

FAMOUS POTATOES

In a small town called Pemberton, north of Whistler, in British Columbia, exists the home of world-famous potatoes. These potatoes are respected internationally by almost every potato farmer in Canada and the United States. Why? Since 1949, the area has been quarantined. Isolated, Pemberton is situated in a valley, surrounded by mountains on all sides. Only locally cultured and laboratory-inspected potato seeds are allowed to be grown. This makes the Pemberton potatoes virtually free of virus and disease. Most of the potatoes are shipped to other growers who use them as seed. In fact, Idaho potatoes are grown from Pemberton seed potatoes.

CHECK AND REFLECT

1. Describe three ways humans can impact or change an ecosystem.
2. Identify one example of human impact on an ecosystem that you could help to lessen. Describe what you could do to lessen this impact.
3. Why may introducing a chemical to kill an insect population have an impact on humans?
4. Predict what would happen if you tried to remove a species from your local ecosystem—be specific.
5. Create a poster or picture that illustrates the present state of endangered or threatened species in Canada.
6. In what ways do the following human activities affect ecosystems?
 - a) clearing farmland to build a new housing development
 - b) cutting down trees to make paper and building materials
 - c) transporting crude oil across the ocean
 - d) burning logs in a fireplace
 - e) growing an apple orchard to sell the apples
 - f) harvesting rare plants to make new medicines from chemicals they contain

IMPACTS ON THE ENVIRONMENT

Humans regularly pollute the air, water, and soil on which all life depends. These pictures show a few examples of ways we have changed or polluted our own planet.



Figure 4.5a) Each year people throw away great amounts of garbage. Potato chip bags, fruit pits and peels, bottles, and paper and plastic of all kinds make up the majority of this litter. Who do you think pays to have the garbage collected? How would living things be affected if we left the garbage where it lay?



Figure 4.5b) This hydro-electric project is located on the La Grande river which flows into James Bay in northern Québec.

The top picture shows the river before the dam was built for the plant, and the bottom picture shows the site seven years later. The dam is nearly 3 km long and now contains the reservoir which extends over 2835 km². In what ways do you think the environment was changed to build the electricity-generating plant? What effects would these changes have had on living things?

Figure 4.5c) Some industries produce pollution. Emissions by these industries must be monitored to ensure that they are within safe limits. Scientific research helps us determine what these safe limits are. How does this pollution affect living things in the air and on land?



Each of these examples of pollution is a technological response to meet a human need. How could this need still be met without creating as much pollution and minimizing the damage to the environment? What could you do at home to help minimize the damage?

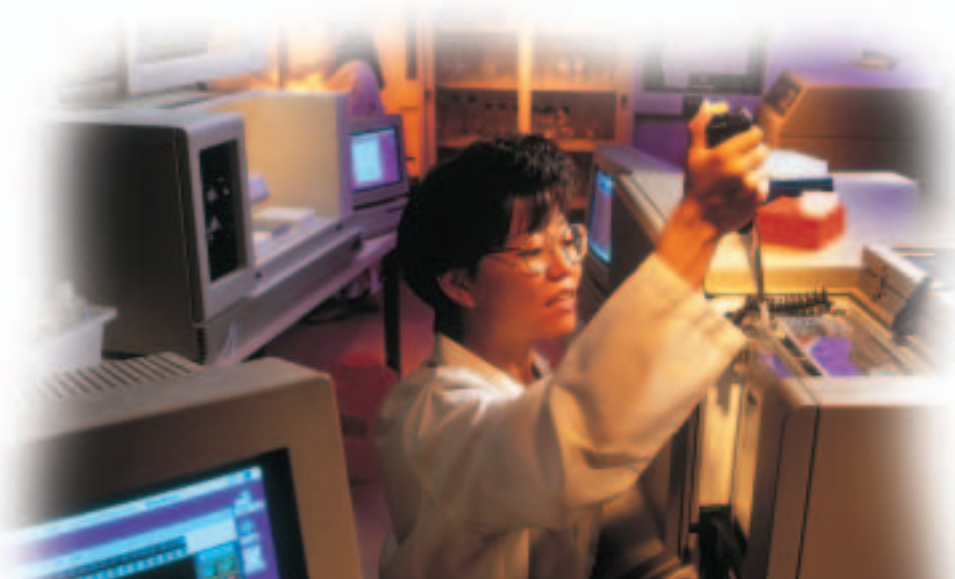
4.2 Information from Scientific Investigations Can Assist Environmental Decision-Making

When scientists want to understand why changes happen in an ecosystem, they plan an investigation to study it. When scientists want to add or take something away from an ecosystem, they study how this could affect the abiotic and biotic factors that are living in it. This information can help us to make a responsible decision about the environment.

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A Pesty Career

Agricultural researchers study insect life cycles to determine how to control these pests without using dangerous pesticides that can harm the environment.



Give it a TRY

A C T I V I T Y

INVESTIGATING THE ELK POPULATION

Ecologists are scientists who study the relationships among living things and their environment. For example, ecologists study the birth and death rates of elk so they can predict the future of the population.

