Topic 1.6

How can our actions promote sustainable ecosystems?

Key Concepts

- We must understand and commit to sustainability.
- We must understand the link between biodiversity and sustainability.
- Our actions can maintain or rebuild sustainable ecosystems.
- You can choose actions that benefit ecosystems now and for the future.

Key Skills

Inquiry
Literacy
Research

Key Terms

sustainability
biodiversity
equilibrium

It began with a single city–Sydney, Australia–in 2007. As 2 million people and 2000 businesses shut down their lights for one hour, they sent a message into the world, to all who might hear: "We are concerned about climate change, and we hope our simple act inspires you to reduce activities that release excess carbon and other substances that contribute to it."

The world heard. As part of the second Earth Hour, Sydney was joined by people from 35 countries and more than 400 cities around the globe. Those people included students from 925 Ontario schools and their families. Across the province, demand for electrical energy dropped 5.2 percent during Earth Hour. At the University of British Columbia, demand dropped a full 100 percent—for the whole day!

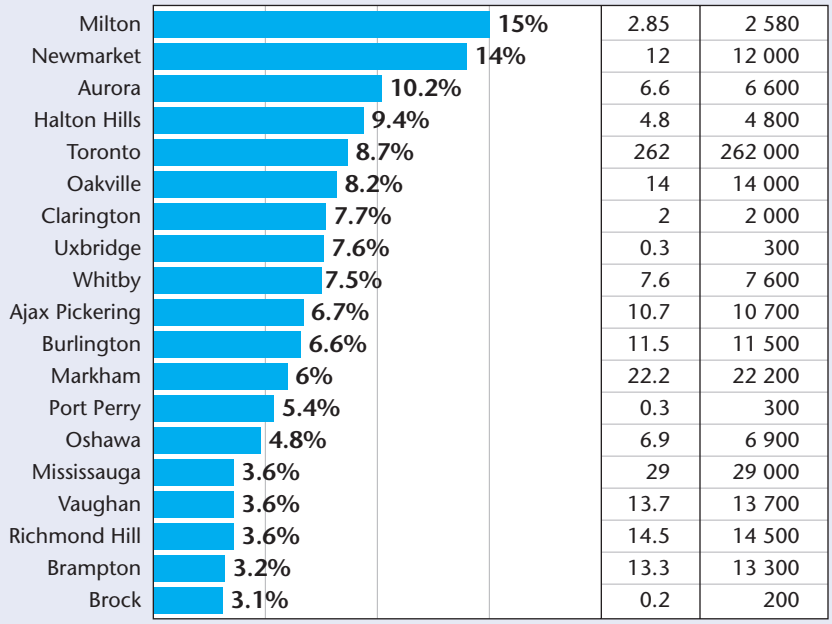
The following year, 2009, was even more successful. People from 88 countries and more than 4000 cities took part. The province of Ontario, minus Toronto, saw an overall decrease of 6 percent in electrical energy used. Toronto, meanwhile, decreased its usage by 15.1 percent.

Starting Point Activity

Almost half of Ontario's energy drop came from Toronto and the surrounding region. The results are shown in the graph below.

1. Many cities and towns kept their own Earth Hour data. Find out the data for the community where you live, plus three other communities in other parts of the province.
2. Earth Hour 2008 asked people to turn off only their lights for one hour. What other things around the home and in the community could be turned off as well?
3. Some people have said that the Earth Hour event has little or no effect on dropping energy use worldwide.
   a) How could the event have a greater effect?
   b) Even if the event has little or no effect on energy use, what other benefits might it have?

Earth Hour Results for Select Cities in Ontario in 2008



	Megawatts saved	Number of homes the saved energy would power
Milton	2.85	2 580
Newmarket	12	12 000
Aurora	6.6	6 600
Halton Hills	4.8	4 800
Toronto	262	262 000
Oakville	14	14 000
Clarington	2	2 000
Uxbridge	0.3	300
Whitby	7.6	7 600
Ajax Pickering	10.7	10 700
Burlington	11.5	11 500
Markham	22.2	22 200
Port Perry	0.3	300
Oshawa	6.9	6 900
Mississauga	29	29 000
Vaughan	13.7	13 700
Richmond Hill	14.5	14 500
Brampton	13.3	13 300
Brock	0.2	200

We must understand and commit to sustainability.

sustainability: maintaining an ecosystem so that present populations can get the resources they need without risking the ability of future generations to get the resources that they will need

The word "sustainability" can mean different things, depending on who uses it and in what situation. In terms of what you have been learning in this unit, one way to think about the word is this: **Sustainability** is maintaining the abiotic and biotic parts of an ecosystem so that present populations can get the resources they need without risking the ability of future generations to get the resources that they will need.

