of the resources (food, shelter) they use in their community and compare this to the resources their siblings or classmates use.
8. Students' answers could suggest that the wolf population may have increased because of birth of offspring or movement of wolves into the area because of increased availability of food. It could have decreased because of the death of wolves (due to a predator, disease, or lack of food) or the movement of wolves out of the area because of a lack of food.
9. (a)

ABIOTIC PARTS	BIOTIC PARTS
water	identical water plants
air pump	goldfish
light	water snails
aquarium	

(b) There are three species (water plants, goldfish, water snails).
(c) There are three populations (four water plants, two goldfish, three water snails).
(d) The community is formed by the water plants, goldfish, and water snails.

Pause and Reflect Answers

Encourage students to choose a specific ecosystem so that some of their questions can be more specific than the examples provided here. Students' questions could include:

- How many species are in the ecosystem?
- What is the size of a particular population in the ecosystem?
- What abiotic-biotic interactions occur in the ecosystem?
- What would be the effect of a specific change on the ecosystem?
- What niche does a certain species fill in the ecosystem?
- What would happen if one of the populations were removed from the ecosystem?
- Which species has a narrow range of tolerance and would not be able to live outside this ecosystem?
- Do any species have adaptations that help them live in this ecosystem?
- What is the habitat of one of the species in this ecosystem?

Students should recognize that to answer their question they may observe, infer, make predictions, develop hypotheses, take measurements, classify things, design experiments, collect data, analyze data, and interpret data.

Other Assessment Opportunities

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

CHAPTER 1 ASSESSMENT, pp. 30–31

PREPARE YOUR OWN SUMMARY

Student summaries should incorporate the following main ideas:

1. Ecosystems in Atlantic Canada
   - Coastlines and oceans are a challenging habitat because they are covered by water yet are exposed to air as the tides move. Examples of life found in this ecosystem include seaweed, small animals (barnacles, mussels, starfish, rock crabs), and a variety of fish.
   - Rivers, lakes, and ponds are freshwater ecosystems that can support fish, mammals, birds, amphibians, reptiles, and plants.
   - The arctic ecosystem is called a cold desert because of low temperatures and lack of precipitation. Permafrost is a permanently frozen layer of soil found in this ecosystem.
   - Forest ecosystems cover much of Newfoundland, and poorly drained areas sometimes turn into bogs and marshes.
2. Abiotic Parts of the Environment
   - Abiotic parts of the environment are non-living components, such as temperature, light, air, water, rocks, and climate.
   - Plants and animals are adapted to different abiotic conditions and can survive only within certain ranges of each abiotic condition, called the range of tolerance.
   - Light is used by green plants to produce food through photosynthesis.
   - Temperature affects the rate of growth and reproduction of micro-organisms and plants. The body temperature of reptiles is directly related to the temperature in the atmosphere around it.
   - Soil contains small particles of rock, serves as a source of nutrients for plants, and provides a home for various organisms.
   - Air is necessary for the survival of animals and plants as a source of oxygen and carbon dioxide. Wind can distribute plants seeds and aid in propagation.

- Water is used by all organisms for survival, whether for drinking, as a habitat, or as a means of obtaining food and nutrients.

3. Biotic Parts of the Environment
   - Biotic parts of the environment are living components, such as plants, animals, bacteria, and fungi
   - Ecosystems include many different species of organisms.
   - Members of a species can reproduce among themselves to produce offspring that can also reproduce successfully.
4. Levels of Organization
   - One organism is called an individual.
   - A population is an entire group of individuals of the same species living together in one ecosystem.
   - A community consists of interacting populations of organisms.
   - A community, along with the abiotic parts of the environment that affect the community, form an ecosystem.
5. Niches
   - Different species have different roles and use different resources in their community.
   - The roles include where a species lives, how it obtains its food, and how it affects its environment.
   - These roles make up the ecological niche of a species.

CHAPTER REVIEW ANSWERS

Checking Concepts

1. Accept any reasonable answer (e.g., a frog in a pond).
2. Any three of coastlines and oceans; rivers, lakes, and ponds; arctic; and forest.
3. Answers may include any five living organisms found in a marine ecosystem (e.g., seaweed, crabs, seals, plankton, cod, herring).
4. Water, and the associated tide and waves, is an abiotic factor that has a large impact on mussels along the shore. Accept any other reasonable answers, such as temperature or pollution.
5. An individual organism is a single member of a species. A species is a classification that groups a number of individuals sharing specific characteristics, including the ability to interbreed and produce fertile offspring.
6.

NEEDS OF LIVING THINGS
food
air
water
habitat

7. (a) The duck's feet are webbed to aid in swimming.
   (b) The falcon's feet are flexible and have sharp,curved claws for grasping small animals.
8. Individual, population, community, ecosystem.
9. Students' answers can depict fungi, mammals, invertabrates, amphibians, plants, reptiles, insects, or birds that would be found in a forest ecosystem.
10. Accept all reasonable answers. Make sure that students explain that an adaptation helps organisms survive despite a change in abiotic conditions, is inherited, and over generations becomes a common trait. Their example should illustrate that they understand an adaptation is not a single occurrence, such as an individual having a long neck, but a population with long necks that has a survival advantage as the food source grows taller.
11. Student models should specifically include reference to or examples related to the terms abiotic, adaptation, biotic, community, ecosystem, habitat, individual, niche, organisms, population, range of tolerance, and species.
12. Scientists must be precise, and if they use the same term (such as species), they can be sure that everyone is talking about the same organism.
13. Students' answers could include birds, insects, amphibians, plants, reptiles, fish, or mammals, (e.g., leopard frog, bulrushes, beaver, water lily, mosquito, mallard duck, trout, red-winged blackbird, water strider, algae.) You could draw their attention back to Figure 1.12 for suggestions.
14. Accept all reasonable answers. Students should not include biotic–abiotic interactions.

15. Students should recognize that the polar bear has a white-colored coat to provide camouflage against the snow. Other answers could note that it has thick blubber to insulate against the cold temperatures, fur between its toes to aid in walking on ice, and large paws and a slender head for swimming.
16. A polar bear's niche is in the arctic ecosystem, where it hunts seals and fish.

Understanding Key Ideas

17. Students' answers can include that a rotting log is an ecosystem within a forest ecosystem, a tidal pool is an ecosystem within an ocean ecosystem, a pond is an ecosystem within a forest ecosystem, or an oasis is an ecosystem within a desert ecosystem.
18. No, it is not scientifically useful because a population has to be at the species level. "Birds" can refer to more than one species. A more precise statement would be "I took a walk along the beach this morning and counted a population of 96 herring gulls."
19. Student drawings should resemble the photo on page 31. Explanations should note that the west-to-east wind will cause the trees to bend in the same direction.
20. Students' answers could include that the wind would affect the direction the trees grow and cause them to be misshapen and stunted. Salt from the water could stunt the growth of the trees as well. The scanty soil on the rock cliff will not retain much water or nutrients for growth.
21. To increase the butterfly population, the habitat would need to be more suitable for the insects. Students could suggest changing the neighbourhood by providing more of the kind of food they like (nectar-rich flowers), removing or discouraging predators, or providing more shelter.
22. Answers should include a clear identification of the location of the ecosystem, a description that categorizes it as one of the ecosystems in Atlantic Canada, and a reasonable explanation for the dominating effect of the chosen abiotic factor.

Pause and Reflect Answer

Students' models or drawings should show an understanding of biotic and abiotic factors but may use the terms "living" and "non-living" to help a younger audience. Ideally, the model should include some reference to invisible abiotic factors, such as temperature, sunlight, wind, etc., as well as visible abiotic factors, such as rocks and soil.

CHAPTER 2 OPENER, pp. 32–33

USING THE PHOTO AND TEXT

The photograph of the seabird colony provide an opportunity to introduce students to interactions that occur among various components of the environment. This chapter reviews interactions between living and non-living things in ecosystems. You may wish to have students discuss questions from the opening text or have students try to predict the answers to these questions.

In small groups or as a class, consider having students generate a list of all living and non-living factors that may be present in the ecosystem shown in the photograph. Ask students to attempt to link each factor to the seabirds highlighted in the Chapter Opener. For example, the sunlight entering the ecosystem is used for growth by algae in the ocean, which are in turn consumed by small crabs, which are eaten by an octopus. The octopus dies and the seabirds then consume it as it washes to shore. List the biotic and abiotic factors on the board as they are provided by students and interconnect them with arrows to show their interrelationships.

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

Read What You Will Learn, Why It Is Important, and Skills You Will Use aloud with students, defining terms as needed. You may want students to brainstorm answers to the following questions:

- What different interactions occur between abiotic and biotic parts of an ecosystem?
- How do the roles organisms play in ecosystems differ?
- How does energy flow through an ecosystem?
- How is matter cycled in an ecosystem?
- What happens to dead organisms?

The answers can help you determine students' prior knowledge of ecosystem interactions.

Encourage students to use the What You Will Learn points as a chapter organizer.

USING THE FOLDABLES™ FEATURE

See the Foldables™ section of this resource.

2.1 TYPES OF INTERACTIONS

BACKGROUND INFORMATION

Some organisms do not fit easily into one particular relationship category, such as predator/prey or parasite/host. In general, parasites and predators are at opposite ends of a size continuum, with small, often-microscopic parasites at one end, and larger predators at the other. To further distinguish between the two, parasites live on or in a host. They do not kill their host. Conversely, predators do not live on or in their host. They kill and consume their prey.

The impact of parasites has been felt throughout human history. In Newfoundland, cold weather kills off some, but not all, potential parasites. Students may be interested to know that during the excavation of the oldest toilet in North America, found at the 17th century archaeological site at Ferryland, some 80 km south of St. John's, eggs from four species of parasites were found in the remains of the 400-year-old privy.

It can be difficult to determine whether both partners benefit from a symbiotic relationship. For instance, it was initially unclear why brownheaded cowbirds spend so much time hovering around the hooves of cattle and bison. However, scientists have learned that the bison and cattle disturb insects as they walk, which the birds consume. Thus the relationship seems to be an example of commensalism. However, the birds also clean the large animals' hides of flies—a distinct benefit that indicates mutualism.

In actuality, there are probably few true cases of commensalism. Both partners in symbiosis are usually affected in some way, although how they are affected may not be clear. However, in the wetter areas of mixed fir forests in Newfoundland and Labrador, old man's beard lichens are frequently seen draped over the boughs of black spruce. This relationship appears to be a true example of commensalism, as the spruce are not affected by the lichen, while the lichen benefit from the relationship, as their position on the tree exposes them to increased light for photosynthesis.

COMMON MISCONCEPTIONS

- Some students may be under the impression that all bloodsucking insects are parasites. They may be surprised to learn that mosquitoes are not parasites. They do not kill their prey, but neither do they live on or in a host. As a result, mosquitoes are often put into their own category of "micro predator."

ADVANCE PREPARATION

- For Think About It Activity 2-1A, The Ups and Downs of Living Together, book the library or computer lab a week or more in advance if using graphing software to complete this activity.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 34–35

Using the Text

Divide students into six groups. Ask two groups of students to brainstorm examples of interactions between two abiotic parts of the environment. Ask two other groups to brainstorm examples of interactions between two biotic parts of the environment. Ask the last two groups to brainstorm examples of interactions between an abiotic and a biotic part of the environment. Each group should assign one student to act as recorder. Have students compare their results by asking each set of groups to share their answers with the class in turn.

Review the Key Terms with your class. Use Figures 2.2–2.8, which begin on page 35, to start a class discussion about symbiotic relationships (parasitism/mutualism/commensalism). These real-life examples are sure to evoke discussion from students. Brainstorm with your students to come up with other organisms that live in symbiotic relationships. List the organisms, classifying their relationship into the different categories. Indicate which role each organism plays in the symbiotic relationship. After compiling the list, ask students the following questions: Which organisms do they find difficult to classify and why? Do some organisms fit into more than one category?

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

TEACHING THE SECTION, pp. 36–38

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

Encourage students to take notes as they read through each chunk. They can use the topic titles 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 found the information interesting. Alternately, these facts can be shared in class discussion.

Reading Check Answers, p. 37

1. Symbiosis is a biological interaction in which two species live closely together over time. There are three main types of symbiotic relationships: parasitism, mutualism, and commensalism.
2. Examples of symbiosis given in the chapter include: barnacles living on whales; fleas, ticks, tapeworms, and roundworms living on or in a host organism; parasitic roundworms found in caribou; mistletoe living as a parasite on trees; micro-organisms that live in the gut of termites; lichens (a combination of algae and fungi); clownfish living among anemone tentacles. Common examples of symbiosis taken from students' own experiences may include pollinating bees or insects and flowers; ants and aphids; and humans and cultivated plants, domesticated animals, and various parasites, such as *Giardia* (beaver fever).
3. Mutualism is a symbiotic relationship in which both partners benefit. Examples given in the chapter include micro-organisms that live in the guts of termites, and lichen.
   Parasitism is a symbiotic relationship in which one partner benefits and the other is harmed. Examples from the chapter include fleas, ticks, and lice, which live on their hosts, as well as tapeworms and roundworms, which live inside their hosts. More specific examples include the

parasitic relationship between roundworms and caribou, and that between mistletoe and trees.
Commensalism is a type of symbiotic relationship in which one partner benefits and the other is unaffected. Examples from the chapter include the clownfish, which live among poisonous anemone. Barnacles living on whales are another example.
Most students will provide examples from the chapter; however, some may use examples from their experience. Accept any reasonable answer.

Using the Did You Know

The Did You Know on page 36 discusses *Elaphostrongylus rangiferi*, a roundworm endemic only to Newfoundland woodland caribou (*Rangifer tarandus terraenovae*). Symptoms are neurological and respiratory, as the roundworms typically infect the membranes lining the brain and spinal cord, as well as the lungs. Infected caribou are unaware of their surroundings, show no fear of humans, and exhibit shaking and staggering while walking. Pneumonia may develop when larvae and eggs block air passages in the lungs. The roundworm is transferred between infected caribou through an intermediate gastropod host (slug or snail).

Students may be interested in learning about other parasites common to Newfoundland and Labrador. Common parasitic relationships include black knot fungi, which live on pin cherry trees; blueberry gall wasps, which lay eggs under the bark of blueberry shoots, where they develop and feed; and dwarf mistletoe, which parasitizes black spruce, resulting in growths often referred to as "witches' brooms."

USING THE ACTIVITY

- Think About It Activity 2-1A, The Ups and Downs of Living Together, on page 38 of the student book is best used after reading the text on predator–prey relationships.

Detailed notes on doing the activity follow.

Think About It Activity 2-1A

The Ups and Downs of Living Together, p. 38

Purpose

- Students plot and interpret a graph of the number of hare and lynx caught by trappers over a 20 year period. Students use this information to answer questions about predator–prey interactions.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Book library or computer lab, if using.	For each student: – graph paper – coloured pens or pencils – ruler
1 day before	Review predator–prey relationships.	

Time Required

- 60 min

Science Background

Prey has a direct relationship with its predator. The larger a prey population is, the more food is available to its predators. Thus, the predators have more energy to reproduce and care for their young. This allows the predator population to increase. With a greater number of predators, the prey population will decline, resulting in more competition among predators for food, limiting the predator population. The predator population declines, and, with fewer predators, the prey population increases.

The information provided in this activity shows the number of Canada lynx and snowshoe hare trapped in northern Canada over 20 years. The increases and decreases in the number of lynxes trapped closely follow increases and decreases in the number of hares trapped. Based on various studies, scientists have concluded that the observed cycles are probably due to a combination of (1) prey population decline due to depletion of food with higher population numbers; and (2) predator–prey interactions. Typically, the hare population peaks one to two years before the lynx population peaks.

Activity Notes

- Students may work in pairs to complete this activity.
- Review graphing skills with students prior to this investigation, considering types of graphs, their components, and graph interpretation. (See Science Skill 1 in the textbook.)
- Discuss the cycle of the lynx and the snowshoe hare populations described in the student book.
- Have students imagine that they are early 20th century trappers who depend on lynx pelts. Have them write a newspaper article explaining why so few lynxes were trapped in 1910, offering solutions for their economic survival until lynx populations recover.
- ICT Option: Have students use graphic software to create their graphs for this activity.

Supporting Diverse Student Needs

- Match students who are weak in logical-mathematical intelligence with partners who are strong in this type of intelligence.
- For enrichment, have students graph the province's human population over 20 years and compare it to the graph they drew in this activity.

What Did You Find Out? Answers

1. (a) Increases in the number of hares follow decreases in the number of lynxes. Decreases in the number of hares occur as the number of lynxes increases.
   (b) Increases in the number of lynxes follow increases in the number of hares by one to two years. Decreases in the number of lynxes follow decreases in the number of hares by one to two years.
2. As the hare population increases, there is more food available for the lynx population. Thus, the lynxes have more energy to reproduce and care for their young. This allows the lynx population to increase. With a greater number of lynxes, the hare population declines, as the lynxes consume increasing numbers of hares. Over time, there is less food to feed the lynx population, so it declines as well. With fewer predators, the prey population increases again and the cycle continues.
3. Predators eat the prey, and so the prey population cannot grow out of control.
4. When there is a lot of prey, the predators have large amounts of food, allowing the predator population to grow. When the number of prey decreases, the predator population also decreases because there is not enough food.
5. Hares would have less to eat and their number would decline. As a result, the number of lynxes would decrease, as they would have less to eat as well.
6. Students cannot state the sizes of the populations numerically; however, students can reasonably predict, based on the pattern evident in their graphs, that the sizes of both populations will have risen.
7. Using the numbers of animals trapped may not be an accurate method of estimating population size because other factors might affect the numbers of animals trapped. Examples include the price and demand for fur, the weather, the health of the animals, trapping regulations, and so forth.
8. Since the northern habitat where these data were collected has relatively few species, the populations of these species fluctuate more than populations do in other habitats where species number is greater. This fluctuation occurs because a species often relies on just one other species as its main food source. If the prey species' population changes, so will the population of the predator species. In other ecosystems with greater numbers of species, a predator will often eat many different species, so that the decline of one of these species will result in a limited fluctuation of the consumer population.