Imagine that the size of the elk population in a small town located in the Rocky Mountains suddenly decreased. How could you find out what happened to the elk? What scientific data would you look at? Would you look at the population over the past few years? Have any new predators been introduced to the region? How could your data help you make an informed decision about the elk population? How could you determine which information is correct?

Compare your ideas with those of your classmates. Did you have similar ideas? Discuss any answers you are unsure of. Modify your answers if necessary.



THE SAVING OF THE PEREGRINE FALCON

Science and technology can be used to observe, monitor, and assess the status of endangered wildlife. In Canada, an organization called Canadian Wildlife Service's Committee on the Status of Endangered Wildlife in Canada (COSEWIC) monitors species at risk of extinction in Canada. COSEWIC is a committee of representatives from federal, provincial, territorial, and non-governmental environmental agencies as well as independent experts. The goal of this committee is to increase the numbers of all at-risk species to levels that are no longer considered endangered.

The peregrine falcon is an example of a species that was placed on the endangered species list. The major cause of the drop in the peregrine falcon populations was agricultural pesticides that were present in the environment. These pesticides caused thinning of the eggshell, which led to eggs breaking. This meant there were fewer eggs that hatched, which in turn reduced the number of birds that were born. This is no longer a major problem because the use of these pesticides has been banned in North America.

Figure 4.6 A peregrine falcon chick that has been tagged so its progress in the wild can be monitored



The peregrine falcon was monitored from 1970 to 1995, where status surveys were conducted in most regions of Canada. The data collected from these surveys helped assess the peregrine's situation. Once the numbers of these populations became dangerously low, a recovery plan was developed to help the survival rate of this bird. Captive breeding programs across the country were used. Captive breeding involves breeding the birds in a protected environment where they cannot be harmed.

Many positive results came of the efforts to help the peregrine. In 1994, at the captive breeding facility in Wainwright, Alberta, a record-breaking 115 young birds were raised. Also, the National Department of Defense agreed to modify its low-level aerial training flights in Labrador, Newfoundland, to reduce the effects on nesting peregrines. Once the birds are able to live on their own, they enter a release program. This program helps the peregrines return to the wild. The birds are tagged so that they can continue to be monitored to assess if their entry to the wild was successful. The captive breeding programs were very successful, and so the peregrine falcon was down-listed from endangered to threatened.

Peregrine falcons released in Toronto, Edmonton, and Calgary build nests on ledges of tall buildings. Scientists think the peregrines are mistaking these buildings for cliffs. Cliffs are natural nesting sites for peregrines.

RESEARCH

The Marmot

Research the Vancouver Island marmot, an endangered species. What type of scientific investigations are being conducted to help save it?

CHECK AND REFLECT

1. How does scientific data assist with environmental decision-making?
2. Is scientific data the only thing that should be considered when making an environmental decision? What else needs to be considered?
3. Design an action plan to help solve an environmental issue in your community. How would you collect your data? Explain your answers.



4.3 There Are Limitations to Scientific and Technological Knowledge

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Ultraviolet Radiation

Ultraviolet radiation is produced by high-temperature surfaces, such as the sun. Most of the ultraviolet radiation in sunlight is absorbed by oxygen in Earth's atmosphere, which forms the ozone layer. When the ozone layer becomes thin, more ultraviolet radiation reaches Earth's surface and may have hazardous effects on organisms.

When people are trying to decide what to do about a specific environmental issue, they often involve scientists to plan investigations or conduct research so that an informed decision can be made. Unfortunately, not all issues can be addressed by science and technology. Sometimes there is no answer, due to lack of evidence, or studies, about an issue.



Figure 4.7 The golden toad

Such is the case with the golden toad of Monteverde, Costa Rica. This amphibian has been missing since 1988, and researchers have no idea what happened. In fact, it is not the only frog to have puzzled biologists. Around the globe, in such locations as Australia, North America, Costa Rica, Puerto Rico, and Brazil, there are many unexplained amphibian die-offs, and a high rate of deformities have occurred in a large number of the amphibians that remain. Where a habitat has been destroyed or contaminated, the cause is obvious. Yet more often than not, this is not the reason. No one can pinpoint the cause, but most scientists think the environment is somehow to blame. The four top theories are climate change, pollution, disease, and increased ultraviolet radiation due to the thinning of the ozone layer. However, researchers are not sure just how many of the world's amphibian species are in trouble because in many parts of the world, including most of Asia and Africa, they haven't been studied.

THE WALK THAT NO WOLF WOULD TAKE

In 1996, Parks Canada completed a project designed to allow animals to cross the Trans-Canada Highway safely. Large sections of the road were fenced off, and two overpasses and 10 underpasses were designed specifically to encourage wildlife to use them and not the highway. Monitoring devices have spotted elk, deer, coyotes, and other mammals using the overpasses and underpasses. The Bow Valley wolf pack is using the underpasses, but no wolf has used either of the two overpasses yet.