Sustainability helps to ensure that populations stay within the carrying capacity of their ecosystem. It is a way of believing, and thinking, and acting that takes into account the effects that our actions will have on the ability of future generations of all living things to live a good life.

LEARNING CHECK

1. In terms of this unit, what does sustainability mean?
2. What resources do we humans use that future generations will need as well?
3. Provide two examples of ways that we can ensure that future generations will have what they need to live a good life.
4. Provide three examples of your own actions that affect ecosystems. Classify these actions as sustainable or unsustainable.

Literacy Focus

Activity 1.16

REFLECTING ON RESPONSIBILITIES

Read and listen to the words below, spoken by the wise of the Haudenosaunee, who are also known as the Iroquois.

1. As you read and listen to these words, how do you feel:
   - about yourself?
   - about others who are dear to you?
   - about your past, present, and future?
   - about your connection to our shared planet Earth?

   Share your feelings with others or record them only for yourself, as you wish.
2. Read and listen again to the last line: "We must consider the effects our actions will have on their ability to live a good life." This line helps to guide us in the way we feel, think, and act toward Earth as we live our lives. Non-Aboriginal people today describe this guidance as "sustainability." Use a word map to show how you would explain the meaning of this term.

We acknowledge one another, female and male. We give greetings and thanks that we have this opportunity to spend some time together.

We turn our minds to our ancestors and our Elders. You are the carriers of knowledge, of our history.

We acknowledge the adults among us. You represent the bridge between the past and the future.

We also acknowledge our youth and children. It is to you that we will pass on the responsibilities we now carry. Soon, you will take our place in facing the challenges of life. Soon, you will carry the burden of your people. Do not forget the ways of the past as you move toward the future. Remember that we are to walk softly on our sacred Mother, the Earth, for we walk on the faces of the unborn, those who have yet to rise and take up the challenges of existence.

We must consider the effects our actions will have on their ability to live a good life.

We must understand the link between biodiversity and sustainability.

There are at least 2 million species (kinds) of organisms on Earth. These are just the species we know about. Some scientists estimate there could be as many as 100 million more species yet to be discovered. There is truly a great diversity of species of living things on Earth.

Now think about ecosystems. An ecosystem's size and the number of populations it supports is limited only by the abiotic and biotic parts of that ecosystem. Any ecosystem may contain tens, hundreds, thousands, and more smaller ecosystems. There is truly a great diversity of ecosystems on Earth.

biodiversity: all the diversity of species that live in an ecosystem, as well as all the diversity of ecosystems within and beyond that ecosystem

There is a word that describes the great diversity of Earth's species and the great diversity of Earth's ecosystems at the same time. That word is biodiversity. **Biodiversity** is all of the diversity of species that live in an ecosystem, plus all of the diversity of ecosystems within and beyond that ecosystem. So biodiversity is all the different kinds of living things in a certain place, as well as all the different kinds of places within that place and elsewhere.

Linking Biodiversity with Sustainability

equilibrium: a state of balance in an ecosystem

So how are biodiversity and sustainability linked? You already know the answer when you remember that everything is connected. A sustainable ecosystem must maintain a state of balance between its diverse living parts and its non-living parts. This state of balance is called **equilibrium**. An ecosystem that is in equilibrium (in balance) tends to have a high degree of biodiversity. Such an ecosystem tends to be a sustainable ecosystem.

LEARNING CHECK

1. Explain how biodiversity refers to species as well as ecosystems.
2. How does the term "equilibrium" apply to ecosystems?
3. Draw a picture to represent a sustainable ecosystem. Include the ideas of species diversity, biodiversity, and equilibrium.