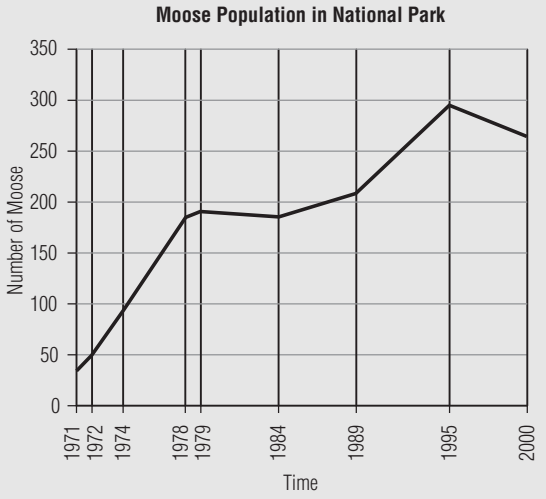
SECTION 2.1 ASSESSMENT, p. 39

Check Your Understanding Answers

Checking Concepts

1. Possible answers include the Sun evaporating water or melting snow, wind blowing clouds across the sky, water wearing away rock or moving dirt, and wind blowing sand.
2. Possible answers include a human or animal breathing air, plants using energy from the Sun to make food, organisms drinking or absorbing water, and an animal warmed by the heat of the Sun.
3. Parasitism is a symbiotic relationship between two species in which one benefits and the other is harmed. Mutualism is a symbiotic relationship in which both partners benefit.
4. Parasites and predators are at opposite ends of a size continuum, with small, often-microscopic parasites at one end, and larger predators at the other. To further distinguish between the two, parasites live on or in a host. They do not kill their host. Conversely, predators do not live on or in their host. They kill and consume their prey.
5. As a population of owls increases in number, they will consume more mice. The number of mice in the ecosystem would thus decrease.

6. (a)



(b) You would not expect to see a similar population change for the wolf population. If the wolf population also increased, more moose would be consumed and the moose population would not be increasing as it is.

Understanding Key Ideas

7. (a) Mutualism. The flowering plant benefits, since it is pollinated. The bee benefits, as it receives nectar.
   (b) Parasitism. The flea benefits, as it receives nourishment (blood). The dog is harmed as the flea takes its blood, resulting in skin irritation and itching.
   (c) Commensalism. The barnacle benefits, as it has a secure anchorage point on the whale, which remains unaffected.

Pause and Reflect Answer

Some students may reflect that the relationship between humans and bees is mutualism, as bees pollinate crops that humans rely upon for food, while humans plant crops that flower and provide bees with nectar. Other students may reflect that the relationship between humans and bees is commensalism, as bees pollinate crops that humans rely upon for food, but bees are unaffected, as there are enough flowers in nature for bees to pollinate without humans planting crops. Accept either well-reasoned answer. A decline in the population of bees could result in possible food shortages for humans if crops are not pollinated. If this shortage is severe enough, this could result in a decline in the population of humans due to starvation.

Other Assessment Opportunities

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

2.2 ROLES OF ORGANISMS IN ECOSYSTEMS

BACKGROUND INFORMATION

During photosynthesis, plants with chlorophyll use sunlight, carbon dioxide, and water to make food (sugars) and oxygen. Producers capture only about 1 to 2 percent of the Sun's energy that reaches Earth. Clouds, particles in the atmosphere, or Earth's surface, either reflect the rest of the energy into space, or the atmosphere absorbs it. Approximately 150 to 200 billion tonnes of organic matter are produced by producers per annum worldwide.

Students may also be surprised to learn that in a field, the mass of decomposers in the soil is far greater than the mass of cows that feed on the grass.

COMMON MISCONCEPTIONS

- Some students may believe that scavengers fall into the category of decomposers. Remind students that scavengers differ from decomposers as they eat dead organic matter and waste, while decomposers release chemicals that break apart dead tissues and cells, and absorb the released nutrients.

ADVANCE PREPARATION

- For Think About It Activity 2-2B, Defending Against Decomposers, book classroom use of the computer and projector a week or more in advance if students are completing a computer slideshow presentation.
- For Conduct an Investigation 2-2C, The Dirt on Decomposers, be sure to gather materials 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. 40–41

Using the Text

Examine Figure 2.10 on page 40 and identify the role (herbivore, carnivore, or omnivore) carried out by each organism. Have students brainstorm a list of other organisms that have similar roles in their ecosystem.

Record and define the Key Terms on the board. On a piece of paper, write a common ecosystem ele-

ment (for example, fox, robin, seagull, wolf, Sun, squirrel, spider, seal, ant, spruce tree, bee, human, hare, crow, larch). Make one for each student. Have students tape their paper on the back of another student without showing it to them. Each student must guess what he or she is by asking questions, using the Key Terms as a guide. For example, "Am I a carnivore?" All questions must require a "yes" or "no" answer. Students have only one guess at what animal they are, and if they are wrong, they are out of the game. Therefore, it is best if they ask lots of questions—both general and specific (such as "Do I have fur?" or "Do I fit in a shoe box?").

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

Using the Did You Know

Students are often fascinated by the bizarre in nature, with dung beetles fitting neatly into this category (Did You Know page 42). Dung beetles (scarabs) were revered by ancient Egyptians, who credited them with making the planet revolve by rolling it like an enormous ball. Industrious by nature, a single dung beetle is able to bury 250 times its weight in dung in one night. They are typically solitary creatures, except when mating. That said, 16 000 dung beetles have been found in one single 1.5 kg heap of elephant dung.

TEACHING THE SECTION, pp. 42–48

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 the roles animals play in the environment?" Then have them review their answer and record questions they have about the various roles played by animals. 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 student book independently, record their thoughts, and then pair up with another student to discuss their ideas.

After Reading—Reflect and Evaluate

Ask students to outline the interesting information they have learned in this section and write a statement explaining why they found it interesting. Ideas can be shared in class discussion.

Reading Check Answers, p. 42

1. Herbivores are animals that eat only plant materials.
2. Carnivores are animals that eat only other animals.
3. Producers produce their own food from the abiotic environment. They are a source of food for consumers, decomposers, and scavengers.
4. Decomposers are organisms that break down dead organisms and waste into their basic parts. Decomposers include many species of bacteria and fungi. They do not eat their food as scavengers do. Instead, they release chemicals that break apart dead tissues and cells, and absorb the nutrients.

Using the Did You Know

The Did You Know? on page 44 describes how sauerkraut was eaten over 2000 years ago when the Great Wall of China was built. You may want to bring some sauerkraut to class so students can taste this ancient fermented food.

USING THE ACTIVITIES

- Think About It Activity 2-2A, Food Preservation, on page 43 of the student book is best used after students have read the section on decomposers and food preservation on pages 43–44.

- Think About It Activity 2-2B, Defending Against Decomposers, on page 45 of the student book is best used after students have read the section on decomposers and food preservation on pages 43–44.
- Conduct an Investigation Activity 2-2C, The Dirt on Decomposers, on pages 46–47 of the student book is best used after students have read the section on decomposers and food preservation on pages 43–44.

Detailed notes on doing the activities follow.

Think About It Activity 2-2A

Food Preservation, p. 43

Purpose

- Students will identify different methods of food preservation and determine how they work.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Review food decomposition and preservation.	None

Time Required

- 30–60 min
  – 30 min for exercise
  – 30 min for extra research, if required

Science Background

The methods of food preservation shown in the picture prevent the decomposition of food by either keeping micro-organisms out of the food, killing them or limiting their growth.

Common preservation methods shown in the picture include:

- Pickles: pickling (preservation with vinegar), canning (keeping micro-organisms and oxygen out)
- Smoked salmon: drying (reducing moisture), vacuum sealing (keeping micro-organisms and oxygen out)
- Coffee: drying (roasting), vacuum sealing
- Beef jerky: drying, vacuum sealing
- Salted fish: salting (reducing moisture), vacuum sealing
- Instant noodles: drying
- Raisins: drying
- Frozen shrimp: freezing (decreasing temperature and reducing moisture)
- Corn: canning

Activity Notes

- Consider bringing in samples of decomposing food, such as fruit or bread, to add a visual-spatial component to this activity. Encourage students to observe changes. Safety Note: Any samples should be sealed securely inside of transparent plastic bags. Students should not touch or inhale any samples.
- Instead of asking students to research the products they are unsure of, you may want to have students form small discussion groups and share their answers. After comparison, any product a group is still unsure about can be presented to the class to see if any other groups identified the preservation method and how it works.
- Advise students to use the student book to research products they are unsure about. Most answers are provided on page 44.

Supporting Diverse Student Needs

- Some Pathway 3 students may come from countries where refrigeration is a luxury. Ask such students to share their experiences with food preservation methods with the class.
- Bringing in samples of decomposing food for observation will add a visual-spatial component to this activity.
- For enrichment, invite someone involved in the food preservation industry (e.g., fish canning) to talk to your class about how the method is carried out in a factory. Alternately, invite a health inspector to talk about the health risks of improperly preserved food.

Think About It Activity 2-2B

Defending Against Decomposers, p. 45

Purpose

- Students research food preservation and make a presentation to the class.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1–2 weeks before	Schedule dates of class presentations and book computer and projector for students doing computer slideshow presentations.	Computer and projector, if required
1 day before	Review food decomposition and preservation.	

Time Required

- A number of class periods
  - 30 min to introduce activity
  - 1 week for independent research
  - Several hours for presentations

Safety Precautions

- Students conducting tests to determine which preservation techniques are best for preserving perishable food items should wear gloves if handling decomposed foods.

Science Background

New methods of food preservation that students may be interested to learn about include the following:

- Radiation of food with ultrasound or high intensity light
- Use of hydrostatic pressure or pulsed electric fields to kill micro-organisms
- Removal of micro-organisms through membrane filtration
- Modification of the atmosphere within packaging
- Using edible food coating that keeps micro-organisms out

Activity Notes

- Be sure to limit time for student presentations.
- This activity works well if done in partners.

Supporting Diverse Student Needs

- Students with reading difficulties will benefit from working with a partner.
- Visual-spatial learners may benefit from conducting a test to determine which preservation technique is best for preserving perishable food items.
- Enrichment can include using novel forms to present research.

What Did You Find Out? Answers

1. The role of decomposers in ecosystems is to break down dead organisms and waste material. Food preservation methods attempt to thwart, or at least reduce the success of, decomposers in this role.
2. Most students will realize that decomposers are both harmful and helpful to humans. They are harmful because they spoil our food and can make us ill if consumed. However, they are helpful because they break down dead organisms and waste materials, removing them from the ecosystem. Some students may recognize that during the decomposition process, nutrients are released back into the soil. Plants use these nutrients to grow, which also benefits humans.
3. Possible answers include the following: old methods work well so people don't feel they need to adopt new ones, people often shy away from things they are unfamiliar with, people may not be confident the new methods work, some preservation methods are closely linked to the culture of a people, old methods may be cheaper, and so forth.

Conduct an Investigation 2-2C

The Dirt on Decomposers, pp. 46–47

Purpose

- Students investigate the process of composting to observe what factors affect decomposition.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Gather the apparatus and materials.	For each group: – 2 identical large plastic pots (approx. 750 mL) with drainage holes – saucers for under the pots – pieces of window screen or similar mesh – magnifying glass – small stones – labels for pots – garden soil (not sterilized) – sterilized soil – water – measuring cup – approximately 500 mL of waste vegetable matter such as peels from carrots, apples, or potatoes, or leaves from cabbage or lettuce
1 day before	Review decomposers and decomposition.	

Time Required

- 40 min for steps 1–7
- Several weeks to complete observations (steps 8–11)

Safety Precautions

- Safety eyewear, lab coats, and gloves must be worn in accordance with provincial safety standards.
- Soil and vegetable matter should be disposed of only as directed.
- Remind students to wash their hands thoroughly after this activity.

Science Background

There are four main factors that affect the speed of decomposition. (1) The more surface area of material available, the faster micro-organisms can break down and digest the material. Chopping material into small pieces can increase surface area. (2) Oxygen and (3) moisture are needed throughout the decomposing material. (4) Temperature is also important. The more heat available, the faster the material will decompose.

Activity Notes

- Keep all the composters in the same area, so that they are influenced by the same conditions.
- Cut waste materials in similarly sized pieces so that students can compare the decomposition that is taking place. Make sure that the waste materials are big enough for students to see some results.
- As a class, discuss the role that composting and decomposition play in our daily lives. If you or any of your students have a composter at home, bring in a compost sample to show students. (Keep it in a sealed bag to prevent any potential contamination in the classroom.) Encourage students to examine possible environmental and economic reasons for composting.
- This experiment works well if done in partners or small groups.
- After the investigation is finished, have students share some of their hypotheses and conclusions with one another. See if the results are consistent among most of the groups. If not, try to determine why any differences exist.

Supporting Diverse Student Needs

- Encourage students with reading difficulties to label the materials and put them in the pots for their groups.
- This hands-on activity is excellent for developing visual-spatial, body-kinesthetic, and naturalist intelligence.
- For enrichment, students could research factors that affect the speed of decomposition.

Analyze Answers

1. Students should observe little or no decomposition in the pot of sterile soil since there were no micro-organisms in it.
2. Students should clearly state whether their hypothesis was supported and explain how the observations they made either supported or refuted it.
3. Controlled variables included the following: type and amount of soil used, type and size of pot, amount of water added, size and amount of waste used, amount of drainage, temperature, light levels, duration of experiment, frequency of watering and checking soil, type of screen used. The responding variable was soil sterilization.

Conclude and Apply Answers

4. Factors that speed decomposition include increased temperature, oxygen levels, moisture levels, and surface area of waste.
5. Factors that slow down decomposition include decreased temperature, oxygen levels, moisture, and surface area of waste.
6. Use Assessment Rubric 5, Conduct an Investigation, to evaluate student results. Hand out Assessment Checklist 3, Designing an Experiment, to help students design their experiments.

USING THE FEATURE

Career Connect: Professor of Environmental Design, p. 48

This feature provides an opportunity to connect sustainability and sustainable business to ecology, especially that of Newfoundland and Labrador. The activities below can act as a springboard for further discussion on this subject.

- Either in small groups or as a class, ask students to discuss what sustainability means to them. If forming groups, you may want to ask students to present their ideas to the class. Other questions you may want students to consider include the following: How do you incorporate sustainability into an average day? How could your choices be more sustainable? How do unsustainable choices, made both locally and globally, affect you personally?
- In groups, ask students to design a business that could make their region more sustainable. Details for students to consider in the design process include what kind of sustainable practices the business would incorporate, how it might address environmental concerns specific to their region, and how the business would compete in the marketplace. Have groups present their businesses to the class. Alternately, have students research a sustainable business currently operating in Newfoundland and Labrador.
- Aboriginal teachings highlight the connectedness of all parts of the environment. Instead of dividing the natural world into abiotic and biotic parts, traditional ecological knowledge classifies natural features, like mountains or rocks, as living parts of

the ecosystem. Ask students how society might treat resources differently if everyone adopted such a view.
- A class discussion of the feature could be focussed on the following questions:
  - What can you do to contribute to sustainability?
  - What does sustainability mean to you?
  - What are renewable energies? What role will these energies play in our future?
  - Do any sustainable industries currently operate in our province? Explain.
  - Identify one chemical, hormone, or antibiotic that is passed through a food chain. What effects does this substance have on the organisms in the food chain and the development of the ecosystem?

SECTION 2.2 ASSESSMENT, p. 49

Check Your Understanding

Checking Concepts

1. Spiders, cats, and owls are carnivores. Other carnivores that students may name are snakes, seals, sharks, lynxes, salmon, trout, cod, polar bears, hawks, coyotes, and eagles. Accept any reasonable answer.
2. The dandelion, grass, algae, and spruce are producers. Consumers include the robin, grasshopper, butterfly, cod, spruce budworm, and lobster.
3. Scavengers will eat the flesh, while decomposers will release chemicals that break apart the dead tissues and cells, and absorb the nutrients.
4. A rotten log, a dead organism, and food that has not been properly stored or preserved. Accept any reasonable answer.
5. The plum will decompose first because it has more moisture in it than the prune, which has been dried. Few micro-organisms can survive without moisture.
6. Typical foods include beer, wine, bread, cheeses, pickled vegetables, and some sausages.
7. (a) decomposer
   (b) consumer
   (c) consumer

Understanding Key Ideas

8. Students are consumers. They must get food from the biotic environment by consuming other organisms.
9. Vegetarian students are herbivores, as they eat only plants. All other students are omnivores, as they eat both plants and animals. It is very rare for any student to be a carnivore.
10. The method of preservation shown is pickling. To preserve food, pickling uses vinegar, an acid in which few bacteria survive.
11. Soil micro-organisms have decomposed the potato peels.

Pause and Reflect Answer

Decomposers play a key role in nutrient cycling. They break down waste and dead organisms, releasing nutrients into the soil, air, or water. Producers rely on these nutrients in order to create food from abiotic factors in the environment. Other organisms consume them in turn. These are consumed themselves or later die, to be decomposed once again. Without this continuous recycling of nutrients, life on Earth would not be possible.

Other Assessment Opportunities

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

2.3 FOOD CHAINS, FOOD WEBS, AND THE TRANSFER OF ENERGY

BACKGROUND INFORMATION

On average, only 10 percent of the energy that is obtained at one level in a food chain is passed on to the next level. This means that about 90 percent of the energy consumed by organisms at each level is lost to the environment as heat or waste.