Figure 4.8 An aerial photograph of Redearth Overpass in Banff National Park

No one is sure why the wolves are not using the overpasses. Opinions are divided. Some experts think that there should be sections of highway elevated or put through underground tunnels to protect the wolves. Other experts think that the wolves need time to get used to the overpasses, and will eventually find and use them.

CHECK AND REFLECT

1. Why do scientific limitations make it difficult to make a decision about an environment? Explain your answer.
2. What types of resources are needed to make an informed decision?

RESEARCH

Limited Knowledge

Research two more environments for which decisions are limited by scientific and technological knowledge. Explain the issues present.

4.4 Using Evidence from Many Sources Can Help Analyze a Local Environmental Problem

As you have worked through this unit, you have had opportunities to learn about ecosystems, abiotic and biotic factors, and the impact of human actions on them. You are also aware of the intended and unintended consequences of human activity on a variety of ecosystems. This leads to the need for responsible decision-making and action to help reduce human impact on these ecosystems.

Is there a way that you can become involved within your community that can make a difference to your local ecosystem and, on a larger scale, to the global ecosystem of Earth? The answer is yes, thanks to some innovative thinking by two researchers at the University of British Columbia.

Mathis Wackernagel and William Rees of the University of British Columbia wanted to find a way to measure the environmental impact of human activities on the planet. At the same time, they were looking for a method to report their results. They wanted the results to be easy to understand and to provide suggestions for how people could reduce their impact on ecosystems.

ECOLOGICAL FOOTPRINT

What Wackernagel and Rees developed was an idea called the **ecological footprint**. Think about the footprint your foot makes. Every time you place your foot on the ground, you affect the biotic and abiotic factors under your foot. When you lift your foot up, you can see the exact area that you've affected. The ecological footprint helps us understand the effect that our way of life has on Earth. It shows us the imprint that our lifestyle makes on Earth's ecology.

To determine an ecological footprint, Wackernagel and Rees looked at the food, housing, transportation, consumer goods, and all the services we use every day. For each item, they calculated



how much energy, materials, and land we need. They also included the land needed to dispose of the waste produced by the way we live. They converted this information into an estimate of the total amount of land required to support each one of us. This amount of land is called the ecological footprint.

The average Canadian has an ecological footprint of 7.7 ha (hectares, 1 ha = 10 000 m²). That means it takes about 7.7 ha of land for each one of us to have food, travel in cars, heat our homes, shop at the mall, throw out garbage, etc. This number tells us how much of the world's ecological resources an individual Canadian like you uses. But is that a lot or a little?

COMPARING ECOLOGICAL FOOTPRINTS

Wackernagel and Rees used their technique to calculate how much land is actually available to support each person on Earth. This number is only 1.7 ha per person! When they looked at most of the countries in the world, they found that the average ecological footprint per person worldwide was 2.2 ha. This means that overall, people on Earth are using more of Earth's resources than they should if they want to protect the environment. And in Canada and other similar countries, we are using a great deal more than we should. In fact, if everyone on Earth had the same ecological footprint as the average Canadian, we would need four Earths to support us!

Now for the good news. There are ways to reduce your ecological footprint. Some of these changes can be immediate, while some will take a long time. These changes include reducing the amount of water, energy, and materials we consume and recycling the waste we produce.

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A City's Footprint

The City of Edmonton has a population of about 656 000. If each resident has an ecological footprint of 7.7 ha, the whole city has an ecological footprint of about 5 051 200 ha. But the actual area of the City of Edmonton is only about 67 000 ha. So the people of Edmonton require 75 times more land to support their lifestyle than they actually live on.