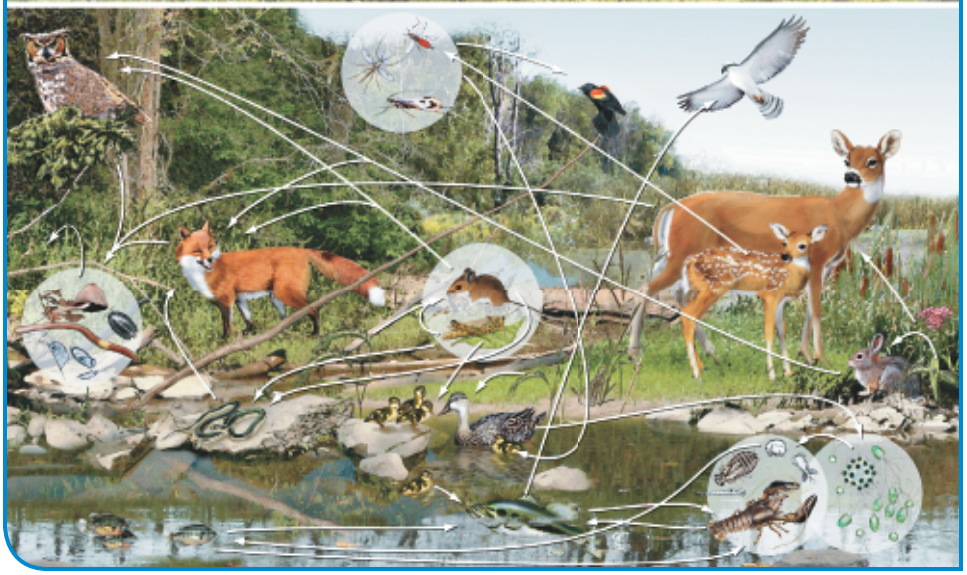
Inquiry Focus

Activity 1.17

LOOK FOR THE LINKS

The pictures show food webs in a forest ecosystem and an arctic ecosystem.

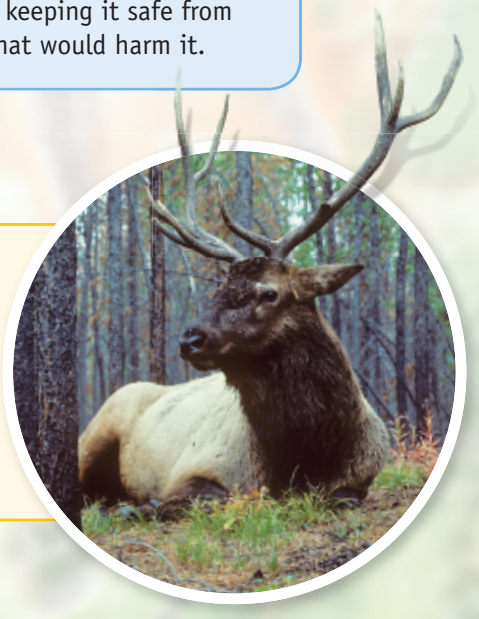
1. Compare the abiotic parts of these two ecosystems. For instance, how does the amount of sunlight in each ecosystem compare? What about temperature, water, and shelter?
2. Compare the biodiversity in these two ecosystems. Why would one ecosystem have a higher biodiversity than the other?
3. A rainforest has a much higher biodiversity than a desert. And yet both ecosystems can be in equilibrium. In other words, both ecosystems can be equally sustainable. What does that tell you about the link between biodiversity and sustainability?



Our actions can maintain or rebuild sustainable ecosystems.

We can harm ecosystems when we forget to think about the consequences of our activities. But we also have the power to heal ecosystems. Many communities have adopted programs to maintain ecosystems that are in danger of becoming unhealthy and to rebuild ecosystems that have already become so. The pictures on these two pages give a sample of the many ways that human activities are helping ecosystems.

A healthy wetland is a hotbed of biodiversity. Alfred Bog in southern Ontario is one such place. Thanks to the efforts of concerned citizens and government officials, more than 70 percent of this wetland is managed as a nature reserve, keeping it safe from mining and other activities that would harm it.



Elk were once native to Ontario, but by the late 1800s, these majestic animals were gone as a consequence of growing human settlements and over-hunting. Efforts to restore elk to Ontario have been in place since the mid-1990s. Four populations are now re-established in the areas of Sudbury, Bancroft/North Hastings, Lake of the Woods, and the north shore of Lake Huron.