Some food chains depend on a source of energy other than the Sun. In soil, salty lakes, hot springs, and deep under the ocean's surface, various bacteria use energy in the bonds of certain chemicals to produce carbohydrates through chemosynthesis. Chemosynthetic organisms near volcanic vents on the sea floor were first discovered in 1977 near the Galapagos Islands, at a depth of 2500 m. Living in total darkness near acidic, scalding water of up to 350°C, chemosynthetic micro-organisms are able to support an entire ecosystem of unique aquatic organisms where no light penetrates.

COMMON MISCONCEPTIONS

- Most food chains are short. In Canada, where short growing seasons limit plant productivity, this is especially true. Complex food webs illustrating

numerous feeding relationships within a community may impress upon students that food chains have more levels than they actually do in most cases.

ADVANCE PREPARATION

- For Find Out Activity 2-3A, Eating at the Copepod Café, gather materials at least a week in advance.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 50–51

Using the Text

Before reading about energy flow and food chains, ask students what the term "food chain" implies to them. What images do students associate with the term? After students give some suggestions, have students read pages 50–51 in the student book and see if they can add to the definition.

To foster an appreciation of ecosystems and the complexity of the interactions of organisms within them, try to arrange a field trip to a nearby forest or marsh area. Ask students about their experiences with nature. Showing a nature video may also be a springboard to discussion.

Have students study Figure 2.16 on page 51, and review each food chain separately to understand the flow of energy among organisms. See if students can identify where the energy starts in the chain and how it moves along with each organism. Draw students' attention to the fact that in each food chain, energy originates from the Sun, although it is not shown. Encourage students to create examples of food chains that would occur in a local ecosystem, such as a pond or field. Have students share their ideas and drawings.

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

TEACHING THE SECTION, pp. 52–58

Using Reading

Pre-reading—Predict–Read–Verify

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

During Reading—Note-Taking

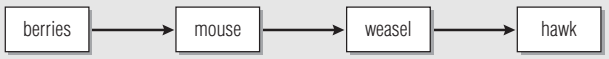
Encourage students to take notes as they read through each chunk. They can use the topic titles to generate questions, and then take notes as a means of answering the questions.

After Reading—Reflect and Evaluate

Have students review their notes and select three facts that they find the most interesting. They can then write a statement as to why they find the information interesting. Alternately, facts can be shared in class discussion.

Reading Check Answers, p. 57

1.



2. A food chain is a model that shows the transfer of energy from organism to organism. This differs from a food web, which shows the interconnection of several different food chains to produce a more complex model of feeding relationships.
3. An energy pyramid shows the decrease in the total energy available to organisms at each consecutive level of a food chain. Because there is less energy available to organisms at each link in a food chain, the animals at the top of a food chain are generally less numerous than those below.

Using the Activities

- Find Out Activity 2-3A, Eating at the Copepod Café, on pages 52–53 of the student book is best used after students have read "The Roles of Organisms in Food Chains" on page 51.
- Think About It Activity 2-3B, The Riddle of the Pyramids, on page 57 of the student book is best used after students have read "Energy Pyramids" on page 56.

Detailed notes on doing the activities follow.

Find Out Activity 2-3A

Eating at the Copepod Café, pp. 52–53

Purpose

- Students model a food chain in an estuary.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Gather materials.	– 20 strips of cloth, 30 cm long (10 of one colour, 10 of a different colour) – stopwatch – whistle – 1 large plastic self-sealing bag per student – 4–5 L of popped popcorn or foam "peanuts" used for packing
1 day before	Review food chains and food webs.	

Time Required

- 60 min

Safety Precautions

- Make sure that students are not too rough when they tag other players.
- Ensure that there is adequate space for students to run around and to sit on the sidelines once they have been tagged.
- Remind students not to eat the popcorn.

Science Background

Copepods are small crustaceans that are found in most saltwater and freshwater habitats around the world. They either drift in surface waters (planktonic) or live at the bottom of a body of water (benthic). Planktonic copepods play a crucial role in food chains, as they are a main source of food for whales, fish, seabirds, and krill. They form the largest single animal biomass on the planet.

Activity Notes

- Have students copy the data tables into their notebooks. They should have their notebooks at the game site while they are playing.
- Divide students into three groups. For the first trial, the students should be in groups of equal size. For the second trial, the ratio in the group membership should reflect a 1 heron: 3 fish: 9 copepod ratio.
- You may want to do at least three rounds of the game so that students have a chance to play all the roles.
- You may wish to have students work in pairs to record data and answer questions.

Supporting Diverse Student Needs

- Have Pathway 3 students describe a similar food chain from their home country.
- This is an excellent investigation for enhancing body-kinesthetic intelligence.
- For enrichment, have a class discussion about what would happen if there were only 2 copepods, 6 fish, and 18 herons. Students can also discuss what might happen if an additional organism were added to the food chain, such as another predator. Have them come up with as many variations as they can and list them.
- ICT Option: Use computer software to graph results.

Analyze Answers

1. The second trial is closer to what happens in nature. The second trial has more organisms at the bottom level, fewer at the middle level, and the least at the top level.
2. If only half as much food was available to the copepods, there would be fewer of them. This would mean that there would be less food available to the fish, and so less food for the heron. Thus, all three populations would decrease in size.
3. (a) The copepods would have no predators, and the copepod population would grow.
   (b) The heron population would be reduced because the herons would not have enough food. Eventually, they would have to find something else to eat or leave the ecosystem. Otherwise, most individuals in the population would starve.
4. If there were other species in this estuary, the fish and heron may feed on organisms other than copepods and fish, respectively. Similarly, other organisms would feed on the copepods and fish, and perhaps even the herons. As a

result, a change in the population size of one species would have a smaller effect on that of the other species in the food web.

Think About It Activity 2-3B

Riddle of the Pyramids, p. 57

Purpose

- Students create a model of an energy pyramid.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
Several days before	Gather materials.	For each student: – pencil – ruler – scissors – large sheet of blank paper
1 day before	Review food chains and energy pyramids.	

Time Required

- 30 min

Safety Precautions

- Make sure that students are careful when handling scissors.

Science Background

In addition to pyramids of energy, ecologists also use pyramids of numbers and pyramids of biomass to show how energy is transferred through an ecosystem. However, pyramid of numbers and biomass can be inverted in special cases. Pyramids of energy can never be inverted because there can never be less energy in a lower level than in a higher one.

Activity Notes

- Assign students a specific ecosystem to choose organisms from when labelling their pyramid. For example, forest, coastline, pond, or Arctic.

Supporting Diverse Student Needs

- Have Pathway 3 students describe an energy pyramid from their home country.
- This is an excellent investigation for visual-spatial learners, body-kinesthetic learners, and students with learning difficulties.
- For enrichment, have students research other ecological pyramids used by ecologists.

What Did You Find Out? Answers

1. Only about 10 percent of energy consumed by organisms is transferred to the next level in a food chain. As a result, there is less energy available at each consecutive level of the food chain, which will support fewer organisms.
2. Only about 10 percent of the energy consumed by organisms is transferred to the next level in a food chain. After three or four transfers of energy, there is too little energy left to support another link in the food chain.

USING THE FEATURE

Science Watch: Fisheries and Ecosystems, p. 58

This feature provides an excellent opportunity to link the chapter concepts of food chains, food webs, and energy transfer to an environmental issue affecting Newfoundland and Labrador. Some students may come from families that were directly affected by the collapse of the cod fisheries. Ask these students to share any experiences their family members may have had in this respect. Alternatively, as a class or in small groups, have students discuss ways in which unsustainable fishing practices have affected individuals and families in Newfoundland and Labrador.

Science Watch Answers

1. Sample food chain:

2. Abiotic factors that could affect the cod population are changes in water temperature and oxygen levels, as well as increased levels of aquatic pollution.
3. If the entire cod stock died off, the ecosystem could change dramatically. The population of prey species would increase, since cod are no longer consuming them. The larger a role a prey species plays in the diet of cod, the larger the impact will be. Conversely, the population of predator species would decrease, due to the lack of cod. The larger a role cod plays in a predator's diet, the larger the impact will be.
4. (a) Severe conservation measures have been put in place. In 1992, the federal government placed a moratorium on the northern cod harvest in Newfoundland in hopes of rebuilding extremely low cod stocks. In 1993, they banned all cod fishing in Canada. In 1997, the southern cod harvest was re-established to a limited extent. In 2003, the federal government closed cod fishing in the Gulf of St. Lawrence and in Newfoundland and Labrador as well. The

allowable catch of capelin, a main food source for cod, has been reduced by 40 percent. Seal exclusion zones and no trawling zones have been created. Millions of dollars have been dedicated to scientific research on the impact of seals on cod stocks.

(b) In July and August 2007, recreational cod fishing was reopened to all residents of Newfoundland and Labrador for a brief three-week window.

(c) Salmon fishing is often similarly regulated in Canada.

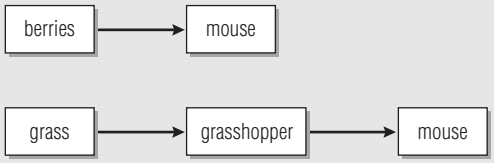
SECTION 2.3 ASSESSMENT, p. 59

Check Your Understanding

Checking Concepts

1.

2. Students answers may include the following: human, mouse, chicken, pig, dog, seagull, crow, raccoon, starfish, fly. Accept any reasonable answer. Students should draw two food chains, one illustrating the omnivore's consumption of a plant and one illustrating the consumption of an animal.

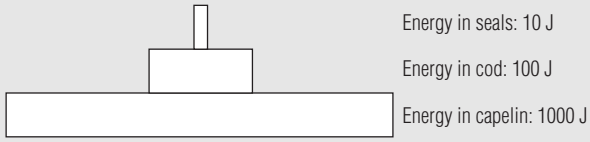


3. All the energy in one level of a food chain is not available to organisms at higher levels of the food chain because an average of 90 percent of this energy is lost as unusable heat generated during respiration and as waste that was not absorbed by the lower-level organisms.

Understanding Key Ideas

4.

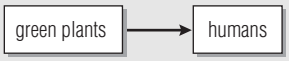
Sample energy pyramid:



5. Student answers should include drawings of two food chains. Each linear food chain should include a producer and a primary consumer, and possibly a secondary consumer. At least one should include a top carnivore. Students who are vegetarian/vegan will only have two levels in their food chain.

6. (a) The most energy in green plants is lost before it reaches humans in the following food chain:

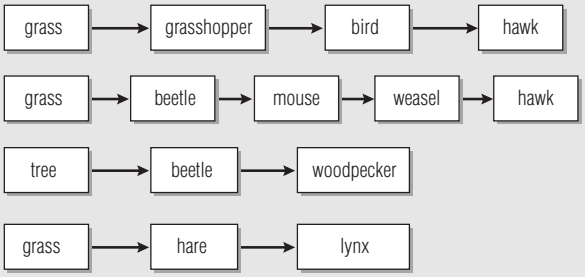
(b) The food chain that provides the maximum amount of energy for humans is shown below:



Because there is only one step in this food chain, the greatest amount of energy (about 10%) is passed to humans. The more steps that occur in the food chain, the less energy is passed on to organisms further along the food chain. This is because each transfer of energy results in a loss of energy to the environment as heat or waste.

7.

Sample food chains:



Pause and Reflect Answer

Every bit of food you eat is like eating sunshine because the energy you absorb from your food was initially energy from the Sun. Producers use this energy to create food. When consumers consume producers, a portion of this energy is transferred to them. When you consume producers or consumers as food, a portion of this energy, which initially came from sunlight, is transferred to you.

Other Assessment Opportunities

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

2.4 CYCLES OF MATTER IN ECOSYSTEMS

BACKGROUND INFORMATION

Excess nutrients can be harmful to an ecosystem, particularly in aquatic systems. Excess nutrients, such as nitrogen and phosphorous, result in a phenomenon known as eutrophication. Eutrophication is a consequence of algal overgrowth (an algal bloom) in aquatic ecosystems that keeps sunlight from reaching the lower levels of water. As a result, plants that live under the surface do not receive enough light to photosynthesize and they die. With all this dead plant matter available, the decomposer population grows so quickly that the dissolved oxygen in the water is soon depleted. Fish and other oxygen-requiring aquatic organisms die as a result.

COMMON MISCONCEPTIONS

- Some students may believe that nutrients are like geological minerals that are contained in rocks. They may have a hard time grasping that nutrients, as well as minerals, can be found in living organisms.

ADVANCE PREPARATION

- For Find Out Activity 2-4A, Round and Round It Goes, be sure to secure a source of tennis balls well in advance of starting the activity.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 60–61

Using the Text

To communicate the importance of nutrients to plant growth, grow plants in the classroom with and without fertilizers. Compare and discuss the differences that result.

Have students create a list of foods they typically eat in one day. Invite students to create food chains for some of these food items. Then, have students create nutrient cycles that include the organisms in these food chains. Remind students that decomposers, such as soil bacteria, play a role in nutrient cycles and must be added to their models.

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

TEACHING THE SECTION, pp. 61–62

Using Reading

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

Define the term "nutrient." Ask students to record their answers to the question "What do I know about nutrients in the environment?" Then, ask them to review their answer and record questions they have about nutrients, for example, what they are and why are they an important part of an ecosystem. Later, students can share their questions as a class and discuss the answers.

During Reading—Elaborative Interrogation

Have students generate "why?" questions from key points in the student book. For example: "All organism need nutrients." Question: "Why do all organisms need nutrients?" Have students review the student book to answer their own questions. Alternately, students can exchange questions.

After Reading—Reflect and Evaluate

Ask students to outline interesting information in this section and write a statement explaining why they found the information interesting. These can be shared in class discussion.

Reading Check Answers, p. 61

1. carbon and nitrogen
2. Nutrients are used to build and repair cells and tissues.
3. A nutrient cycle is a process that moves nutrients back and forth between the biotic and abiotic environment.

USING THE ACTIVITY

- Find Out Activity 2-4A, Round and Round it Goes, on page 62 of the student book is best used after students have read and discussed nutrient cycles on page 61.

Detailed notes on doing the activity follow.

Find Out Activity 2-4A

Round and Round It Goes, p. 62

Purpose

- Students model a nutrient cycle to illustrate how waste eventually becomes part of their food.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
Several days before	Gather materials.	For each group: – one tennis ball
1 day before	Review nutrient cycles and food chains.	

Time Required

- 40 min

Safety Precautions

- Remind students not to throw tennis balls around the classroom.

Science Background

During nutrient cycles, nutrients are stored for various periods of time in nutrient reservoirs, such as organisms, air, water, and soil. When nutrients cycle between reservoirs quickly, such as in the example provided in this exercise (from consumer to decomposer to soil to producer to consumer again), this is referred to as rapid cycling. Nutrients can also undergo slow cycling, where nutrients stay in reservoirs (e.g., as fossil fuels in rock) for long periods of time and are unavailable to organisms.

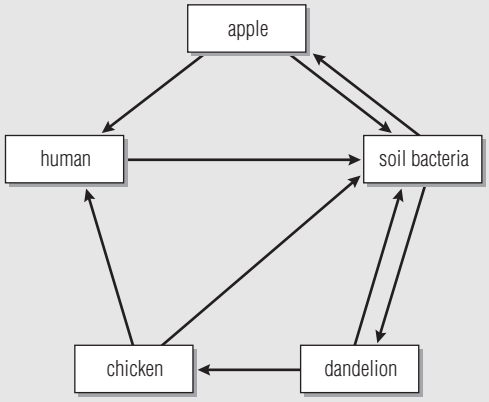
Activity Notes

- Arrange students into groups of five for this activity.

Supporting Diverse Student Needs

- You may want to ask students with reading difficulties to to read the story aloud to the group.
- This activity helps develop verbal-linguistic intelligence and is an excellent exercise for auditory learners.
- For enrichment, have students use a computer graphics program to illustrate the relationships between organisms in food chains and nutrient cycles. (ICT Option)

What Did You Find Out? Answers

1. The apple tree that the apple came from and the dandelion are producers. The student and the chicken are consumers. The soil bacteria are decomposers.
2. 

3. Two sample food chains are provided below. Accept any logical food chain.

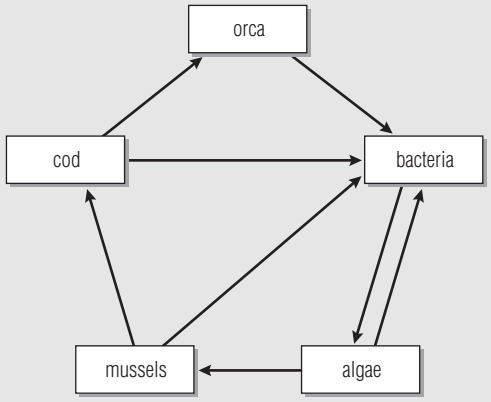
SECTION 2.4 ASSESSMENT, p. 63

Check Your Understanding Answers

Checking Concepts

1. Producers obtain nutrients from the soil, water, and air.
2. Consumers obtain nutrients from their food.
3. Decomposers break down dead tissues, cells, and waste matter, releasing nutrients into the soil, air, and water.
4. Nutrients are cycled between the biotic and abiotic environments via nutrient cycles.
5. The leaves in the picture contribute to the nutrient cycle in several ways. Some consumers consume the leaves, and in this way the nutrients stored in the leaves are passed along the food chain. They are also broken down by decomposers, which break down waste and dead organisms. This releases the nutrients into the soil, air, or water.

Understanding Key Ideas

6. A scavenger has probably consumed the body of the butterfly, as it is rich in nutrients.
7. 

8. The chemical may be absorbed by algae or other pond plants. Fish would eat the plants and absorb the chemical. The osprey would eat the fish, and the chemical would end up inside its body.
9. The cultivator would break up any plant material in the soil and increase the surface area of the plants that can be broken down by decomposers. Cultivation also breaks up soil clumps, releasing micro-organisms. Thus it would facilitate decomposition and increase the nutrient content in the soil, as nutrients from the dead plants would be released more quickly.