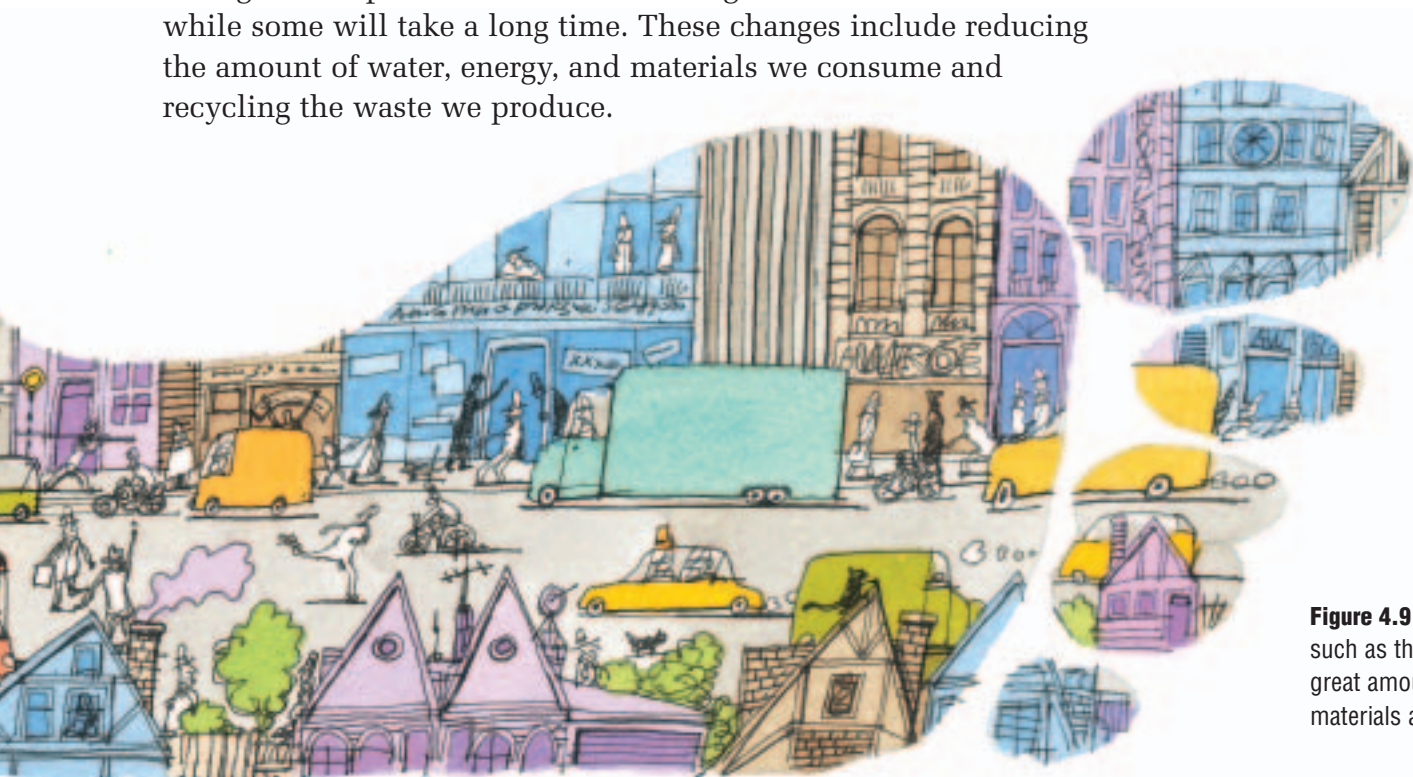


Figure 4.9 Busy lives such as these use a great amount of materials and energy.

WHAT CAN YOU DO TO REDUCE YOUR ECOLOGICAL IMPACT?

The Issue

Part of reducing your ecological footprint is to understand how your actions have an impact on the environment. For example, do you bring a drink for lunch each day? Do you use a reuseable container or do you throw away your container each day? Using a reuseable container helps to reduce your ecological impact. In this activity, you will be examining activities that may have an ecological impact. You will also be identifying strategies that you can use to reduce this impact. Using these strategies will help you work toward reducing your ecological footprint.

Background Information

Below are three activities that you can do to help you find ways of reducing your ecological impact. You will work either alone or in a group to complete each activity. For each activity, you will need to construct a table to record your information.

Activity 1—Water

- 1 Over the next 24 h, you will need to record how much water you use and what you use it for. While this will be only an estimate of your water usage, it will give you an idea of the amount of water you use.
- 2 To help you estimate your water usage, you will need to check with a variety of sources. Look in your math textbook or ask a math expert about how to calculate your water use, or check the Internet for statistics on water consumption. Or, you can use the chart shown here.



Figure 4.10a) Try to conserve water as much as you can.

Activity	Typical Water Use
toilet flushing	15 L
shower	20 L/min
bath	150 L
teeth brushing	10 L
dish washing (for 3 meals)	40 L
washing clothes	225 L
washing car	400 L
watering lawn	35 L/min

- 3 Determine how much water you use in a 24-h period.

Activity 2—Waste and Pollution

- 4 There are four categories of waste to consider: organic (will decompose), inorganic (will not easily decompose), items to be reused or recycled, and miscellaneous. In this activity, you will determine how much waste you generate in a day.
- 5 Use the garbage can in class to determine what categories of waste can be found. If a balance is available, determine the mass of each category. How could you determine how much waste per student was generated today? Wash your hands after you have touched the garbage.
- 6 When you go home today, observe and record what materials are put in the garbage. What materials could have been recycled or reused?



Figure 4.10b) This garbage should be sorted for recycling.

Activity 3—Materials and Goods

- 7 Make a list of everything you purchased in the last week. This includes any food.
- 8 Using catalogues and newspaper flyers, determine the approximate cost of these items.
- 9 Calculate the total cost for the week.
- 10 Review your list and identify which materials could be classified as not essential.
- 11 Recalculate your total cost for the week, but have two totals: one for essential materials and the other for non-essential materials.

Support Your Opinion

- 12 Make a plan that describes what you could do to reduce your ecological impact. Consider the following when creating your plan.
 - Who in your class had the lowest totals in each activity?
 - What did the person with the lowest totals in each activity do differently than you?
 - What is one good idea you learned from your classmates that you could do to reduce your ecological impact?



reSEARCH

A Sustainable Lifestyle

The idea of the ecological footprint was developed to help people understand why they need to find a sustainable lifestyle. Find out what is meant by a sustainable lifestyle.