This beetle, originally from Europe, is one of the species of insects used in the fight against purple loosestrife. Use of living things to control introduced species is called biocontrol. This can be effective in reducing the population size of an introduced species. However, it rarely can remove the invader entirely.

LEARNING CHECK

1. Describe two ways that humans are helping ecosystems.
2. Converting a strip mall to condominiums instead of building on a field is an example of smart growth. Explain why.
3. What might be some unintended consequences of using an introduced species for the purpose of biocontrol?

ACTIVITY LINK
Activity 1.18, on page 73

Go to **scienceontario** to find out more

Farmers and home-owners in rural areas, as well as in cities, often set up special boxes to provide places for birds to establish nests. People who love and respect birds and their role in ecosystems put up nest boxes to make up for the trees that have been logged to clear space or provide timber for various products.

Urban sprawl happens as cities with growing populations increase their size by spreading into natural areas and farmland. A strategy called smart growth helps by concentrating growth in the centre of a city, rather than in outlying areas. Homes and businesses intermingle, while green spaces are preserved. Smart growth also enhances public transit, which reduces traffic pollution.

INVESTIGATION LINK
Case Study Investigation, on page 76

You can choose actions that benefit ecosystems now and for the future.

Consumers have power. What choices do you make about the products you will and will not buy? What reasons lie behind, or motivate, your choices?

Volunteers inspire by their commitment and example. Where do you, or can you, volunteer your time? Who benefits from your willingness to share a part of yourself?

Change in society starts with change in individuals. Each one of us has tools and gifts that can help us bring about change. At the start of this unit, you thought about this statement:

"Instead of waiting for change that might never come, many people are choosing to become the change they are waiting for."

Citizens have responsibility. In what ways are you a citizen of your community? Your province? Your country? Your planet? What responsibilities do you have as a citizen?

Over the course of this unit, you have seen ways that humans can harm ecosystems as well as help them. Each of us holds in our thoughts, in our hands, and in our hearts the ability to create a more sustainable future. How do you use this ability now? How will you use it in the future?

Making a DIFFERENCE

In Grade 9, Yvonne Su found out that her Newmarket school was not recycling, because it lacked the resources. So she and some friends and teachers decided to tackle the problem themselves. They started a recycling and environmental club. Yvonne has been engaged in environmental activities ever since.

"As Grade 9s, my friends and I didn't know where to turn to learn more about our planet. But after speaking to some teachers, we found out that our greatest resources were right in front of us—our science classes."

The more Yvonne and her friends learned, the more they wanted to share their knowledge. They organized campaigns at their school about environmental issues. They then took their campaigns to schools across Canada.

What changes could be made at your school to help the environment?

Students at a Toronto school have adopted a local aquatic ecosystem. Over the past 10 years, students in Chaminade College's science classes and environmental club have worked on projects to restore the Black Creek. "The Black Creek was once a pristine, cold-water trout and salmon fishery, which, with some effort, can be returned to its former glory," says science teacher Tino Romano, who is moderator of the environmental club.

The school's efforts include an ongoing project to decrease erosion of the banks of the creek. Students have planted aquatic and terrestrial plants in and around the creek. They also have removed garbage from the creek and the area around it. The school also has its own fish hatchery. Each year, students raise thousands of brown trout and 100 Atlantic salmon in the hatchery and release them into the nearby Humber and Credit Rivers. Through their efforts, Chaminade students hope to re-establish spawning grounds for brown trout.

Is there a local stream that your school could "adopt" and help restore?

Research Focus

Activity 1.18

TOWN COUNCIL MEETING

When it comes to environmental decision making, not everyone has the same opinion. People come from different backgrounds and have different life experiences. As a result, people's viewpoints on the same environmental issue may differ dramatically.