Pause and Reflect Answer

If organisms did not die, the nutrient cycles on Earth would grind to a halt because nutrients would remain trapped in the living organisms and not return to the environment.

CHAPTER 2 ASSESSMENT, pp. 64–65

PREPARE YOUR OWN SUMMARY

Student summaries should incorporate the following main ideas:

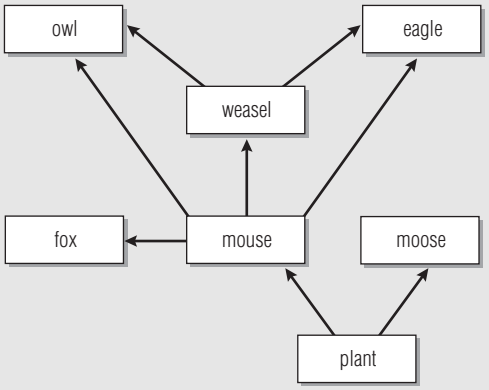
1. Symbiosis
   - Symbiosis is a biological interaction in which two species live closely together over time.
   - There are three main types of symbiotic relationships: parasitism, mutualism, and commensalism.
   - Parasitism is a symbiotic relationship between two species in which one benefits and the other is harmed.
   - Mutualism is a symbiotic relationship between two species in which both species benefit.
   - Commensalism is a symbiotic relationship between two species in which one benefits and the other is unaffected.
   - The population size of a predator species can affect the population size of a prey species, and vice versa.
2. Producers, Consumers, and Decomposers
   - Organisms can be classified based on what they eat and how they obtain their food. Producers such as green plants make (produce) their own food. Consumers such as insects and coyotes eat producers and/or other consumers. Decomposers break down dead and decaying matter.
   - Dead organisms and waste matter are a food source for scavengers and decomposers.
   - People protect food from decomposers by keeping them out of the food, by killing them or by stopping or slowing their growth.
   - Decomposers, such as yeast, break down sugars to produce alcohol and carbon dioxide gas via fermentation.
3. Food Chains
   - A food chain is a model that illustrates the transfer of energy from one organism to another in an ecosystem.
   - Producers occupy the first link in food chains.
   - The second link in food chains consists of consumers (herbivores or primary consumers) that eat producers.
   - The third link in food chains consists of consumers (carnivores or secondary consumers) that eat other consumers.
   - A food web is a complex model of feeding relationships that shows the interconnection of several different food chains.
4. Energy Transfer
   - After eating a meal, some of the energy consumed is stored in the bodies of organisms.
   - The remaining energy passes out of the body as unusable heat or waste.
   - Energy is lost with each consecutive transfer along a food chain.
   - An energy pyramid is a model that shows the gradual loss of energy in food chains.
5. Nutrient Cycles
   - Organisms need nutrients to build and repair their bodies.
   - Because there is a limited supply of nutrients available, nutrients are continuously re-used.

- The processes that move nutrients back and forth between the biotic and abiotic environment are called nutrient cycles.
- Decomposers play a key role in nutrient cycles.

CHAPTER REVIEW ANSWERS

Checking Concepts

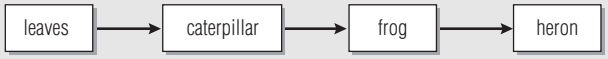
1. Three types of symbiotic relationships are mutualism, parasitism, and commensalism.
   - Examples of mutualism given in the student book include micro-organisms living in the guts of termites, and lichen (a species of alga and a species of fungus).
   - Examples of parasitism given in the student book include fleas, ticks, and lice, which live on their hosts, as well as tapeworms and roundworms, which live inside their hosts. More specific examples include the parasitic relationship between roundworms and caribou, and that between mistletoe and trees.
   - Examples of commensalism given in the text include the clownfish, which lives among the poisonous stinging tentacles of anemones. Barnacles living on whales are another example.

   Students may also use examples from their own experience.
2. A prey species may affect the population size of its main predator through changes in its own population size. For example, snowshoe hare is the main prey species of Canada lynx. If the size of the hare population decreases, for example, due to over-predation or lack of food, the population size of the lynx will decrease as well, as the lynx population has less prey to feed on and starvation would become a factor. If the size of the hare population increases, for example, due to reduced predation or abundance of food, the lynx population will increase as well, as prey is now abundant.
3. A food chain is a model that shows the transfer of energy from organism to organism. This differs from a food web, which shows the interconnection of several different food chains to produce a more complex model of feeding relationships.
4. An energy pyramid.
5. Owls are further along the food chain than mice. Each time energy is transferred from one organism to another along a food chain, some of it (about 90 percent) is lost as waste or heat. This lost energy is not available to organisms further along the food chain.
6. Scavengers eat decaying animals and waste materials. Decomposers break dead and waste materials down into their basic parts. They do not eat their food as scavengers do. Instead, they release chemicals that break apart dead tissues and cells and absorb the nutrients into their own cells. They are important in an ecosystem because they dispose of waste matter and dead organisms. Decomposers also return nutrients to the soil, air, and water when they break apart dead tissues and cells.
7. About 10 percent of the energy in your food is stored in your body. The rest of the energy in your food is lost as unusable heat or waste.
8. 

9. Plant—producer; mouse and moose—primary consumers/herbivores; weasel and fox—secondary consumers/carnivores; eagle and owl—higher level consumers/top carnivores.

Understanding Key Ideas

10. The food chain given is incorrect as it shows the caterpillar eating a frog. The correct food chain is as follows:

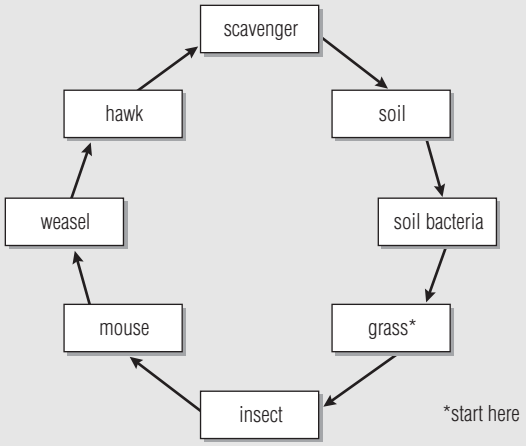


11. A typical student answer is shown below:

    Accept any reasonable answer.
12. There are only limited amounts of nutrients in an ecosystem, or on the planet for that matter.
13. Food chains generally have few large carnivores because there is less energy available to organisms that are further along a food chain. Each time energy is transferred from one

organism to another, some of it (about 90 percent) is lost as waste or heat. This lost energy is not available to the organisms higher on the food chain. Large carnivores are at the top of their food chains. Thus the energy available to them will only support a small number of individuals.

14. Moisture—drying or freeze-drying reduces the amount of moisture in food so that micro-organisms can't grow. Freezing, salting, and sugaring food also remove moisture.
    Warmth—keeping food cool in the refrigerator or frozen in the freezer reduces temperature to levels where micro-organisms cannot grow or survive, respectively.
    Oxygen—canning or vacuum sealing food removes oxygen so that micro-organisms cannot respire.
    Non-acidic conditions—pickling food in vinegar creates acidic conditions in which micro-organisms cannot survive.
15. One possible journey of a nutrient in a blade of grass as it passes through the nutrient cycle is as follows:



    Answers may be depicted as a flow chart or written in sentence form. Accept any reasonable answer.
16. (a) False. A tick and a deer have a parasitic relationship.
    (b) True.
    (c) False. Seaweed is a producer. Cod, spiders, and cats are consumers.
    (d) True.
    (e) False. There is less energy at the top of a food chain than at the base.
17. Your mass doesn't increase by the same amount because only about 10 percent of the energy you consume is incorporated into your tissues and cells. The rest is either used for respiration and lost as unusable heat energy or passes from your system as waste.
18. The manure contains waste from farm animals, such as cows, pigs, or chickens. Micro-organisms break down the waste and help make the nutrients available to the roses. The roses require the nutrients for growth and maintenance.

Pause and Reflect Answer

Plankton are producers. This means that they are the first step in their food chain and are able to produce food directly from sunlight. Because so much energy is available to them, their population can grow to an enormous size. Blue whales are primary consumers, and, therefore, consume about 10 percent of the energy assimilated by the plankton. By eating the large numbers of plankton available to them, the whales are able to attain their great size and weight. If the whales were further along the food chain, less energy would be available to them, as energy is lost with each transfer along the food chain.

CHAPTER 3 OPENER, pp. 66–67

USING THE PHOTO AND TEXT

The opening photograph of a forest fire provides an opportunity to introduce students to natural events and human activities that cause changes in ecosystems. You may wish to engage students in the topic through a visualization exercise, helping students imagine the effects a forest fire has on an ecosystem. A wide variety of nature CDs, including campfire sounds, is readily available. Organize students into four groups and assign each group a different organism, for instance, beetle, squirrel, moose, or robin. Play a selection from a campfire-sound CD and ask students to close their eyes. Have students imagine that they are their assigned organisms, experiencing a forest fire. Ask students to consider how each organism's regular pattern of life is disrupted, beginning at the earliest hints of a forest fire. This includes its interactions with the biotic and abiotic environment. (Mention to your class that most animals do survive forest fires.) After the visualization, ask a member of each group to share his or her visualization.

Alternately, you may want to discuss the questions presented in the opening text as a class or have students brainstorm the answers in groups. Ask your students if any of them have seen a forest fire before. If so, ask them to describe the scene. Where and when did the fire occur? Was it started by human activities, such as smoking or campfires, or did it begin as a seqence of a natural event, such as a lightning strike? These questions can act as a springboard to further discussions about other natural and human events that cause ecosystem change.

Encourage students to find examples of how they cause ecosystem change in their lives. Try to determine what changes each example would bring about. For instance, the land that students and their families currently live on was once a living, growing ecosystem. When it was cleared, the organisms living there perished, adapted, or had to find a new home. Challenge students to see how many connections they can make between their daily activities and the natural world.

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

Read What You Will Learn, Why It Is Important, and Skills You Will Use aloud with students, defining terms as needed. You may want students to brainstorm answers to the following questions:

- In what ways can a biological community change over time?
- How can human activities affect ecosystems?
- What are the pros and cons of conservation?
- How can we monitor the health of ecosystems?

The answers can help you determine students' prior knowledge of ecosystem change.

USING THE FOLDABLES™ FEATURE

Encourage students to complete this exercise as they read the chapter. Students can also complete a similar Foldable™ to compare primary and secondary succession, or to examine benefits and drawbacks of conservation efforts. See the Foldables™ section of this resource for additional information about this feature.

3.1 NATURAL DISTURBANCES AND SUCCESSION

BACKGROUND INFORMATION

In the past, many Aboriginal peoples lit controlled burns to maintain their root harvesting sites. In the 1940s, ecologists discovered that burning in controlled areas helped native seeds sprout, while killing invasive weeds. This was the beginning of modern day "prescribed burning." Today, many organizations advocate managed burns to maintain ecosystem health. Fires help forests by reducing fuel build-up, so that fires stay small, and by recycling nutrients that are held in detritus on the forest floor. As well, fires kill very young trees, leaving larger ones scarred but surviving, reducing competition for resources. Fires also leave behind stumps and snags that are important habitats for many animals. In Newfoundland and Labrador, heat generated by forest fires opens black spruce cones and releases the seeds, making this species a main player in ecosystem reforestation following a fire.

Ecologists now think that ecosystem disturbances are the norm rather than the exception. Whether disturbances are small, like a tree falling in a forest, or large, such as a forest fire, more light is allowed through the tree canopy, which benefits certain species. For instance, black spruce, the provincial tree of Newfoundland and Labrador, is a relatively shade-tolerant tree that flourishes after a small disturbance increases the amount of sunlight it receives.

COMMON MISCONCEPTIONS

- Students typically think in a much shorter time span than is needed to understand the concept of ecosystem recovery from natural disasters. As such, they may think ecosystem recovery takes a relatively short period of time. As a class, discuss how long it might take ecosystems to recover from vari-

ous natural disasters. Some recoveries, such as from a minor landslide, could take a few years. Others, such as areas affected by fire, could take decades.
- Students often have difficulty understanding that catastrophic events, such as fires, can have many benefits and, in fact, are necessary. Bringing frozen black spruce cones into the classroom will allow students to observe that adding heat enables them to open.

ADVANCE PREPARATION

- For Find Out Activity 3-1A, Modelling Succession in a Bottle, on page 69 of the student book, collect the required materials well in advance. Remind students to bring 2 L plastic soda bottles or large-mouthed jars to class several days before beginning the experiment. If the students bring in plastic bottles, cut the tops off the bottles in advance with sharp scissors or a retractable blade.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 68–69

Using the Text

To intruduce this section, have students brainstorm a list of natural events and human activities that can cause ecosystem change. Write the suggestions on the board as they are provided.

Have a class discussion concerning how various organisms are well adapted to the natural disasters that affect their ecosystems. For example, what characteristics would students expect to find in old trees that live in an avalanche zone? What characteristics could help organisms survive repeated drought?

Ask students what they think happens to an ecosystem after it has been disturbed by natural events or human activities. If possible, attempt to visit an overgrown vacant lot that is visibly undergoing succession. Using string and sticks, divide the lot into four quadrants. Divide students into four groups. Assign one quadrant to each group. Ask students to observe their quadrant for 10 to 15 minutes, recording any organisms they see in their notebooks. Upon returning to class, drawn a timeline on the board starting with "disturbance" and ending with the present. Ask students from each group to describe one organism they found to the class. After describing the organism, ask each student to explain when on the timeline he or she thinks the organism colonized the lot. For instance, a bird would not have arrived during the early stages of succession because it would have no shelter and nothing to eat. It could only come after plants, and possibly invertebrates and insects, had arrived. Continue asking students until they run out of organisms. Challenge students to create a complete timeline that shows the entire colonization of the lot over time. After the timeline is completed, ask students to write a short paragraph answering the question "Why do 'vacant' lots never remain vacant?"

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

USING THE ACTIVITY

Find Out Activity 3-1A

Modelling Succession in a Bottle, p. 69

Purpose

- Students create a mini-ecosystem and identify signs of succession.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Ask students to collect 2 L plastic soda bottles or large-mouthed jars. Contact an aquarium supply store to get aquatic plants. Collect other materials.	For each student: – 2 L clear plastic soda bottle with the top cut off or large-mouthed jar – potting soil – ruler – water – small aquatic plant – 50 mL wild birdseed mix
1 day before	Review succession.	

Time Required

- 6 weeks or longer (depending on student interest and depth of inquiry)
  Steps 1–3: 10–20 min
  Step 4: 5–10 min, the day after steps 1–3 are done
  Step 5: 10–20 min once a week, for as long as the activity continues
  Step 6: 5 min 2–3 times a week, for as long as the activity continues

Safety Precautions

- Students should wash their hands thoroughly after handling the materials in this activity.
- Safety eyewear, lab coats, and gloves must be worn in accordance with provincial safety standards.

Science Background

In this model of secondary succession, the bottle ecosystem is mimicking conditions that exist in an aquatic ecosystem that is evaporating as a result of reduced inflow. Over time, the water level falls and aquatic plants can no longer survive. Wildflowers and grasses from the wild birdseed mix sprout in the moist soil and replace aquatic plants.

Activity Notes

- Students can work in groups or pairs if space or time is an issue.
- Have students bring bottles to class several days before starting the activity. If the students bring in plastic bottles, cut the tops off bottles in advance with sharp scissors or a retractable blade.
- Provide tape or stickers so that students can identify their bottles easily.
- Review Science Skill 2, Designing and Conducting Experiments, with students prior to this activity.
- Provide students with Assessment Checklist 3, Designing an Experiment, to help them prepare for question 5.

Supporting Diverse Student Needs

- Special education students benefit from the hands-on nature of this investigation.
- This is an excellent activity for building naturalist intelligence, as well as visual-spacial and body-kinesthetic intelligence.
- For enrichment, invite students to take photographs of their ecosystems as they undergo succession and develop a display highlighting the important aspects of this process. If students use a digital camera, photos and information can be used in a computer presentation. (ICT option)

What Did You Find Out? Answers

1. (a) Before step 5, the ecosystem was very wet and there was an aquatic plant growing in it.
   (b) After step 5, the ecosystem was much drier. The aquatic plant died, but sprouts began to grow in the soil.
2. Students were asked not to add water in the initial part of this experiment because, at this stage, the experimental conditions were mimicking those that exist in an aquatic ecosystem that is evaporating as a result of reduced inflow. By not adding water, the ecosystem became drier with time, enabling succession to occur.
3. Similarities: The ecosystem contained both soil and water at the start and end of the activity. The same amount of light entered the container. Differences: The ecosystem was much wetter at the start of the activity and an aquatic plant was growing in it. At the end of the activity, the soil was moist, but not wet, and sprouts were growing in the soil.
4. Most students should find that the changes in their ecosystem modelled succession well because changes in ecosystem conditions were followed by changes in organisms. For instance, as the water evaporated, the ecosystem conditions were no longer suitable for the aquatic plant, and it died. As the soil got drier, wildflowers and grasses began to take its place, as the ecosystem became a suitable habitat for them.
5. Provide students with Assessment Checklist 3, Designing an Experiment, to help them design their own experiment.

TEACHING THE SECTION, pp. 70–72

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 how ecosystems can change overtime?" Then have them review their answers and record questions they have about the various ways in which ecosystems can change. Later, students can share their questions as a class.

During Reading—Elaborative Interrogation

Have students generate "why?" questions from key points in the text. For example: "Ecosystems are always changing." Question: "Why are ecosystems always changing?" Have students review the text to

answer their own questions. Alternately, students can exchange questions.

After Reading—Reflect and Evaluate

Have students select three facts that they found the most interesting from the section. They can then write a statement as to why they found the information interesting. Alternately, facts can be shared in class discussion.