FACTORS THAT REDUCE YOUR ECOLOGICAL FOOTPRINT

Factors that can help reduce your ecological footprint include reducing the amount of water, energy, and materials you use and recycling waste. When considering the amount of water you use, think of all the different ways you consume water. For some of the activities that involve water, it may be possible to reduce your water usage.



Figure 4.11
Four ways
to reduce
consumption

Reusing and recycling materials is another way to help reduce your ecological footprint. For example, if you reduced your household garbage by 20 kg and recycled another 10 kg, your ecological footprint could be reduced by 4%. This may not seem like a lot, but it does help to reduce your impact on your local ecosystems, and consequently, the global ecosystems.

CHECK AND REFLECT

1. Why did Mathis Wackernagel and William Rees invent the concept of the ecological footprint?
2. How does the ecological footprint of an average Canadian compare to the world average? Why do you think there is a difference?
3. What steps can you take to reduce your ecological footprint?
4. In this section, the term lifestyle was used. What types of lifestyle activities or actions do Canadians have that could be considered to have a negative impact on a local ecosystem? a positive impact?



Assess Your Learning

1. Rising beaver populations are an issue in many communities in Alberta. List three ways how this could be dealt with. Discuss the intended and unintended consequences of each choice.
2. A community in Calgary is trying to decide whether their local ravine should be made into an off-leash area for dogs.
 - a) What might you predict would happen in this ecosystem if the designation is changed from a leashed area to an off-leash area?
 - b) Is it enough just to ask the residents what they want? Why?
 - c) What else needs to be considered before a decision like this is made?
 - d) How might you use science and technology to help you to make an informed decision about this issue?
3. What is an ecological footprint? What is its significance to the ecosystems in your area?
4. Describe two things you could do to reduce your ecological footprint.
5. Do you think species that are endangered or threatened should be saved? Write a paragraph explaining your view on this question. Consider why others may have a different point of view.

Focus On

SOCIAL AND ENVIRONMENTAL CONTEXT

Decisions regarding scientific and technological development involve a variety of considerations. In this last section, you studied how maintaining sustainable environments requires knowledge, decisions, and actions. As you begin to work on your project, think about the following:

1. What environmental issues did you consider in this section? How will that help with your project?
2.
 - a) Where could you find reliable information about reducing human impact on ecosystems?
 - b) Explain whether you agree or disagree with the statement: Human impact on ecosystems is necessary to meet our needs, but we must consider both the social and economic costs.

Forest Harvesting

The Issue

What methods can be used to harvest Canada's forests? What factors need to be considered when deciding how to harvest trees?

The most common method of harvesting trees in Canada's forests is called clear-cutting. With clear-cutting, all the trees in an area are cut down. After the area is harvested, seedling trees are planted. These new trees are protected from pests and weeds as they grow. Later they are thinned to ensure that the remaining trees have enough space to grow.

Another method of harvesting trees is called selective cutting. This method of logging involves cutting down only those tree species that are suitable for use in making forest products. These trees are then replanted among the other tree species still standing.

Many factors affect how forest harvesting is done in a specific area. For example:

- the size and location of the areas to be cut
- the distribution of wildlife in the area
- the wildlife's need for specific habitat
- the need to maintain ground cover
- the safety of forest workers
- the cost
- recreational or other uses of the area

For each forested area, a detailed plan must be developed that identifies what will work best in that location. For example, a 1-km square block where all the land is similar would be harvested in a certain way. A 1-ha area that is not square and includes hills and valleys might be harvested in a different way.

Research is important in understanding forest harvesting. You have an opportunity to be a researcher by gathering and presenting information about forest harvesting methods.



Go Further

Now it's your turn. Look into the following resources to research information.

- Look on the Web: Check the Internet for information on forest harvesting methods.
- Ask the Experts: Try to find an expert on forestry. Experts can be found in many places: universities, forest companies, environmental organizations, and government agencies.
- Look It Up in Newspapers and Magazines: Look for articles about harvesting forests.
- Check Out Scientific Studies: Look for scientific studies about harvesting forests.

Organize the information you have gathered and determine what you will use to answer the questions at the beginning of this case study. Decide how you will present your findings—as a display, a multimedia presentation, or some other method. Use your chosen presentation method to describe what your findings show.



UNIT SUMMARY: INTERACTIONS AND ECOSYSTEMS

Key Concepts

Section Summaries

1.0

- interactions and interdependencies
- environmental monitoring
- environmental impacts
- environmental management

1.0 Relationships exist between living things and their environments.

- Ecosystems are places on Earth where biotic factors interact with abiotic factors and other biotic factors.
- There are three major types of symbiotic relationships: commensalism, mutualism, and parasitism.
- The basic needs of all organisms are water, energy, food, oxygen, and sustainable living conditions such as space and a place for waste to go.
- There is a need for responsible decision-making and actions using scientific information, and that involves consideration of environmental impacts.