What To Do

1. As a class, identify a local project that will have an effect on the environment if it is carried out. Examples include building a new golf course, introducing a sport fish that is not native to local streams, or paving over a city green space. You can also create your own scenario to use for this activity.
2. Agree on four to six citizens who will present their point of view at a town council meeting concerning this project. The citizens should all have different points of view about the project. For example, the project may be to open a mine near a fishing lake. Citizens presenting their point of view might include an unemployed miner, a local business person, the head of a company that uses minerals from the mine, a local angler, the Minister of Tourism, and a resident concerned about water quality.
3. Form groups so that each group represents one citizen. You do not have to agree with the point of view of your group's citizen, but you must present it fairly.
4. Use your library, the Internet, and other sources to research the issues concerning the project. Focus on questions that your citizen would likely want answers to. For example:
   - What economic or social benefits will the project bring that will affect me?
   - What impacts will it have on the soil, vegetation, and water that I might care about?
   - Use an organizer such as a PMI chart to organize the results of your research.
   - How might the direct and indirect effects of the project affect my future and the future of those I care about?
   - Do the impacts of this project sit well with my beliefs and values?
5. Once you have collected your information, prepare a presentation for the town council (played by your teacher) that explains your views and concerns about the project. Explain why you do or do not support the project. Use charts, tables, or graphs to display data where helpful.
6. Present your point of view to the council, allowing time for questions from the council and other citizens (your classmates).
7. Based on the information presented, try to come to a joint decision, as a town, to approve, abandon, or modify the project.

What Did You Find Out?

1. Give an example of how the knowledge you gained in this unit helped you research and present your citizen's position.
2. What other issues were raised during the presentation? Identify any that you thought were interesting or important.
3. Do you think the process you modelled is an effective way to make decisions about local projects that have an environmental impact? Explain.

Securing a Bright Future for Songbirds

Cardinals are common visitors to urban Ontario green spaces.

ELECTRONEWS

SATURDAY, JUNE 2, 2114.

TORONTO NOVA

TORONTO, ONTARIO

Toronto's Oldest Citizen Remembers Songbird Past

Toronto resident Jared Riozk is celebrating a milestone. Born at the end of the 1990s, Riozk is celebrating his 115th birthday today. Living with his 58-year-old granddaughter, Riozk enjoys quiet times with his family and an occasional game of Masiko, which he got hooked on when it came out in 2065. Although he doesn't get out much these days, Riozk spends a lot of time recalling a greener, feather-filled Toronto. "There were a lot of songbirds when I was young," Riozk recalls. "Cardinals, chickadees, goldfinches, orioles—you name it." Riozk smiles a bittersweet smile. "People tried to preserve the areas where songbirds lived and bred, but it was too late. Urbanization pushed its way through the last of the natural ecosystems in this city, and pushed the songbirds out right along with them." Asked what he would do differently if he could go back in time, Riozk replied, "I don't know. Not think someone else would take care of it, I guess. Take action. Make a difference." Riozk stares at the empty blue horizon as he speaks. The last songbird was spotted in Toronto 22 years ago.

The Science behind the Story

Every day, multiple futures lie before us. But we also have opportunities to influence these futures, to create the world we wish to see. Today, urban sprawl plays a large role in the destruction of many natural ecosystems. Native songbirds rely on the plant life in these ecosystems for food, shelter, and other resources. Without these ecosystems, the future of songbirds may be bleak in these urban areas.

Pause and Reflect

1. How can urban sprawl affect songbird populations?

Unless adequate conservation measures are put in place, human expansion may make birdsong a rare sound in urban areas such as Toronto.

How can we influence the future of songbirds?

Private citizens can make a difference when it comes to preserving songbird habitat in urban areas. In the greater Toronto area, for example, 80 percent of the natural green spaces are privately owned. This means that native backyard plantings and water sources can provide songbirds with the resources they need to thrive in this area. Not only does the number of songbirds increase, but so does their diversity. Even native plantings on balconies can help provide a stop-over sanctuary in the city that songbirds can rely on year after year.

Pause and Reflect

2. How can private citizens help preserve songbird habitat in urban areas?

What projects are already forging a brighter future?

Project CHIRP! encourages people to restore natural vegetation to private and public green spaces in southern Ontario. CHIRP stands for **C**reating **H**abitat in **R**esidential **A**reas and **P**arkland. The project hopes to inspire gardeners to plant native plants in their gardens, providing food, water, and shelter for local songbirds. It was started by Christina Sharma, an Etobicoke, Ontario, gardener who turned her love of native plants and songbirds into an environmental program that makes a difference.