Reading Check Answers, p. 71

1. In primary succession, the sequence of changes begins with bare rock. In secondary succession, the sequence of changes begins with a disturbed area (such as following a fire) in which soil, seeds, and in some cases, vegetation, remain. Undamaged biological communities usually surround the area.
2. Species that can establish themselves in areas with little or no soil and few nutrients are called pioneer species.
3. A climax community is a diverse group of species that forms a stable ecosystem that can remain relatively unchanged for centuries.

USING THE ACTIVITY

- Activity 3-1B on page 72 of the student book is best used after students have read the section on succession on pages 70–71.

Detailed notes on doing the activity follow.

Think About It Activity 3-1B

Secondary Succession From Beaver Pond to Bog to Forest, p. 72

Purpose

- Students describe the changes that occur during secondary succession by analyzing a series of diagrams.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 day before	Review succession.	None

Time Required

- 60 min

Science Background

Typically, a beaver actively maintains a dam for about 30 years. The stages of a beaver dam's existence are classified as new active, old active, and abandoned. In the new active stage, the dam is formed, along with a small pond. Trees flourish and wooded cover remains overhead. In the old active stage, the dam and pond both broaden. Little leafy cover is found overhead. In the abandoned stage the pond starts to fill in as the water level decreases, resulting in a bog. Herbaceous plants and shrubs are most prevalent. Eventually as succession continues and the site dries further, trees recolonize the area.

Activity Notes

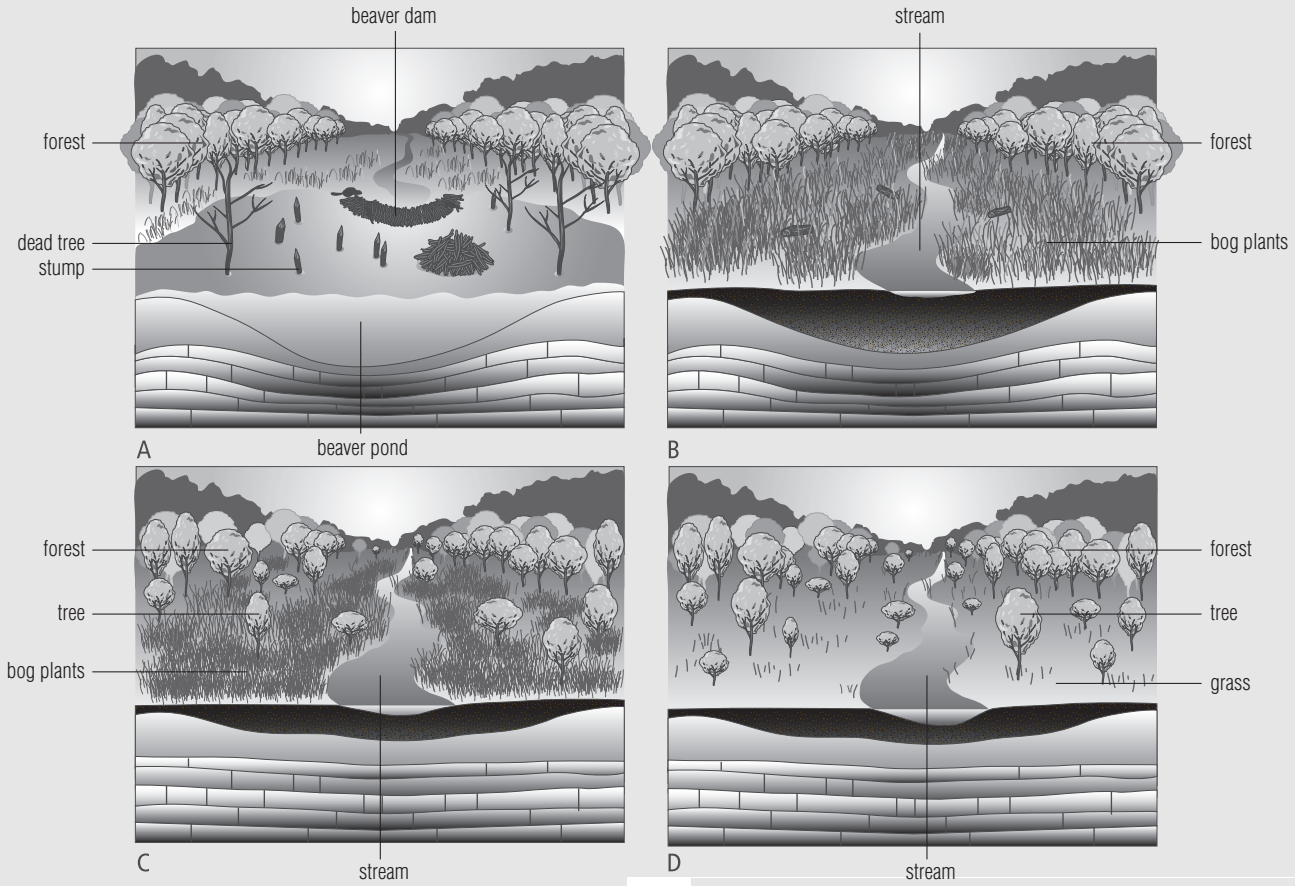
- Ask students if any of them have previously seen an area that was undergoing succession. If they have, ask them to describe the scene. Where and when did they see the area? What sort of organisms did they observe living there? Students may be surprised to learn that if they have seen an abandoned lot or field, they have seen an area undergoing succession.

Supporting Diverse Student Needs

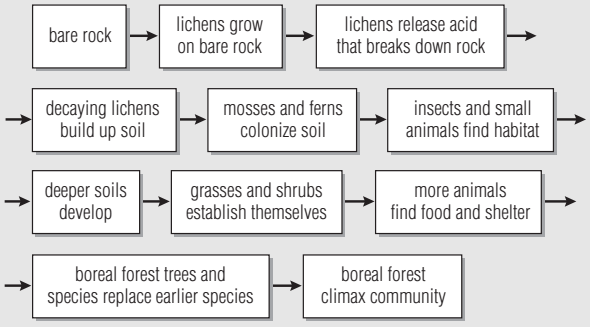
- Have academically weaker students struggling to complete the written descriptions work with a partner.
- Students with good naturalistic and visual-spatial intelligence will enjoy this exercise
- For enrichment, visit a local area where secondary succession is occurring, such as a vacant lot that has been overgrown with grasses and other herbaceous vegetation, and possibly some shrubs or young trees. Have students draw a series of diagrams similar to those shown for the beaver pond, illustrating the stages of secondary succession for this ecosystem. Have students compare their diagrams to those provided for the beaver pond and write a brief explanation of their similarities and differences.

What to Do Answers

1.



2. Stage A—The soil is covered by pond water. Plants include aquatic plants, stumps, dead trees in the pond, and living trees and other plants on the shore. Animals living in the pond include fish and other aquatic animals, as well as waterfowl. Songbirds and woodland animals live in the woods on the shore. There is full sunlight on the pond. The surrounding forest is shady.
   Stage B—The pond begins to evaporate and the edges fill in with soil, which is damp and bog-like. Bog plants replace pond plants. Fish and other aquatic animals may still live in the stream or bog. Animals that thrive in a bog, such as waterfowl, may flourish. There is full sunlight on the bog. The surrounding forest is shady.
   Stage C—The soil becomes drier as the bog starts to evaporate. Early trees and shrubs start to colonize the area. Full sunlight strikes the area.
   Stage D—The bog has dried up completely. Dead plants have built up the soil nutrient level and water retention, allowing more trees and shrubs to colonize the field, bringing along more birds and woodland animals. Shade levels increase as trees and shrubs grow larger.
3. The river's edge would represent the earliest stage of succession, as the soil here is still wet, resulting in bog-like conditions. Further from the stream, the soil becomes drier, allowing trees and shrubs to grow in the next stage of succession. Finally, you reach the forest, which represents the climax community that the rest of the ecosystem will eventually evolve to.
4.

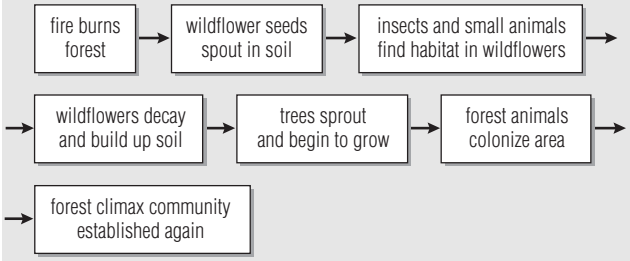


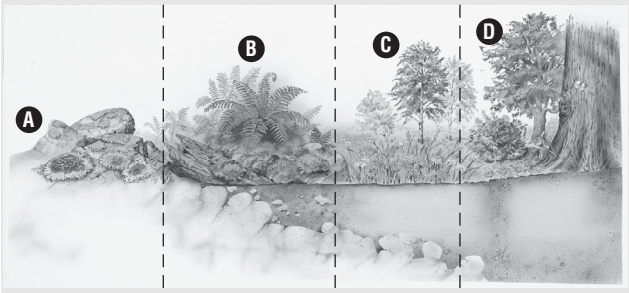
Primary succession begins with bare rock and no soil or nutrients. Pioneer species colonize the rock and break it down. Over time, dead organisms build up soil nutrient levels. In secondary succession, the soil and nutrients are already present. Seeds may also be in the soil. The area is usually surrounded by a mature ecosystem.

SECTION 3.1 ASSESSMENT, p. 73

Check Your Understanding

Checking Concepts

1. The process by which a biological community changes over time is called succession.
2. Student answers should include one example of a natural event (e.g., a landslide, avalanche, drought, flood, storm, tree falling, beaver dam, or forest fire) and one example of a human activity (e.g., logging, draining a bog, a prescribed burn, creation of a hydroelectric dam, or land clearance).
3. 

4. Lichen is a pioneer species because it can settle and grow on bare rocks as long as it has a supply of water and light, even if no soil or nutrients are present.
5. Two examples of climax communities provided in the student book are the northern boreal forest and the prairie grasslands. The northern boreal forest can be found in the northern reaches of all Canadian provinces other than PEI, New Brunswick, and Nova Scotia. Prairie grassland can be found in Alberta, Saskatchewan, and Manitoba. Students may also provide examples from their own knowledge base.
6. 

A Lichens grow on bare rock. They produce acids that start to break down the rock. Particles of rock and decaying matter from dead lichens begin to form soil.

B The resulting soil is thin and does not have many nutrients. However, plants such as small mosses and ferns can tolerate these conditions. The plants and soil create habitats for insects and other small animals.

C Organisms add more decaying matter and build up the soil. Deeper soils hold water and allow grasses and other plants to grow. More species of animals find food and shelter.

D Taller shrubs create shade. Their deep roots help stop soil erosion. Different communities of plants and animals replace earlier ones. Bushes and trees provide niches for a greater diversity of species.

Understanding Key Ideas

7. You might find evidence of aquatic organisms that lived in the area during earlier stages of succession in the deeper layers of soil.
8. Students should predict that the field would have more shrubs and possibly some trees on it after several more years, as well as an increased number of small animal species. These changes would occur because, over the years, dead plants would continue to add more decaying matter to the soil. These deeper soils hold more water and nutrients, allowing more shrubs and trees to grow. Bushes and trees provide niches for a greater diversity of animal species, which find food and shelter in the ecosystem.
9. Sample answer 1: A beaver creates a pond, which supports the growth of aquatic plants. The increased number of plants attracts waterfowl to the area.
   Sample answer 2: In primary succession, lichens produce acid that break down bare rock. Decaying matter from dead lichens build up soil. Mosses and ferns tolerate these conditions. They create habitat for insects and small animals. Trees and shrubs grow in the deeper soil, providing increased shade and niches that support a greater diversity of species.

Pause and Reflect Answer

Most students will argue that we should be concerned with the destruction of ecosystems, no matter whether the cause is natural or human in origin. Ecosystem recovery from natural and human events can take a long period of time. For instance, an area affected by fire could take decades or longer to recover. When an ecosystem is destroyed, valuable habitat is also destroyed. Such loss of habitat could further endanger species that are already threatened. Additionally, valuable human resources, such as timber, tourism, or recreation, could be affected by the loss for many years.

Other Assessment Opportunities

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

3.2 THE IMPACT OF PEOPLE ON ECOSYSTEMS

BACKGROUND INFORMATION

In the last century, we were not as aware of our impact on Earth as we are today. People hunted species like the passenger pigeon, at one time the most numerous bird in North America, into extinction. If the passenger pigeon were an endangered species today, there would be a campaign—including strict controls on hunting and habitat preservation—to save it. Despite what we have learned about overhunting, the rate of extinction is still increasing.

In Canada, the national list of wildlife species and populations at risk is determined annually by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The designations for species include: extinct (no longer exists anywhere in the world); extirpated (no longer found in some locations but still found in others); endangered (extinction or extirpation is imminent); threatened (likely to become endangered if no action is taken); special concern (especially vulnerable to ecosystem changes but not threatened). In Newfoundland, the great auk, known as "the penguin of the north," was extirpated in 1800. This large flightless bird, which had lived in large numbers on the coast of Newfoundland, was an easy target for hunters. The last great auk was killed in Iceland in 1844, and the species is now extinct. The Newfoundland wolf, a unique subspecies of wolf found only on the island of Newfoundland, became extinct in the early 20th century. The reason for its extinction is still not completely clear.

Over the last few decades, introduced species have begun to pose an increasing threat to native species in Canada. In 1995, the CNF (Canadian Nature Federation) sponsored their Lady Beetle Survey as part of a program called Endangered Plants and Invertebrates of Canada (EPIC). By keeping track of lady beetles for a five-year period, scientists were able to determine that native populations have declined as non-native numbers (those introduced as a means of biological control) have increased. The recent arrival of the European green crab, an invasive species that is capable of decimating local shellfish populations in Newfoundland waters, has also given rise to concern. The crab, which can be identified by five spines on the top front edge of each side of its shell and flattened rear legs (other native crab species are also green), likely found its way into Newfoundland waters by catching a ride in ballast water from oil tankers.

COMMON MISCONCEPTIONS

- A species can be native to a country but non-native to a region. Students may be confused to learn that moose, a common animal indigenous to Canada, is actually exotic to Newfoundland.

ADVANCE PREPARATION

- For Find Out Activity 3-2A, Mapping Your Home, on page 75 of the student book, secure a source of one or more sample maps (if using) several days before starting the activity. You may also wish to book library or computer resources in advance in case students require further research to complete this activity.
- For Think About It Activity 3-2B, The Pros and Cons of Conservation, on page 83 of the student book, schedule dates of class presentations and book a computer and projector for students doing computer slideshow presentations well in advance.
- For Find Out Activity 3-3C, Checking the pH, on page 83 of the student book, you may want to take students to collect water samples a day (or more) before completing this activity.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 74–75

Using the Text

This section lends itself to learning through discussion and debate. Have students scan newspaper or magazine articles for several weeks before discussing this section of the student book. Ask them to cut out articles that relate to human impacts on ecosystems. If possible, find a current local concern. This should start a lively discussion.

Draw students' attention to the photographs in Figure 3.5. Ask students to brainstorm how growth of their own town or city may have affected ecosystems in the local area. If possible, bring in photographs of the region that were taken early in its history, or visit a museum where such images are displayed.

Ask students to consider the impact of human activity on ecosystems as they read the opening pages of this section. You may wish to introduce and discuss the term "ecological footprint." (An ecological footprint is the corresponding area of productive land and aquatic ecosystems required to produce the resources used, and assimilate the wastes produced, by a defined population at a specified material standard of living.) Have students research the ecological footprints of various nations (including Canada), comparing other nations' footprints to Canada's. In general, what types of nations have smaller ecological footprints? Which have larger ones? Most likely, students will conclude that developing countries have much less effect on the environment than developed countries. However, this situation changes quickly as developing countries try to "catch up" to the quality of life in developed countries.

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

USING THE ACTIVITY

Find Out Activity 3-2A

Mapping Your Home, p. 75

Purpose

- Students draw a map of the ecosystem around their home to learn more about their natural surroundings.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Book library or computer resources	For each student: – a large sheet of paper – coloured markers
1 day before	Gather materials.	

Time Required

- 40 min (longer if research is required)

Science Background

City dwellers frequently know very little about the ecosystems that surround them. The source of their drinking water or destination of their garbage is often the tap and the garbage truck, respectively. In comparison, rural inhabitants often have extensive knowledge of their ecosystem.

Activity Notes

- Help students visualize their task by preparing and posting a sample map.
- Emphasize that the purpose of this exercise is not to make great works of art. The goal is to collect and place the appropriate information on the maps.
- To wrap up the activity, have students share their completed maps in small groups. Discuss which, if any, questions students had difficulty answering. Ask for volunteers to share their maps with the class. Encourage students with unique maps to share their maps and explain them.
- You may wish to book library or computer resources in advance in case students need to conduct further research to complete the activity.

Supporting Diverse Student Needs

- Encourage Pathway 3 students and students with weak verbal-linguistic intelligence to share and explain their maps.
- This activity helps build both intrapersonal and interpersonal intelligence.
- For enrichment, you may want to have students use graphics software to prepare their maps. (ICT Option)

What Did You Find Out? Answers

1. Ask students to answer this question with specific references to the details they included on their map.
2. Some possible ways that students can increase their understanding of the environment in which they live:
   – explore their neighbourhood (nature walk)
   – spend more time outdoors
   – research their natural community using library resources or the Internet, or by talking to long-term community members and Elders
   – talk to sewage treatment or water purification workers in their community
   – join a local environmental stewardship group
   – follow environmental articles or a nature column in their local paper
3. Some possible ways that students' daily activities could affect the natural community around their home:
   – local food that they consume may be grown with pesticides and fertilizers that harm the local natural community, or they may be grown in a sustainable fashion that protects this community
   – food and consumer goods they buy that are not local are transported to the community, usually by air and truck, increasing air pollution in the local natural community
   – waste that they dispose of may be transported to a landfill where pollutants leach into the soil
   – composting wastes helps reduce the impact of waste on the local natural community
4. Possible answers: counting the number of a species on a regular basis; taking a survey to determine the biodiversity of the ecosystem; using radio tags or callers to monitor movement of animals within the ecosystem; using tags to determine the number of fish in bodies of water; using aerial photos to track the movement of large mammals; analyzing tissues of dead animals for pollutants.
5. Students may suggest that ecologists could study the species in the ecosystem by counting them and observing their health, behaviour, and range over a long period of time, and comparing the findings from one year to the next. Similarly, data on environmental conditions in the ecosystem could be maintained over years and compared to see if any changes have occurred.