2.0

- interactions and interdependencies
- producers, consumers, and decomposers
- nutrient cycles and energy flow
- environmental impacts

2.0 The flow of energy and the cycling of matter can be traced and interpreted in ecosystems.

- Ecosystems are composed of food webs that energy flows through. This energy is supplied by the sun.
- Matter continually moves from the non-living things to the living things and back to the non-living things. Two important cycles of matter are the water cycle and the carbon cycle.
- If any part of a food web changes, it will have an effect on all living things in that ecosystem.

3.0

- interactions and interdependencies
- environmental monitoring
- environmental impacts
- species distribution
- succession

3.0 Changes can be observed and monitored in ecosystems.

- Ecosystems provide living things with all their needs.
- Some of the ways that changes can occur in ecosystems include human activity, bioinvasion, resources competition, predation, and weather.
- There are two types of succession: primary succession and secondary succession.

4.0

- endangered species
- environmental monitoring
- environmental impacts
- extinction
- environmental management

4.0 Maintaining sustainable environments requires knowledge, decisions, and actions.

- Pesticides, such as DDT, can enter and move through an environment with deadly effects.
- The consequences of human actions may have an impact on both the local and global environments.
- The information that scientists collect can help them make informed decisions, but unfortunately, not everything that happens in ecosystems can be explained by science and technology.
- When looking at a local environmental problem, it helps to analyze information from many sources to get a complete picture to make an informed decision.

DESIGN A LAND-USE PLAN



Getting Started

In this unit, you learned that ecosystems develop and are maintained by natural cycles and succession, and are impacted by human change. You have investigated human impacts on ecosystems, and you understand that human actions have intended and sometimes unintended consequences. Environmental monitoring and research are important in the decision-making process. Look through your notes from this unit. Think about the ways human actions can affect ecosystems. With a partner, discuss the responsibilities that people have for making sure that ecosystems are healthy. List the categories you think people should use when they make decisions that affect ecosystems. Afterward, share your list with other groups. In what ways are they similar and different? Are there any additions you would like to make to your list?



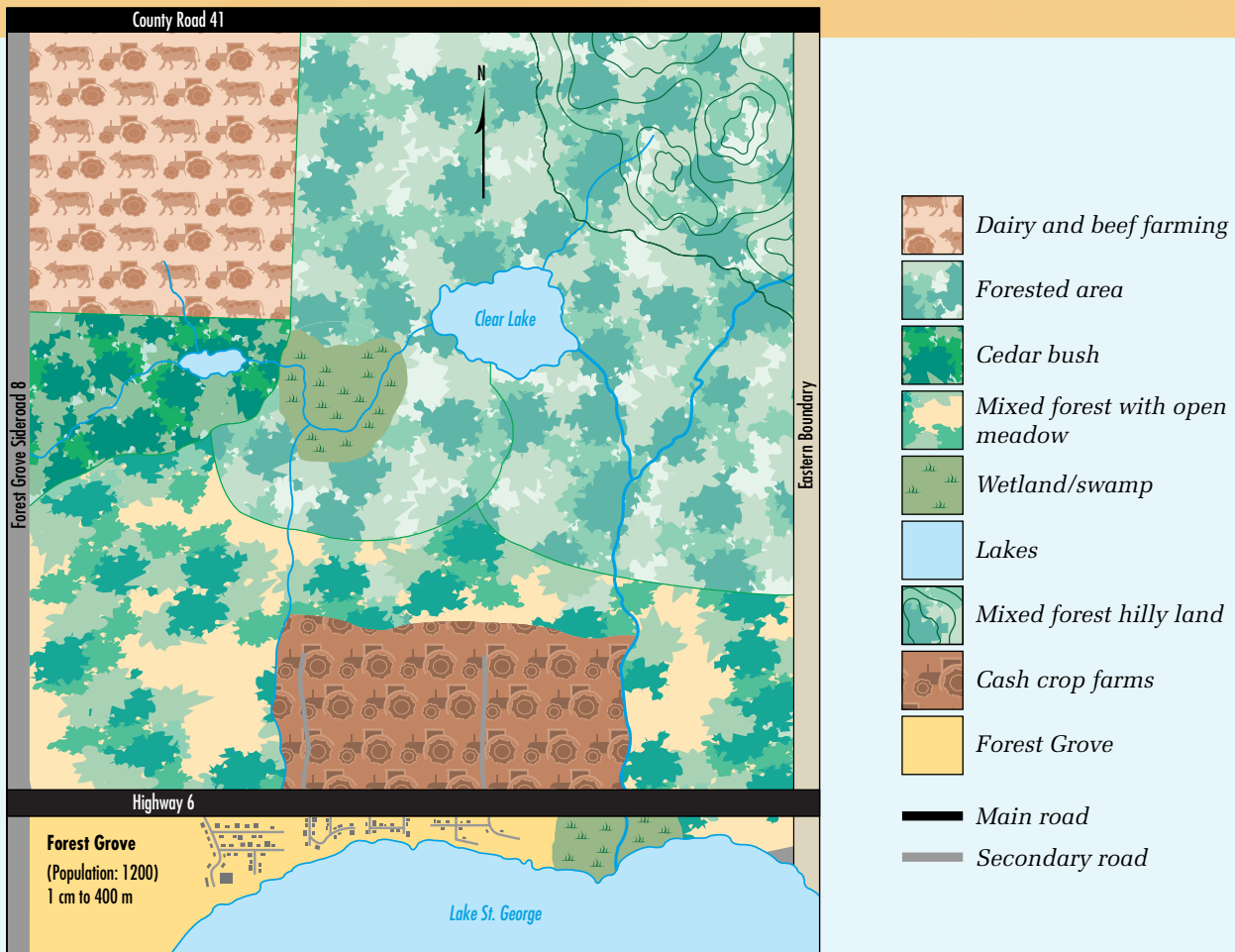
Your Goal

Your goal is to balance the needs for human growth and development with the needs of the biotic and abiotic factors of ecosystems.