Pause and Reflect

3. How does Project CHIRP! make a difference for urban songbirds?

Inquire Further

4. Find out which native plants provide food and shelter for songbirds where you live.

5. Design a garden that would increase the number of songbirds that visit your school grounds.

6. Investigate other projects that restore wildlife populations where you live.

Project CHIRP! shows people how to plant native plants in gardens such as this one. Such gardens provide food, water, shelter, and other resources for songbirds.

Skill Check

- ✓ Initiating and Planning
- ✓ Performing and Recording
- ✓ Analyzing and Interpreting
- ✓ Communicating

Investigating a Local Environmental Project

Do you have a friend who is part of a group that is working to preserve a local bog? Is your neighbour involved in a spring riverbank clean-up each year? Are you involved in a local frog count? In this investigation, you will research an environmental program or project to find out how it is linked to the sustainability of a local ecosystem.

What To Do

1. With your class, identify sources of information that could be used to discover local projects that promote the sustainability of a terrestrial or aquatic ecosystem in your area.
2. With your group, use these resources to choose a local project that interests you. Ask your teacher for permission to research this project before you continue.
3. As a group, write a list of questions that you would like to answer about your chosen project. Your goals are to learn more about the project in general and find out why it is important to the sustainability of the ecosystem it is targeting.

   Below are examples of questions that your group could ask.

   - Is there a program that is working to green the grounds of your school? What impact has this program had on the local ecosystem? What other plans could be put in place to help this program succeed?
   - Is there a project in your community to reduce the amount of pollution released into a nearby river or lake? How has this aquatic ecosystem become more sustainable as a result of the project? What other actions could be taken to improve the sustainability of the ecosystem?
   - Has the implementation of an Environmental Farm Plan (EFP) changed practices on a farm near your community? What changes have been made? How have these changes affected the sustainability of nearby terrestrial and aquatic ecosystems?
4. Use your research to design a website, poster, or brochure to inform other community members about the project.

What Did You Find Out?

1. How has the project you investigated improved the sustainability of a local ecosystem?
2. Suggest another way the project could make the ecosystem more sustainable. How would your suggestion do this?

Topic 1.6 Review

Key Concepts Summary

- We must understand and commit to sustainability.
- We must understand the link between biodiversity and sustainability.
- Our actions can maintain or rebuild sustainable ecosystems.
- You can choose actions that benefit ecosystems now and for the future.

Review the Key Concepts

1. K/U Answer the question that is the title of this topic. Copy and complete the graphic organizer below in your notebook. Fill in four examples from the topic using key terms as well as your own words.

2. K/U Revisit the word map you made in Activity 1.16 that described what sustainability meant to you. Now that you have finished the topic, add any new understandings or insights to complete your picture.

3. T/I Many towns and cities in the country ban the use of pesticides in parks and on home lawns. This is one example of a human activity that can work in support of, rather than against, ecosystems.

a) Identify at least three other human activities that you think work in support of ecosystems.

b) Conduct a risk-benefit analysis in the form of a PMI chart to assess one of these activities. Based on your analysis, would this action be something worth doing to promote sustainable ecosystems?

4. C Choose a different activity from the ones you identified in question 3. Create a poster or write an opinion piece such as an editorial or blog to persuade people why they should undertake that activity.

5. K/U What does it mean to say that an ecosystem is "in equilibrium"?

6. A Refer to the photo of the pond ecosystem below. Suppose that a poisonous substance leaked into the water and killed most of the fish. Explain how this change in equilibrium might affect the sustainability of the ecosystem.

A pond ecosystem

7. K/U **a)** What does "urban sprawl" mean?

b) Use a cause-and-effect map to show possible effects on a city of using the strategy known as "smart growth."

8. T/I Use the Internet to find examples of different online campaigns that people have launched to promote sustainability. Present one example to the class and discuss whether or not you think the campaign has been effective. How might you take advantage of technology to help maintain or develop sustainable ecosystems?

SCIENCE AT WORK

CANADIANS IN SCIENCE

▲ Chandler Eves is an inventory project coordinator for the Lake Simcoe Region Conservation Authority.