TEACHING THE SECTION, pp. 76–84

Using Reading

Pre-reading—Key Word Concept Maps

There are a large number of new terms in this section. Before they begin reading, have students read the Key Terms and review those that require clarification. During reading, terms can be linked to text.

During Reading—GIST

Have students read the text under each section heading and summarize the ideas presented in the text. Challenge students to reduce each passage to just twenty words that capture the gist of the text.

After Reading—Semantic Mapping

Use semantic mapping to help students organize and recall the information presented in this section. Have students begin by using the student book headings to identify the core concepts covered in the unit. Next, ask students to create a semantic map for each core concept by linking ideas that clarify and provide further explanation to each concept with a series of lines.

Reading Check Answers, p. 79

1. Water, oil, metals, lumber, fish, and land are examples of natural resources mentioned in the student book.
2. A species is extinct when there are no longer any living individuals of that species anywhere in the world. A species is endangered when it has such a low population that it is nearly extinct.
3. A native species is a wild species that has lived in its environment since before humans settled the land. An introduced species is a species that has spread beyond its natural range into new locations as a result of human activities.

Reading Check Answers, p. 81

1. Renewable resources are resources that grow and reproduce in a fairly short time to replace those taken from the environment. For instance, fish are a renewable resource if they are not overharvested. Eventually, as the remaining fish in the population reproduce, they will replace those that were caught. Similarly, if trees are cut down in the forest, eventually new trees will grow in their place.
2. When renewable resources are renewed as quickly as they are used, their use is sustainable. A resource that is harvested at a sustainable rate can be used year after year, indefinitely, without danger of disappearing.

3. When resources are harvested faster than they can be renewed, their use is considered to be unsustainable. Overharvest due to high demand, wasteful practices, or lack of conservation measures can make harvesting a resource unsustainable.

Reading Check Answers, p. 82

1. When people grow crops as a monoculture, they often have to use more pesticides on the crop, as a single crop planting may be inundated with insects more easily than a mixed planting. These pesticides can pass from insects into food chains, where they may kill other organisms such as birds and frogs.
2. Pollutants are substances that cause harm to the air, soil, water, or living things.
3. Burning fossil fuels produces waste gases that contain sulfur and nitrogen. These pollutants combine with water vapour in the atmosphere to produce acids. The acids fall in precipitation as acid rain.

Using the Did You Know?

The Did You Know? on page 78 of the student book draws students' attention to the fact that twenty species in Newfoundland and Labrador are endangered, threatened with extinction, or of special concern because they are sensitive to human activities and natural events. These species are now protected under the province's *Endangered Species Act*. Of the twenty species, the Newfoundland marten, piping plover, wolverine, Eskimo curlew, Longs braya, and barrens willow are endangered. Consider dividing students into six groups and assigning each group one species to research to determine why it is endangered and what measures are being instigated to protect it.

On page 79, the Did You Know? feature discusses the fact that about half the mammals on the island of Newfoundland are introduced species. Students may wonder how, in fact, moose got to Newfoundland. The story of their introduction focusses on one man, a hunter named John Connell, who led the group that brought moose from the Miramichi forests in New Brunswick via sled and train to stock the forests of Newfoundland. All the moose currently found in Newfoundland (over 100 000) are related to this original group of four (two bulls and two cows) travelling moose.

Waste oil dumped from ships kills over 300 000 seabirds annually off the coast of Newfoundland and Labrador (Did You Know? page 82). Seabirds die when they consume the oil as they try to clean it from their feathers. It can also enter their lungs. When seabirds get oil stuck in their feathers, the outer feathers mat and cold water soaks the down beneath them. As a result, the birds quickly die from hypothermia. Seabirds may also be dragged down by the excess weight of oil on their feathers.

USING THE ACTIVITIES

- Activity 3-2B on page 83 of the student book is best used as a wrap-up activity for Section 3.2.
- Activity 3-2C on page 83 of the student book is best used after students have read the section on acid rain on page 82.

Detailed notes on doing the activities follow.

Think About It Activity 3-2B

The Pros and Cons of Conservation, p. 83

Purpose

- Students research a local issue involving the conservation of natural resources and defend their position on the issue through various media.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1–2 weeks before	Schedule dates of class presentations and book computer and projector for students doing computer slideshow presentations.	Computer and projector, if required
1 day before	Review habitat loss, endangered and introduced species, overharvesting, and the impact of pollution.	

Time Required

- 30 min to introduce activity
- 1 week for independent research
- Several hours for presentations

Science Background

Some conservation initiatives have surprisingly more cons than people realize. For instance, ecotourism is an extremely lucrative part of the tourism industry. Although encouraging people to visit, rather than exploit, sensitive regions such as Antarctica or rainforests, has obvious immediate advantages, the long-term impact of growing numbers of people on such regions remains to be seen. Another example of an initiative with strong cons is the establishment of wildlife

corridors , which benefit only certain species in an ecosystem. They can also promote inbreeding and population fragmentation, which can lead to decreased genetic variation. Disease also can spread more easily along wildlife corridors than it would among an isolated population of the same species. Because the decision to establish a preserve for ecotourism or to maintain a wildlife corridor in a region that would benefit from human development can be an extremely costly one, it is important to have a clear understanding of the factors at play.

Activity Notes

- Have a brainstorming session with students after you introduce the activity to come up with possible local issues that involve the conservation of resources. Alternately, divide students into groups and ask them to brainstorm ideas. Each group should assign one student to act as recorder. Have students compare their results by asking each group to share their answers with the class in turn.
- Consider inviting a town or regional councilor to speak to your class about how the local council investigates and weighs both sides of issues that involve the conservation of resources before giving new projects the go-ahead.
- This activity lends itself well to working in partners.
- Be sure to limit time for student presentations.

Supporting Diverse Student Needs

- Pair academically weaker students who may have difficulty conducting research on their own with a partner who is interested in researching the same issue.
- Students who are weak in logical-mathematical intelligence may have difficulties assessing pros and cons in this activity.

What Did You Find Out? Answers

1. Student presentations should clearly identify how the issues they researched involve the local conservation of resources and present the pros and cons of conservation in each specific case. Depending on the form the presentations take, Assessment Checklist 9, Oral Presentation; Assessment Checklist 10, Computer Slide Show Presentation; and Assessment Checklist 11, Poster may be helpful in assessing student presentations.

Find Out Activity 3-3C

Checking the pH, p. 83

Purpose

- Students test the pH value of water samples collected from different sources.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1 week before	Gather materials.	For each student: – clean collecting jars with lids – labels – samples of rainwater – samples of pond or river water – sample of tap water – pH indicator paper
1 day before	Review acid rain.	

Time Required

- Several hours to collect samples
- 20–40 minutes to complete pH testing, depending on number of samples

Safety Precautions

- Remind students to use caution when collecting samples from ponds or rivers.
- Students should clean their work area and wash their hands after completing this activity.
- Safety eyewear, lab coats, and gloves must be worn in accordance with provincial safety standards.

Science Background

Rain is normally slightly acidic, with a pH between 5.6 and 5.7, because atmospheric carbon dioxide dissolves slightly in rainwater to produce carbonic acid. Acid rain occurs when the products of burning fossil fuels (sulfur oxides and nitrogen oxides) react with water in the atmosphere to produce various strong acids, including sulfuric acid and nitrous acid. Acid rain may have a concentration of acid 1000 times higher than that of normal rainwater. In many regions in Canada, alkaline, limestone-containing rock and soil act as a natural buffer against acid rain, as the calcium carbonate in the limestone neutralizes the acid. The lack of such natural buffers in the granite-containing rock found in the Canadian Shield covering much of eastern Canada, including Newfoundland and Labrador, results in higher acidity in water bodies in these regions, affecting the health of various aquatic organisms.

Activity Notes

- This activity works well if done in groups.
- You may want to collect water samples with students a day or more before completing this activity.
- After the activity is finished, discuss the results with students. Was the pH of the water samples close to that of pure water? Was the pH of all the water samples the same? If not, try to determine why any differences exist. What factors might affect the pH of water at different locations?

Supporting Diverse Student Needs

- This is a very good hands-on activity for developing visual-spatial intelligence.
- For enrichment, have students research different factors that could affect the water in their community.

What Did You Find Out? Answers

1. Students will likely find that water samples taken from their neighbourhood are somewhat acidic.
2. Drinking water parameters attempt to maintain the pH of tap water within the range of 6.5–8.5; however, many localities will have tap water with a pH that falls outside these parameters. Areas of the province that receive their water supply from a watershed that has a large number of bogs frequently have drinking water with low pH levels (the pH of bog water is 3–4).
3. Student answers should reflect their observations in this activity. If most samples had a low pH, students could reasonably assume that their area has been affected by acid rain. However, note that water samples taken from a bog would be naturally acidic.

USING THE FEATURE

Science Watch: Protecting the Limestone Barrens, p. 84

This feature provides an opportunity to introduce students to an ecologically sensitive area in Newfoundland and Labrador where various endangered and threatened species are found. The activities below can act as a springboard for further discussion about the need for conservation and species protection in the province.

- If possible, arrange a class field trip to the Limestone Barrens.
- In small groups, ask students to discuss question 2, "Do you think it is important to save unique places like the Limestone Barrens? Why or why not?" Afterwards, have one student from each group share their group's opinion and reasons for their choice with the class.
- Have students research the Limestone Barrens in greater detail using the Internet. In small groups, have students create an information campaign designed to help protect the region. This could be in the form of a poster, computer slide show presentation, a brochure, or other type of communication media. (ICT Option)
- Have students prepare a report on how the Limestone Barrens Habitat Stewardship Program (LBHSP) has helped protect this fragile habitat.

Science Watch Answers

1. Calciphiles thrive in the calcium-rich soil, despite the harsh environmental conditions.
2. Accept any well-supported answer.

SECTION 3.2 ASSESSMENT, p. 85

Check Your Understanding

Checking Concepts

1. Possible suggestions include the following: increased human population, greater use of land, higher standard of living, more advanced technology.
2. Possible answers include the following: land clearing for farming, building roads, or urbanization; industry such as logging, mining, oil drilling, manufacturing, and fishing; building dams; draining bogs; creating pollution via transportation and industry; dumping garbage and hazardous waste; outdoor recreation; introducing non-native species.
3. Habitat loss, overharvesting, pollution, and introduced species.
4. Species interact within a biological community. If one species becomes extinct, it will have a direct impact on other species that are linked to it as a predator or prey species. It will also have an indirect impact upon other species in the same food chain.
5. Introduced species are species that have spread beyond their natural range into new locations as a result of human activities.
6. Fish reproduce in a fairly short time to replace those taken from the environment.
7. Sample answer: Unsustainable harvesting refers to using resources faster than they can be renewed, resulting in a shrinking supply of resources. For instance, when fish are harvested in such large numbers that they cannot renew their population, they are being unsustainably harvested.
8. Possible answers include the following: farming, building roads, logging, mining, oil drilling, manufacturing, fishing, building dams, use of transportation, dumping garbage and hazardous waste, outdoor recreation, heating homes.

9. Possible natural disturbances include the following: flood, forest fire, storm, drought, volcanic eruption, tsunami, glaciation, beaver dam, fallen tree, avalanche, landslide. Possible human disturbances include the following: land clearing for farming, building roads, or urbanization; industry such as logging, mining, oil drilling, manufacturing, and fishing; building dams; draining bogs; use of land for outdoor recreation; introducing non-native species.

Understanding Key Ideas

10. None of the technologies shown are essential for survival. The car uses gasoline and oil to run, as well as electricity. It also uses land indirectly as roads are built for cars to drive on and factories are constructed to produce cars. Further, metals are mined to make car bodies. The refrigerator and computer use electricity to run, as well as land and metals. Fossil fuels may also be used to manufacture these items.
11. Only one type of tree is grown at one time on the plantation.
12. Most species cannot survive if their habitat is destroyed.
13. (a) Because the species of wildflower grows only in the wetland, it must require a wet habitat to survive. If a building project nearby has been draining parts of the wetland and filling other areas with dirt, it may be directly responsible for the decline of the plant population because it is altering the plant's habitat.
    (b) The company constructing the project could put conservation measures in place that protect the wildflower's habitat while allowing the building to continue. For example, they could designate the wetlands protected and stop altering the ecosystem with their building practices. The company could also move the project to a less ecologically sensitive area.

Pause and Reflect Answer

Humans rely on a lot of species for natural resources, food, and medicine. Thus, we should be concerned about the extinction of species, as it will only hinder our own welfare. Students may also question whether humans, as the globally dominant species, should protect species rather than allow them to go extinct due to our activities. Species do go extinct naturally, but this does not mean it is acceptable for us to accelerate this rate for our ends. Some students may be aware that extinctions are currently occurring at an extremely high rate, a rate that has only been matched five times in the past. When such mass extinctions occur, ecosystems become less stable and species change is inevitable. Thus, at the current rate of extinction, humans may be altering life on this planet to such an extent that, over time, we may not be able to survive the changes ourselves.

Other Assessment Opportunities

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

3.3 MONITORING AND MANAGING ECOSYSTEMS

BACKGROUND INFORMATION

Canadian citizens carry out various plant and wildlife monitoring programs each year. Your students may be interested in learning more about these programs, a few of which are summarized below:

The Christmas bird counts originated in 1900 when Frank Chapman, a leading ornithologist and editor of "Bird-Lore," wanted readers of the publication to start a new Christmas holiday tradition of counting birds instead of shooting them. Previously, the Christmas tradition involved people divided into two teams with each "side" trying to kill the most birds. Many participants became concerned about the indiscriminate killing and the dwindling numbers of some types of birds. On that first Christmas bird count, 27 participants were involved in 25 different bird counts in North America. A total of 90 species were counted. Today, the Christmas bird counts continue and are the ultimate source of information about early-winter birds. For more information, contact the National Audubon Society.

The Canadian Wildlife Federation sponsors the coast-to-coast butterfly survey. To participate, you simply spend time in a garden, park, or near a porch light and report your sightings of butterflies and moths. The status of moth and butterfly populations is an especially good indicator of the health of insect habitats. For further information, contact the Canadian Wildlife Federation.

FrogWatch and PlantWatch are part of a monitoring program that identifies ecological changes that may be affecting our environment. Both programs allow participants to discover how and why our natural environment is changing. Frogs are more susceptible to environmental changes than other organisms

as a result of their amphibious life cycle, permeable skin, UV sensitivity, and climate sensitivity. Spring is the best time to monitor frogs because that is when they make their way to breeding ponds and males begin calling. FrogWatch participants are encouraged to listen at a pond on a number of evenings over the calling season. In the PlantWatch program, participants track spring flowering times of up to eight plant species common to North America. Participants learn how the weather affects bloom times of these species in their area, thereby indirectly monitoring climate change. For more information about either program, contact the Canadian Nature Federation.

Monitoring is extremely important in determining large-scale environmental change such as global warming. All the major extinctions in the past, including the extinctions at the end of the last Ice Age, have been associated with widespread climate change. Global warming is thought to change rainfall patterns, resulting in widespread flooding or droughts. Increased temperatures have already caused the polar ice caps to shrink at a rate of 10 percent per decade since 1980. They may also result in changes in ocean circulation patterns. Students may be interested to learn that since 2004, a team of scientists from the National Oceanography Centre in the United Kingdom has been using a novel method to measure the rate of Atlantic thermohaline circulation. Thermohaline circulation drives the massive system of ocean currents, including the Gulf Stream, which conveys warm tropical waters to the North Atlantic, moderating European temperatures. This new observation system monitors ocean flow with moored instruments, rather than the ship-based measurements used in the past. A total of 22 monitors were moored on the floor of the Atlantic Ocean to conduct the experiment. Anchored to the seabed by cables up to 5000 metres long, the monitors continuously measure ocean temperature, salinity (salt levels), speed, and pressure. The early results of the group's research show a 30 percent decrease in ocean flow. It is estimated that a flow rate reduction of this magnitude could cause temperatures in Europe to fall several degrees within the next 20 years.

COMMON MISCONCEPTIONS

- Students may be surprised to learn that volunteers play such a large role in long-term monitoring projects. They often mistakenly believe that only trained scientists can complete environmental monitoring.

ADVANCE PREPARATION

- For Think About It Activity 3-3A, Modelling an Environmental Impact Assessment, on page 92, if asking students to bring in articles, be sure to remind students to start their search a few weeks before starting the activity.
- Consult the Unit front matter for a list of BLMs that can be used when teaching this section.

INTRODUCING THE SECTION, pp. 86–87

Using the Text

Discuss Figure 3.15 on page 86 as a class to illustrate the different types of ecosystem monitoring. Ask students if they have ever participated in any type of ecosystem monitoring. Perhaps some of your students are involved in bird watching or a similar activity. Discuss with students the various volunteer monitoring programs that are mentioned in the Background Information for this section. Students who are interested in voluteering to become involved in a monitoring program can also be directed to www.discoveringsicence.ca for relevant links.