What You Need to Know

The town of Forest Grove has a population of 1200 people. The unemployment rate has been 20% for the past several years. The town council has decided to develop a piece of unused land. It hopes to attract businesses, industries, and people to Forest Grove. The piece of land has an area of 2000 ha. (One hectare, or 1 ha, measures 100 m by 100 m.) Imagine you are a member of a land-use planning group. Forest Grove's town council has hired your team to design a plan to develop this land.

The map shown here outlines the various features of the land. Study it closely. Many different groups of people have ideas for developing this land. You will have to decide which ideas to use, which to ignore, and which to change. Use the Impact Assessment Checklist to help you evaluate your plans.



A map of Forest Grove

Impact Assessment Checklist

In what ways can your plans

- allow opportunities for more growth and development in the area?
- minimize the effects of growth and development on the habitats of the area?
- minimize the effects of growth and development on the living things of the area?
- deal with pollution and other negative effects to the area?
- balance the need for preserving natural ecosystems with the needs of people and their families?

Steps to Success

- 1 Design a land-use plan that addresses the following interests.
 - a) Industries: These will provide employment for the townspeople.
 - A hospitality company wants to develop a camping and motel site. This complex will include a 25-unit motel, a small restaurant, a wooded camping area (about 5 ha), a recreation centre with tennis courts, a swimming pool, and a boat-launching ramp.
 - A distribution company wants to set up a large warehouse depot for transferring goods to and from the surrounding communities. They will need good roads to get to the nearby highway.

- b) Housing developers: They will want to build two new subdivisions for Forest Grove's growing population. The subdivisions will require roads to link them up with the existing town. They will need services such as water and electricity. The people who move into the new homes will also want their garbage handled in some way.
 - c) Businesses: These will provide stores and services such as restaurants, health care, a movie theatre, and a new shopping centre. Businesses will also need water, electricity, and garbage handling.
 - d) Local farmers: There are currently seven farms located to the west of the land you will be developing. All the farmers have expressed interest in expanding their operations. They would like some of the land set aside for them to lease or buy.
 - e) Private citizens: Many people in Forest Grove would like the land to be used for recreational purposes, such as parkland, with trails for walking and biking. They would also like to swim and boat on the river and in the lakes. A small group of citizens is urging you to leave the land as it is to preserve the local plant and animal populations. They are willing to consider limited use of the land for camping to attract people (and their money) to Forest Grove.
- 2 With your team, come up with a plan for the use of this land. Some of the questions you will need to take into account include:
 - a) How will you address the increase in garbage and other wastes?
 - b) What will happen if the town council wants to add to your development plans 10 years from now?
 - c) How will your decisions affect the quality of the air, water, and land?
 - d) How will your decisions affect the number and health of existing plant and animal populations?
 - 3 Design a two-dimensional or three-dimensional model of the piece of land. Use different colours or structures to represent the different land uses.
 - 4 When you have completed your plan, present it to your classmates. Be prepared to explain and, if necessary, defend your decisions.

How Did It Go?

- 5 Look back at the criteria you developed at the start of the Project. Look also at the Impact Assessment Checklist. How well does your finished plan reflect all these criteria?
- 6 In your opinion, how well did your plan balance the needs of people and other living things? Be as specific as possible in your answer.
- 7 If you could redesign your land-use plan, what would you decide to do differently. Why?



UNIT REVIEW: INTERACTIONS AND ECOSYSTEMS

Unit Vocabulary

1. Create a mind map that illustrates your understanding of the following terms.

abiotic	food web
biotic	ecosystem
producers	succession
consumers	matter
decomposers	energy
food chain	human impact
interactions	endangered species

Check Your Knowledge

1.0

2. What is the difference between biotic and abiotic factors in an ecosystem?
3. Define mutualism and give an example of it.
4. What are the basic requirements of all living things?

2.0

5. Describe the unique role plants play in a food chain.
6. a) Give two examples of helpful microscopic organisms. Explain why they are helpful.
b) Give two examples of harmful microscopic organisms. Explain why they are harmful.
7. What are two different types of consumers?
8. What are food chains and what is their purpose?

9. How is a food web different from a food chain?
10. Describe the difference between how matter and energy move through a food web.