Lake Simcoe is one of the largest aquatic ecosystems in Ontario and is home to many different populations of organisms. It is also less than an hour away from half of Ontario's human population. Development around the lake continues to put stress on the ecosystem. The Lake Simcoe Region Conservation Authority works to restore and protect Lake Simcoe and its watershed. Chandler Eves started working for the authority as a fisheries technician six years ago. Fisheries technicians conduct field research and collect data that can be used by municipalities to make decisions about what types of development should take place in and around an ecosystem.

What challenges do you face in your job?

The biggest challenge is unpredictability. "Humans can sometimes forget that we are not always in control. Field work is extremely unpredictable," says Chandler. Fisheries technicians have to be good at solving problems and adapting to change.

What do you find most rewarding about your job?

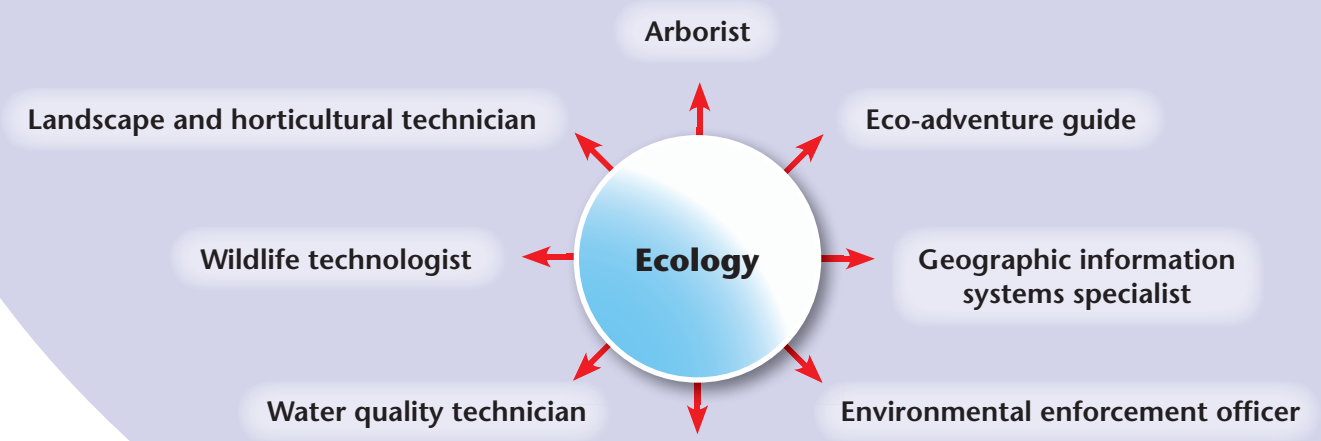
Chandler says the most rewarding part of his job is seeing how data he collects is used to make important decisions. For example, he might collect information about water temperatures and fish species in a section of a stream. Some species of fish can breed in warm water and some breed only in cold water. Building and development can lead to thermal pollution, making water warmer and not suitable for the breeding of some species. Information Chandler collects can be mapped, and municipal planning departments can use the maps to make decisions about where development should be allowed.

What advice do you have for students who are interested in getting into your field?

Chandler thinks students interested in working in his field should gain as much field experience as possible, as soon as possible. Find opportunities to volunteer with local conservation authorities or nature groups, he says. "If you are interested, stay interested and plan ahead to ensure you have all the course requirements to enrol in an appropriate program."

Ecology at Work

The study of ecology contributes to these careers, as well as many more!



▲ Water quality technicians collect and analyze water samples and may also inspect sites for sources of contamination. They work for water treatment plants, governments, conservation authorities, and environmental consulting companies.

▲ Forestry technologists measure, survey, and map treed areas. They may be involved in reforestation, fire protection, harvesting, or tree health.

▲ Environmental enforcement officers help protect Canada's wildlife and natural resources from poachers, smugglers, and other people who break the law. They work for the federal government across the country.

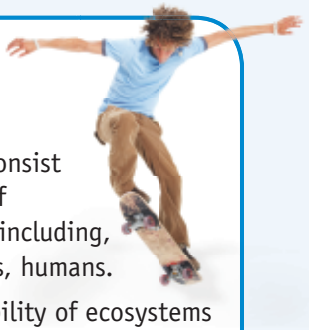
Over To You

1. If you could interview Chandler Eves, what questions about his work would you ask him?
2. Why is it valuable for a fisheries technician to be a good problem solver?
3. Research a career involving ecology that interests you. If you wish, you may choose a career from the list above. What are the essential skills needed for this career? e-LINK

Go to **scienceontario** to find out more

Unit 1 Summary

Topic 1.1: What are ecosystems, and why do we care about them?