As a means of introducing students to the four main types of environmental monitoring depicted in Figure 3.15 on page 86, try the following activity. Divide students into small groups. Ask students to create an environmental monitoring plan for a local ecosystem of their choice using the four types of environmental monitoring shown in Figure 3.15. Have students give a brief presentation explaining how they would use each type of monitoring to detect environmental change.

Using the Key Terms and Section Summary

At the beginning of each section in the student book 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 terms listed in 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 useful 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 1-2, Unit 1 Key Terms listing all the terms listed in the unit can be used to assist students.

Using the Did You Know

The Did You Know on page 87 refers to bacteria that live near hot volcanic vents on the sea floor or in hot springs. They use energy in the bonds of certain chemicals to produce carbohydrates through chemosynthesis. Chemosynthetic bacteria living on the sea floor were first discovered in 1977 around volcanic vents on the seabed near the Galapagos Islands. The water coming from these vents is acidic and very hot; however, regardless of these harsh conditions, chemosynthetic bacteria are able to support an entire ecosystem of unique aquatic organisms in the vicinity of the volcanic vents. Over 300 new species have been discovered in deep-sea vent communities. These include such unique organisms as giant tubeworms (*Riftia pachyptila*), which grow to be several metres in height, and a variety of smaller sea worms. Other organisms that make up the ecosystem include blind shrimp with super-sensitive receptors that detect dim light and heat, along with various clams, crabs, and mussels. Even octopuses have been found in deep-sea vent ecosystems—all thriving on the ocean floor without sunlight.

TEACHING THE SECTION, pp. 88–92

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

Encourage students to take notes as they read through each chunk. They can use the topic titles 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. Alternately, facts can be shared in class discussion.

Reading Check Answers, p. 89

1. Physical, atmospheric, biological, and chemical.
2. Baseline data are measurements that form a starting point from which later changes can be monitored. For instance, scientists might count the average number of trees per hectare in a forest. If a forest fire occurs, they can use this data as baseline data, together with the size of the area burned, to estimate the number of trees that were destroyed or to determine if the number of trees growing after a fire is greater, smaller, or the same as before the fire. Essentially, any population count or ecosystem observation can be used as baseline data if the observations are made before ecosystem change occurs.
3. Populations may change naturally from year to year. As a result, in order to discover if the environment is changing in a significant way, it is necessary to carry out long-term monitoring over a period of many years.
4. Surveys in which individual organisms are counted are commonly used to monitor the size of animal populations, specifically via manual counts, aerial photographs, tags, leg bands, or radio collars. Students should mention one specific method in their answers.

Reading Check Answers, p. 91

1. After wolves became extinct on the island in the 1920s, there were no natural predators to control the moose population.
2. Groups mentioned in the student book include The Conservation Corps, World Wildlife Fund, Canadian Parks and Wilderness Committee, and the David Suzuki Foundation. Students may choose other groups from their own experience.
3. It is important to be able to predict changes to ecosystems so that we can make reasonable predictions about the impact of human activities upon them.
4. An environmental impact assessment is a report that outlines how an activity will affect the environment.

Using the Did You Know

The Did You Know on page 91 introduces West Nile virus which is spread by mosquitoes that have bitten infected birds. The virus is carried by over 150 species of birds. In humans, the virus may cause no symptoms upon infection, while some individuals come down with flu-like symptoms. In some cases,

the virus may cause serious illness and even death. Ten different species of mosquito carry the virus in Canada, although only 1 percent of the mosquitoes in a given area will typically be carriers. Although scientists do not believe West Nile will become a serious problem in Newfoundland and Labrador, surveillance programs are in affect in the province.

USING THE ACTIVITY

- Activity 3-3A on page 92 of the student book is best used as a wrap-up activity for Section 3.3.

Detailed notes on doing the activity follow.

Think About It Activity 3-3A

Modelling an Environmental Impact Assessment, p. 92

Purpose

- Students model an environmental impact assessment.

Advance Preparation

WHEN TO BEGIN	WHAT TO DO	APPARATUS/MATERIALS
1–2 weeks before	Book computer room or library for student research.	None

Time Required

- 30–40 min to introduce the project, select topic, and agree on roles
- 2–3 hours to complete research and create presentations
- 1–2 hours to give presentations

Science Background

An environmental impact assessment is a report that predicts the environmental effects of a proposed action. The environmental impact assessment is released to the public and other agencies for comment and review. The purpose of the assessment is to ensure that decision makers consider all environmental impacts of a potential project before a ruling is made on whether to proceed with the project. Environmental impact assessments were first conceived in the United States in 1970, with Canada quickly adopting their use in 1973. The province of Newfoundland and Labrador created one of the earliest provincial review processes for assessments by establishing its *Environmental Assessment Act* in 1980.

Activity Notes

- A few weeks before beginning this activity, ask students to begin scouring local newspapers and media for articles identifying local projects that involve a conflict over land or water use. Have students bring the articles to class. After reviewing the articles, choose several to share with students. Have students vote on the issue they would most like to use for this activity. If possible, visit the (potential) project site.
- If time is limited, research can be completed independently of class time.
- Students have likely heard about some land development and the impact it has, or might have, on the environment. This is a natural springboard for discussion of the value of environmental impact assessments. Ask students why they think environmental impact assessments are so important. Discuss who conducts the assessment—a neutral third party might present a different assessment than a developer or a conservation group.
- Invite a person involved in planning and development in your community (e.g., a municipal planner) to discuss the steps typically taken before natural areas can be developed and why this process exists.

Supporting Diverse Student Needs

- Encourage academically weaker students to take on an active speaking role during the presentations.
- This is an excellent activity for developing verbal-linguistic and interpersonal intelligence.
- For enrichment, students could present the report drafted in step 6 to the local town or regional council.

What Did You Find Out? Answers

1. Sample answer: My studies of ecosystems helped me to research and present my arguments because they have shown me how to assess the impact of change upon ecosystems and how different monitoring techniques can be used to determine the extent of this impact.
2. Accept any reasonable answers that clearly outline any issues that weren't covered.
3. An environmental impact assessment ensures that decision makers consider all environmental impacts of a potential project before a ruling is made on whether to proceed with the project. However, one disadvantage is that the potential environmental impacts of a project are often predicted by using data gathered from similar projects. Since each project is

unique, the impacts of similar projects cannot always accurately predict the environmental impact of another project.

SECTION 3.3 ASSESSMENT, p. 93

Check Your Understanding

Checking Concepts

1. Long-term monitoring helps us determine if the environment has changed significantly over the years in a way that differs from its natural fluctuations over time. This knowledge can tell us wheter conservation measures are necessary.
2. Physical monitoring: for example, satellite maps show how fast forests are shrinking and deserts are growing.
   Atmospheric monitoring: for example, tracking changes in air and water temperatures and weather patterns, such as hurricanes and droughts.
   Chemical monitoring: for example, tracking changes in the levels of chemical pollutants in the air, water, and soil.
   Biological monitoring: for example, tracking changes in the distribution and population size of organisms.
3. (a) Baseline data are measurements that form a starting point from which later changes can be monitored by comparing the later measurements to the baseline data.
   (b) Such data are useful because they can be used to compare conditions before and after an incident that causes ecosystem change, such as a forest fire.
4. To carry out long-term monitoring, researchers often use volunteers to help them collect data. Bird counts typically use volunteers to monitor the population size of different bird species in different areas. Volunteers are important in such programs as they greatly increase the number of individuals able to collect data.
5. Sample answer: The population size of organisms, such as birds, can be measured by an annual survey. A direct visual count could be used to collect the data.

Understanding Key Ideas

6. The goal of an environmental impact assessment is to determine how an activity will affect the environment.
7. You would use baseline data that tracks the pH of water in the region over time.

Pause and Reflect Answer

For questions (a)–(c), answers are all based on student opinions. Accept any reasonable answers backed by solid reasoning.

Other Assessment Opportunities

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

CHAPTER 3 ASSESSMENT, pp. 94–95

PREPARE YOUR OWN SUMMARY

Student summaries should incorporate the following main ideas:

1. The Process of Succession
   - Ecosystems are frequently disturbed by natural events, such as fires, and by human activities, such as land clearance.
   - An area of bare rock can eventually develop into a complex community of plants and animals through the process of primary succession.
   - An ecosystem that has been disturbed but still possesses soil, nutrients, and even seeds will develop into a climax community over time via secondary succession.
2. Examples of Human Activities
   - Humans make use of natural resources to meet their basic needs, such as food, water, and a place to live.
   - Human activity has a major impact on ecosystems, mainly because of our powerful technologies and large population.
   - Over the past 50 years, human activities have increased, so that we now use greater areas of land and more natural resources, such as fish, lumber, metal, oil, and water.
3. Impacts of Human Activities
   - The main human impacts on ecosystems include loss of habitat, introduction of alien species, overharvesting of natural resources, and pollution.
   - The loss of habitat is the largest single cause of the decline in populations of wildlife.

- Some species, known as introduced species, have spread beyond their natural range into new locations as a result of human activities.
- Renewable resources are harvested unsustainably by humans when they cannot be renewed as quickly as they are used.
- Human generated pollutants, such as acid rain, can harm both land and aquatic ecosystems.

4. Monitoring and Managing Ecosystems
   - Environmental monitoring is used to detect changes in ecosystems.
   - There are four main types of environmental monitoring: physical, chemical, atmospheric, and biological.
   - Data from monitoring can be used to help manage and protect ecosystems.
   - In order to discover if the environment is changing in a significant way, it is necessary to carry out long-term monitoring over a period of many years.
   - Developers and governments use environmental impact assessments to plan how to minimize the harm an activity may cause in an ecosystem.

CHAPTER REVIEW ANSWERS

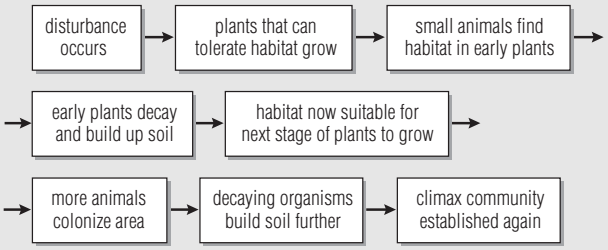
Checking Concepts

1. (a) secondary succession
   (b) pioneer species
   (c) introduced species
2. Some examples include lumber, fish, stone, metals, oil, water, and land for building and growing crops.
3. Some examples include oil, fertilizers, acid rain, pesticides, car and factory exhaust, and chemicals that leach from wastes.
4. Any three of the following: new fishing technology, more demand, lack of conservation, unsustainable harvesting.
5. (a) False. Unsustainable rates of harvesting occur when resources are being used faster than they can be renewed.
   (b) True
   (c) True
   (d) False. Lichen is an example of a pioneer species.
   (e) True
6. Sample answer: An introduced species, such as purple loosestrife, can affect an ecosystem by out-competing native species in wetlands and removing much of the water from these areas over time, making them unsuitable for the hundreds of species of plants and animals that depend on wetlands to survive.
7. (a) Lower
   (b) The pH is neutral, neither acidic nor basic.
   (c) 2
   (d) 11
   (e) 5.6

Understanding Key Ideas

8. (a) The events shown in photo A
   (b) In the process of secondary succession, wildflowers and grasses are now growing in the sunny, open spaces between the dead tree trunks.
   (c) A forest of trees will grow where the wildflowers once thrived and the ecosystem will be shadier than it is now.
9. The garden, which was originally cleared and maintained in this state, was abandoned and has begun changing as wildflowers, small bushes, and shrubs started establishing themselves as a consequence of secondary succession.
10. Long-term monitoring helps us determine if the environment has changed in a significant way that differs from its natural fluctuations over time.
11. If the methods used to monitor ecosystems are not consistent, one cannot easily determine whether changes in data are due to changes in the environment or changes in methodology.
12. Most students will identify Long's braya, mentioned as an endangered species in the Science Watch on page 84 of the student book. It is endangered because it has a very specialized habitat that has been further threatened by excavation of the Barrens for limestone and gravel, and used as a racetrack for all-terrain vehicles (ATVs), which tear up rare plants and compress the limestone gravel so that new plants cannot grow in their place.
13. Student answers should include one example of a natural event (e.g., a landslide, avalanche, drought, or flood) and one example of a human activity (e.g., logging, recreational use of the lake, overharvesting fish, introduction of a non-native species, pollution (such as fertilizer) run-off, draining the lake for building or agriculture, or creation of a hydroelectric dam on a river that feeds or drains the lake).

14.



15. Sample answer: Scientists have determined that Earth is undergoing major shifts in climate, based on long-term monitoring of changes in atmospheric gases, air and ocean temperatures, melting of glaciers, and other data. Analyzing these trends, they predict that much of the planet will experience warmer average temperatures in the future.
16. (a) Conduct long-term monitoring of the tree by counting the number of insects in a permanent plot (the same part of the tree is sampled each year).
    (b) Use sonar to detect the number of whales in the bay.
    (c) Catch the fish to count them and tag the fish before they are released so that they are not counted twice.

Pause and Reflect Answer

Answers are based on student opinion. Accept any reasonable answers in which students outline the changes they view as acceptable and the circumstances under which these changes could acceptably occur. Many students may argue that some ecosystem change that allows humans to maintain their standard of living is acceptable, as long as species are not endangered or threatened, and the change is as minimal as possible.

UNIT 1 ASSESSMENT

PROJECT

Making a Garbage-Reduction Diary, p. 98

Purpose

- Students measure and record how much garbage is produced at home, at school, or at a workplace.

Advance Preparation

None

Time Required

- 30 min to introduce the project
- 1 week to complete data collection
- 1 hour to complete Report Out questions

Science Background

Each Canadian generates about 383 kg of household waste per year, according to Statistics Canada. Surprisingly, the majority of the household waste we produce in Canada is organic. This means much of it could be diverted from landfill if more households began composting their food waste. Paper and paper products make up 33 percent of household waste in Canada. Only 25 percent of this waste is actually recycled. Manufacturing paper also creates waste. Paper manufacturing is the third largest user of fossil fuels globally. About 324 L of water is used to make 1 kg of paper. Contrary to popular belief, computers and the Internet do not reduce paper consumption. Personal computer users use 115 billion sheets of paper each year, and the average Internet user prints 28 pages per day. Plastic is another major form of household waste. In Atlantic Canada, 490 million plastic bags are used each year. Half the paper and the majority of plastic that is thrown out by households come from packaging.

Activity Notes

- Remind students that there are many secondary costs that result from contributing large amounts of waste to the landfill. For instance, landfills are responsible for 38 percent of our total methane (a greenhouse gas 21 times more potent than carbon dioxide) production in Canada. Have students brainstorm other secondary costs of a high waste lifestyle.
- Discuss Newfoundland and Labrador's Green Depot bottle recycling program as a class. When consumers purchase a ready-to-drink beverage container in the province, they pay a deposit. When the containers are returned to one of the province's Green Depots, the consumer is reimbursed an amount per container. What are the pros and cons of such a system? Do students think it actually works? Why or why not? (Green Depots divert millions of beverage containers from landfills each year.)
- Consider setting up several worm compost bins for your classroom. Inform students about what sort of food waste can be composted. Encourage students to compost their food waste from snacks and lunches and keep track of the food that was composted. At the end of the week, tally the data to see how much organic waste was kept out of the landfill.
- As an ICT option, consider having students create their data tables using a spreadsheet program.
- Wrap up this activity by asking several students to report the outcome of their garbage-reduction diary to the class. Try to choose students who have

collected data from different locations, such as home, school, work, or another location, for comparison purposes. Have the class brainstorm ways that waste can be reduced in each location.

Supporting Diverse Student Needs

- This activity helps strengthen logical-mathematical and interpersonal intelligence.
- For enrichment, have students research the feasibility of reusable and decomposable packaging options. Are these packaging options currently available in Newfoundland and Labrador?

Report Out Answers

1. Students' charts should clearly indicate the total amount of each type of waste and the overall total waste produced by each participant during the week. Charts should have an appropriate heading.
2. Most of the waste produced in an average Canadian household is organic food waste (over 50 percent), followed by paper (33 percent), and then plastic. In an office or school, paper waste will most likely be significantly more.
3. Students may suggest the following garbage-reduction strategies: compost food waste and use the compost in a garden, buy products with minimal packaging, bring own bags to store, donate used magazines to the library or share with a friend, purchase only recyclable plastic containers, share a newspaper subscription with a neighbour, purchase fewer consumer goods, print less paper from the computer, use both sides of printer paper, return used beverage containers to the bottle depot, make art and gifts out of used materials. Accept any reasonable answer that provides five strategies.

Other Assessment Opportunities

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

INTEGRATED RESEARCH INVESTIGATION

Saving Endangered Spaces, p. 99

Purpose

- Students research an endangered ecosystem and inform people about the region through various presentation media.

Activity Notes

- Students may complete this activity in partners.

Supporting Diverse Student Needs

- Pathway 3 students will benefit from working with a partner for this activity.
- Encourage visual-spatial learners to create a poster or brochure to present their research.
- For enrichment, invite someone involved with an ecosystem conservation group to talk to your class about the work they do to preserve species and habitats.