3.0

11. Identify three ecosystems that you have walked through in the past few days. Explain how you know they are ecosystems.
12. Identify natural factors that can alter the living conditions in ecosystems.
13. What is succession? Give an example.
14. Describe three types of human activities that can impact an ecosystem.
15. What is meant by the term *bioinvasion*? Give an example of how this can impact an ecosystem.
16. Describe other factors that can affect ecosystems besides bioinvasion.

4.0

17. Identify a pollutant that moves through an environment and causes serious harm.
18. Look around your community. What evidence do you see of environmental problems caused by human activities? What evidence is there that your community is working to support living things and their living spaces?
19. Why have some species become endangered or extinct in North America?



UNIT REVIEW: INTERACTIONS AND ECOSYSTEMS

20. Describe a situation that science and technology cannot answer.

Connect Your Understanding

21. a) Why would you expect to find each of the following in any ecosystem? Give reasons to support your answer.

- producers
- herbivores
- decomposers

- b) Which group (or groups) of consumers is missing from part a) above? Why might it be possible for this group (or groups) to be absent from an ecosystem?

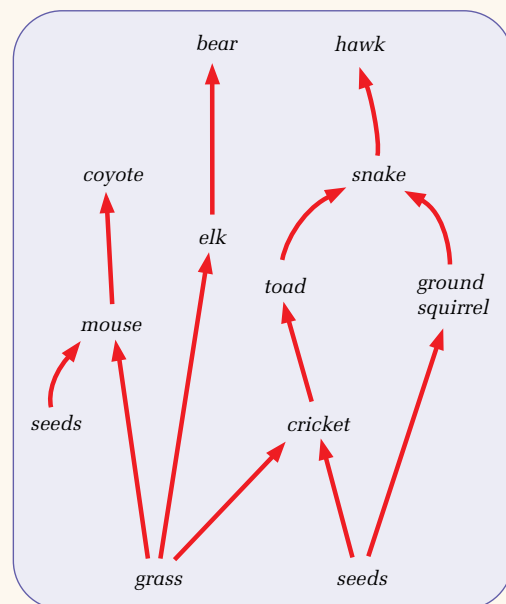
22. Listed below are four elements of ecosystems followed by five statements. Choose two of the statements. Take each chosen statement as a topic, and write a paragraph using the four elements of ecosystems.

- the role played by food webs
- the cycles of matter
- the flow of energy through ecosystems
- the interactions between living and non-living things

- a) You sort your family's wastes into recyclables and non-recyclables.
b) A concerned citizen is arrested for blocking a road to prevent loggers from cutting trees.
c) A food manufacturing company hires local villagers in Costa Rica to remove rain forest vegetation so it can set up a ranch to raise beef cattle.

- d) A government decides to build a water-powered electricity generating plant. To do so, it must build a dam to stockpile water. Building the dam means that thousands of hectares of meadows and villages will be flooded.
e) Several families move to an island that has lots of rare slow-moving animals and flightless birds. The families decide to bring their pet cats with them.

23. a) Examine this food web.



Design a chart to record the following:

- all the producers
 - all the herbivorous consumers
 - all the carnivorous consumers
 - all the scavengers and decomposers
- b) Where might this food web be located?
c) Add eight living things to your chart, including: two each of producers, herbivores, carnivores, and decomposers.

24. A population of noisy crows has moved into your neighbourhood. They're chasing away the local birds, and their wastes are fouling the streets and rooftops. What action, if any, should be taken?

Practise Your Skills

25. In 1944, soldiers from the U.S. Army moved a herd of 29 reindeer to a remote island in the Arctic. Then the soldiers left. The only other consumers on this island were arctic foxes and voles (voles are mouse-like animals). There were numerous producers including grasses and plant-like living things called lichens, which reindeer love to eat.

In 1957, scientists visited the island. They discovered that the number of reindeer had increased to 1350. They also observed that there were fewer producers on the island. However, there were still plenty for the reindeer to feed on.

In 1963, scientists visited again. The reindeer now numbered 6000. The producers were nearly gone. One year later, when scientists arrived once more, they discovered that most of the reindeer had died. Only 42 remained.

- Sketch a food web to show how you think the biotic factors of this island ecosystem were related.
- What factors affected the population of the reindeer? Why?
- What abiotic or biotic conditions might have led to a different ending to this story? Explain your answer.

Self Assessment

Think back to the work you did in this unit.

- Do you think you will make decisions about the environment differently now that you have completed this unit? Why or why not?
- Will you be able to take different perspectives about environmental decision-making? Provide an example to explain your answer.
- In general, do humans respect the environment? Use three examples from the unit to support your answer.
- What is one idea or issue covered in this unit that you would like to explore in more detail? Why?

**Focus
On**

SOCIAL AND ENVIRONMENTAL CONTEXT

In this unit, you investigated the social and environmental context related to interactions and ecosystems. Consider the following questions.

- What examples did you investigate that demonstrated how science and technology are developed to meet human needs?
- Describe a hobby or interest for which science and technology provided an opportunity through the study of this unit.
- Reread the three questions on page 7 about the social and environmental context. Use a creative way to demonstrate your understanding of one of the questions.