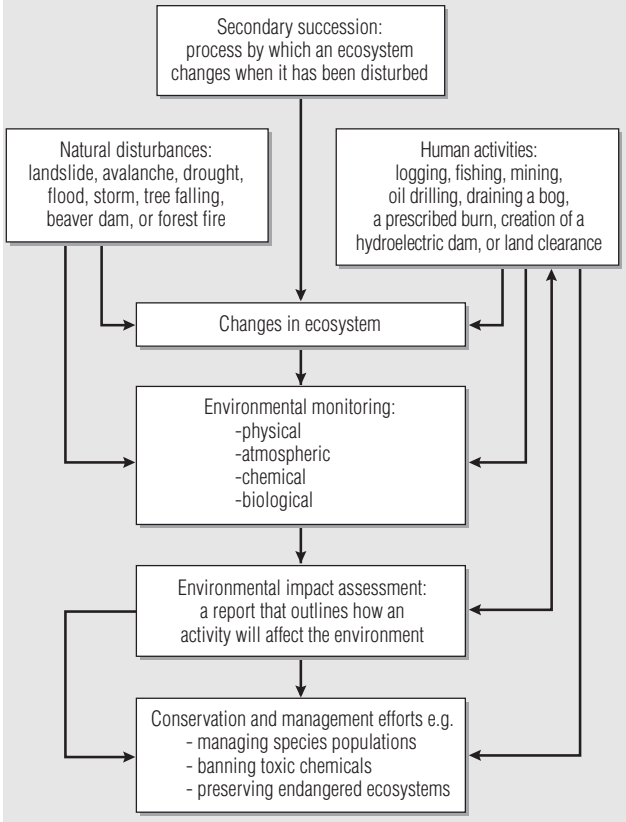
Other Assessment Opportunities

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

UNIT 1 REVIEW ANSWERS, pp. 100–103

Visualizing Key Ideas

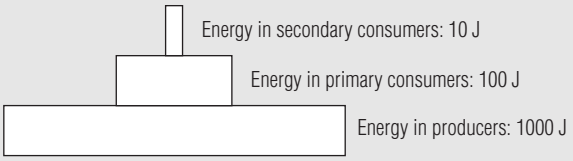
1.



Using Key Terms

2. Answers to student quizzes should correctly use ten of the terms provided. Quizzes must include a solution key.

Checking Concepts

3. Sample answer 1: A tree uses the energy in sunlight and carbon dioxide from the air to create food. It uses oxygen from the air for respiration. It absorbs water from the soil to carry out its life processes and anchors itself in the soil to remain upright. The Sun warms the air and soil so the plant does not freeze.
   Sample answer 2: A rabbit eats plants that use sunlight to make food. It uses oxygen from the air for respiration. The rabbit takes in water to carry out its life processes. It burrows in the soil to stay warm when temperatures drop. The Sun warms the air and soil to a temperature that is warm enough for the rabbit to survive.
4. Possible answers include sunlight evaporating water or melting snow, wind blowing clouds across the sky, water wearing away rock or moving dirt, wind blowing sand, and sunlight warming soil. Accept any reasonable answer.
5. individual → population → community → ecosystem
6. Possible ecosystems and examples of plants and animals that live in each ecosystem are as follows:
   - Coastline and ocean—seaweed, plankton (microscopic plants), barnacles, mussels, starfish, rock crabs, cod, seals, whales, jellyfish.
   - Freshwater ecosystem (pond, lake, river, bog)—willows, tamarack, aquatic plants, lake whitefish, sticklebacks, beavers, muskrats, ducks, geese, frogs, insects, snails.
   - Arctic—low shrubs, mosses, lichens, small flowering plants, caribou, wolves, arctic foxes, arctic hares, lemmings, migratory birds.
   - Forest—balsam fir, white birch, black spruce, mountain ash, moose, caribou, black bear, lynx, red fox, marten, mink.
7. Range of tolerance refers to the range of conditions within which an organism can survive. The tree line marks the limit of trees' range of tolerance for temperature and moisture conditions.
8. Producers are the only organisms that produce their own food from the abiotic environment, so consumers must depend on producers for food.
9. (a) The role of scavengers and decomposers in ecosystems is to consume and break down dead organisms and waste material, helping recycle nutrients in an ecosystem.
   (b) Scavengers eat dead tissues or waste. Decomposers do not eat their food as scavengers do. Instead, they release chemicals that break apart dead tissues and cells and absorb the nutrients.
10. A food chain only shows the transfer of energy from one organism to another in a linear fashion, while a food web is an interconnection of several different food chains, producing a more complex model of feeding relationships among various organisms in an ecosystem.
11. Sample food chains:
    - green plants → snowshoe hare → owl
    - green plants → insects → bat → owl
    - green plants → mouse → weasel
    - green plants → grouse → weasel
    - green plants → insects → shrew → owl
12. 

13. Sample answer 1: The dead leaf falls to the ground, where bacteria in the soil break it down. The nutrient leaves the leaf and enters a bacterium. The bacterium dies and the nutrient enters the soil, where it is taken up by another plant.
    Sample answer 2: The dead leaf falls to the ground. It is broken down by the elements and enters the soil. An earthworm consumes it. The nutrient leaves the leaf and enters the earthworm. The nutrient passes from the earthworm in its waste and is released into the soil, where it is taken up by another plant.
14. Succession is the process by which a biological community changes over time. For example, if land is cleared for a farm and then abandoned, wildflowers and weeds will eventually recolonize the area. As these die, they build up the nutrient content of the soil and increase its ability to hold water, allowing trees and shrubs

to take root. These soon shade out the weeds and wildflowers, and the biological community changes over time.

15. Possible activities include the following: land clearing for farming, building roads, or urbanization; industry such as logging, mining, oil drilling, and manufacturing; building dams; draining bogs; outdoor recreation. These activities might threaten the survival of a species as a result of loss of habitat. Students may also mention introducing non-native species, which could threaten the survival of a native species by out-competing it or altering its ecosystem. Creation of pollution via transportation and industry or dumping garbage and hazardous waste could threaten species survival by poisoning the organisms over time. Overharvesting a natural resource, such as fish, could threaten species survival because species would not be able to renew their numbers as quickly as they are harvested.
16. When a resource is renewed as quickly as it is used, it is a sustainable resource. Overharvesting a sustainable resource can make it unsustainable, however. For instance, if fish stocks are overharvested to such as extent that they can no longer renew themselves, they will no longer be a sustainable resource.
17. Because no cattle have been grazing the field for years, shrubs and small trees have had a chance to establish themselves and succession is occurring.
18. Permanent plots are sample areas of a habitat that scientists monitor year after year, providing annual data that indicate any changes in the sample area. This is useful because it is likely that any changes that are observed in the sample plots are also taking place in the ecosystem as a whole.
19. An environmental impact assessment can be used.

Understanding Key Ideas

20. An ecosystem consists of the biotic and abiotic factors in a unique community. Accept any answer that accurately reflects this definition in the student's own words. Examples of ecosystems include desert, forest, arctic, estuary, freshwater (lake, river, pond), prairie, and ocean.
21. Possible answers include air, water, sand, rock, temperature, salinity, acidity, sunlight, nutrients, and clouds.
22. (a) Examples of mutualism given in the chapter include micro-organisms that live in the guts of termites, and lichen.
    (b) Examples of parasitism from the chapter include fleas, ticks, and lice, which live on their hosts, as well as tapeworms and roundworms, which live inside their hosts. More specific examples include the parasitic relationship between roundworms and caribou, and that between mistletoe and trees.
    (c) Examples of commensalism from the chapter include clownfish, which live among poisonous anemone. Barnacles living on whales are another example.
23. Spider—carnivore/consumer; hawk—carnivore/consumer; corn—producer; mouse—omnivore/consumer.
24. If all carnivores were removed, the forest ecosystem would collapse because the herbivores would increase to such a large number that they would consume the vegetation in the forest in an unsustainable manner.
25. Possible answers include loss of habitat, poisoning due to pollution, competition from an introduced species, and overharvesting.
26. Possible answers include number of predators or grazers, supply of food or access to sunlight, disease, environmental factors such temperature, and size of habitat.
27. An introduced species may out-compete a native population for resources or may prey on a native population or its food source. It may also change an ecosystem so that it is unsuitable for native species and can carry disease that may harm a related native species.
28. Possible answers include becoming active in a campaign to increase awareness about an endangered species and its habitat, decreasing the pollution you generate, and writing a letter to the paper or government expressing your concern.
29. When people grow crops as a monoculture, they often have to use more pesticides on the crop, as a single crop planting may be inundated with insects more easily that a mixed planting. They also often use large amounts of chemical fertilizers. These chemicals can harm nearby ecosystems when they enter the food chain.

30. Physical, chemical, atmospheric, and biological.
31. Food goes bad because decomposers, such as bacteria and fungi, release chemicals that break apart dead tissues and cells in the food to absorb the nutrients in it. Methods of preserving food include the following: pickling (acid or salt deters decomposer growth); drying, sugaring, freeze-drying, and salting (lack of moisture deters growth of decomposers); canning and vacuum packing (lack of oxygen deters decomposer growth); freezing or refrigerating (lower temperatures halt or slow growth of decomposers); radiation (kills decomposers). Students should include four descriptions in their answer.
32. Sustainable harvesting is necessary, in which resources are harvested at the same rate or at a slower rate than they can reestablish themselves.

Thinking Critically

33. This is an example of secondary succession. In the spring following the avalanche, seeds that remained in the soil, or were brought to the area by wind, water, or animals, begin to sprout. That summer, wildflowers, grasses, and weeds will grow in the soil. Insects, songbirds, and other small organisms will be attracted by growing vegetation that provides food and habitat. The soil still has nutrients and the plants receive a lot of direct sunlight, so they will flourish. In the next year or two, small shrubs and trees may start to grow on the site. The dead vegetation from previous years has built up the soil, so it is richer in nutrients and can retain more water, providing enough resources for these larger plants. Larger animals will begin to live on the site as well, as the larger trees and shrubs provide shelter and small organisms provide food.
34. Students may explain that, as a result of secondary succession, the area will soon be filled with wildflowers, grasses, and weeds. In a few years, shrubs and trees will replace these plants. A few years after that, the site will mature into a young forest again.
35. Sample answer: Strawberries: These fruit grow on plants that use the energy in sunlight to make fruit, which I consume. Ice cream: I consume ice cream, which is made by cows, which eat grass, which uses the energy in sunlight to make food. Popcorn: Popcorn comes from corn, which is a plant that uses the energy in sunlight to make food, which I consume when I eat popcorn. If I add butter, this comes from cows, which eat grass, which uses the energy in sunlight to make food, which I consume when I eat the butter.
36. Most students will use the example of cod, which have been overharvested, resulting in a decline in its population. Overharvesting caused stocks to nearly collapse in the 1990s. This was a result of several factors, including the development of new fishing technology, increased global demand, lack of conservation initiatives, and unsustainable fishing practices by both Canadian and foreign fleets.
37. Students may suggest that they could act to reduce the impact of pollution upon an ecosystem, for example, by participating in a shore clean up. They could also become involved in a campaign to encourage a farmer to not plant a monoculture crop in a local field. They might help an organization that is working to have an ecosystem designated as a protected area. Accept any reasonable answer.
38. This isn't a good idea because the fast-growing European plant may escape into the wild from gardens. It may have no natural grazers on the island and may grow so quickly that it out-competes native plants. It may also alter an ecosystem in such a way that it is no longer suitable for the growth of native plants.
39. The correct answer is (b). You should eat the hens first, and then the grain, because the hens will also consume grain, leaving less for you in the end. Only 10 percent of the energy in the grain that the hens consumed will be available to you. The rest will be lost as heat and waste.
40. Most exotic pets will die if they are released into the wild, but some may survive and become invasive introduced species. They may have no natural predators in the ecosystem they are released into and may reproduce very quickly, out-competing native species for resources. They may also consume native species, thus altering the dynamics of the ecosystem. The exotic species may alter an ecosystem in such as way that it is no longer suitable for native species to live in.
41. (a) The meals we eat today are typically made with plants grown on monoculture farms and animals that are raised in large-scale establishments. They are often transported to local grocery stores from around the

world. Our grandparents ate more locally, and the food frequently came from smaller, mixed planting farms, which grew food organically. The meals were also much less processed.

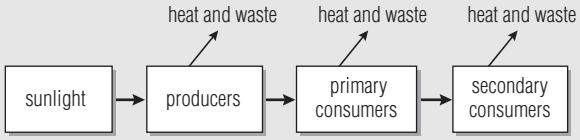
(b) Monoculture farms often use more pesticides on the crop, as single crop plantings often have more pest problems than mixed plantings. Many large-scale farms also use chemical fertilizers. Both pesticides and fertilizers can harm nearby ecosystems. Pesticides may be ingested by animals or taken up by plants. Excess fertilizers can cause plant overgrowth in bodies of water, making ecosystems unsuitable for other species. Transport of food across the globe increases the amount of pollution entering ecosystems as well.

42. When a robin dies, its tissues and cells are decomposed and some of the nutrients enter the soil. The worm takes in these nutrients as it consumes the soil. Thus it is eating the robin in a round about way.
43. The band helps researchers learn more about the habitat and needs of the harlequin duck because it allows them to carry out long-term monitoring of the duck population. For instance, scientists will be able to tell which specific habitats the ducks prefer and how far the ducks move within these habitats. If some ducks are not surviving, or if they are increasing in number, this may tell scientists something about the needs of the species.
44. All life is connected. Something that happens in an ecosystem far away from an urban centre may easily affect city dwellers, who need to get the water, food, and natural resources they consume from ecosystems outside of the city.

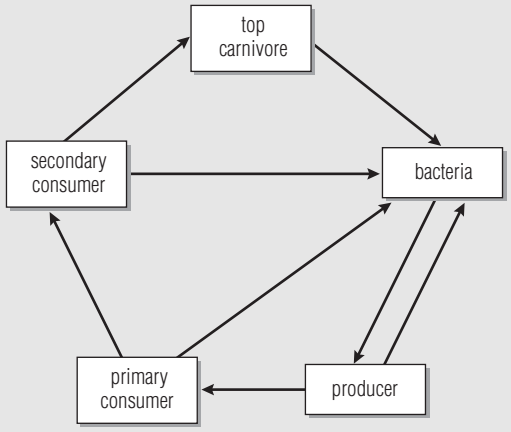
Developing Skills

45. A species refers to all the members—all the individuals—of a population of organisms. An individual is just one member of that population.
46. Although models will vary with different ecosystems, all models must have an input of energy, such as sunlight, and an output of energy, in the form of heat. Abiotic factors may enter and leave the ecosystem (for instance, water and air), as may organisms. Nutrients are recycled in the ecosystem, but they can also be exchanged between different ecosystems.
47. (a) 1900–1949
    (b) 8
    (c) 35
    (d) Most students will guess over 35 species.
48. Students may suggest that they would carry out long-term monitoring of a plant species by establishing permanent plots as sample areas of a larger ecosystem. They would monitor the plant of interest on an ongoing basis in each plot and then extrapolate the data to the ecosystem as a whole. Students monitoring animal populations may suggest using radio collars, aerial photos, leg bands, or tags to monitor animals on a long-term basis. Annual counts can also be used to monitor some animal populations, such as birds, butterflies, and frogs.
49. Sample answer 1: To increase the biodiversity of my yard, I would stop using pesticides that could kill insects and other animals. I would plant plants that would attract more insects, birds, and other animals by providing food and shelter.

    Sample answer 2: To increase biodiversity in the forest that has been logged in our area, I would help plant seedlings of trees that once grew there. This would also attract more animals over time by providing food and shelter.
50. (a)



(b)



51. The introduced species will be exotic to the ecosystem. It is never a good idea to introduce an exotic species, as there are too many unknowns involved. Many organisms in the ecosystem prey on mosquitoes, which are near the bottom of the food chain. They may lose this valuable food source if all the mosquitoes are consumed. Additionally, the introduced species may have no natural predators and may become a problem species itself, increasing in population size to such an extent that it may out-compete all its competitors. This can alter the ecosystem in such as way that it is no longer suitable for some native species.
52. Sample chart:

biotic	abiotic
soil bacteria	-obtain nutrients from dead organisms and waste in soil -live in soil -Sun warms soil so it does not freeze -use water for life processes
grass	-anchored in soil -obtains nutrients and water from soil -uses water for life processes -uses energy from Sun and carbon dioxide in air to make food -uses oxygen in air for respiration
mouse	-Sun warms air so mouse can carry out life processes -uses water for life processes -uses oxygen in air for respiration -eats grass and other plant materials such as seeds -urine and feces provide nutrients for soil organisms
coyote	-Sun warms air so coyote can carry out life processes -uses water for life processes -uses oxygen for life processes -eats mice, hare, and other prey -urine and feces provide nutrients for soil organisms
hawk	-Sun warms air so hawk can carry out life processes -uses water for life processes -uses oxygen in air for respiration -flies through air to capture prey -urine and feces provide nutrients for soil organisms -collects branches to make nest in trees

53. (a) Acid rain would harm, and possibly kill, fish, amphibians, and plants in aquatic ecosystems. It would also harm many plants in a forest ecosystem.
    (b) Building a hydro line would destroy part of a forest ecosystem. If the hydro line were not maintained, secondary succession would begin.
    (c) Chemical fertilizers can run off from neighbouring land into aquatic ecosystems. Some students may recognize that this can result in the overgrowth of algae, which is harmful to the other plants and animals living in the ecosystem.
    (d) If one species is reduced in number, this may result in an increase in the population of the species it preyed or grazed upon. It can also lead to a decrease in population size of species that preyed on it. This could disrupt the functioning of the ecosystem. In a worst-case scenario, the ecosystem could collapse.
54. (a) Mutualism. The flowering plant gains by having its pollen distributed and the insect gains by receiving nectar.
    (b) Parasitism. The flea gains nourishment from the cat, and the cat is harmed by being bitten.
    (c) Mutualism. The flowering cactus gains by having its pollen distributed, and the bat gains by receiving nectar.
    (d) Mutualism. The bird benefits by eating insects that live on the water buffalo's hide, and the water buffalo benefits by being relieved of annoying, biting insects.

Pause and Reflect Answer

This statement refers to the fact that the environment is not just a place where we stock up on the natural resources we need, but it is where we live and enjoy our lives. We will have to live in it, even if we foul it up. Most students will argue that we should consider the entire planet as our home, even if we just live in one small corner of it. All ecosystems on the planet are interconnected, and harm done to one ecosystem may eventually affect others. A good example is how pollution generated in a large urban centre may end up in the Arctic, where very few people live and little pollution occurs.