Key Concepts

- Ecosystems are about connections.
- Ecosystems are made up of biotic (alive) and abiotic (not alive) parts that interact.
- Interactions between terrestrial (land) ecosystems and aquatic (water) ecosystems keep all ecosystems healthy.

Key Terms

ecology (page 11)

biotic (page 12)

abiotic (page 12)

ecosystem (page 13)

terrestrial ecosystem (page 14)

aquatic ecosystem (page 14)

Big Ideas

- Ecosystems consist of a variety of components, including, in many cases, humans.
- The sustainability of ecosystems depends on balanced interactions between their components.

Topic 1.2: How do interactions supply energy to ecosystems?

Key Concepts

- Photosynthesis stores energy, and cellular respiration releases energy.
- Producers transfer energy to consumers through food chains and food webs.
- Interactions are needed to provide a constant flow of energy for living things.

Key Terms

photosynthesis (page 20)

cellular respiration (page 20)

producer (page 22)

consumer (page 22)

food chain (page 22)

food web (page 23)

Big Ideas

- Ecosystems consist of a variety of components, including, in many cases, humans.
- The sustainability of ecosystems depends on balanced interactions between their components.

Topic 1.3: How do interactions in ecosystems cycle matter?

Key Concepts

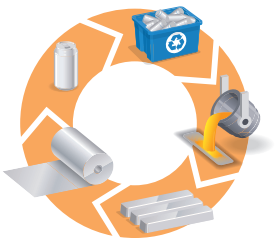
- Abiotic and biotic interactions cycle matter in terrestrial and aquatic ecosystems.
- Photosynthesis and cellular respiration cycle carbon and oxygen in ecosystems.
- Human activities can affect ecosystems by affecting nutrient cycles.

Key Terms

decomposer (page 30)

nutrient (page 30)

nutrient cycle (page 30)



Big Ideas

- Ecosystems consist of a variety of components, including, in many cases, humans.
- The sustainability of ecosystems depends on balanced interactions between their components.
- Human activity can affect the sustainability of terrestrial and aquatic ecosystems.

Topic 1.4: What natural factors limit the growth of ecosystems?

Key Concepts

- Ecosystem growth is limited by the availability of resources.
- Abiotic and biotic factors limit populations in ecosystems.

Key Terms

population (page 42)

carrying capacity (page 42)

limiting factor (page 42)

Big Ideas

- Ecosystems consist of a variety of components, including, in many cases, humans.
- The sustainability of ecosystems depends on balanced interactions between their components.

Topic 1.5: How do human activities affect ecosystems?

Key Concepts

- We cannot always accurately predict the consequences of our actions.
- Introduced species can affect the health of ecosystems.
- Pollutants from human activities can travel within and between ecosystems.

Key Terms

introduced species (page 54)

species diversity (page 55)

watershed (page 56)

Big Ideas

- The sustainability of ecosystems depends on balanced interactions between their components.
- Human activity can affect the sustainability of terrestrial and aquatic ecosystems.

Topic 1.6: How can our actions promote sustainable ecosystems?

Key Concepts

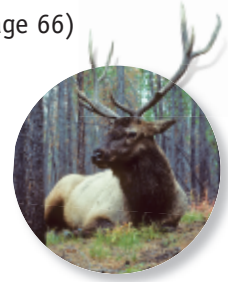
- We must understand and commit to sustainability.
- We must understand the link between biodiversity and sustainability.
- Our actions can maintain or rebuild sustainable ecosystems.
- You can choose actions that benefit ecosystems now and in the future.

Key Terms

sustainability (page 65)

biodiversity (page 66)

equilibrium (page 66)



Big Ideas

- The sustainability of ecosystems depends on balanced interactions between their components.
- Human activity can affect the sustainability of terrestrial and aquatic ecosystems.

Inquiry Investigation: Investigating Compost

Nutrients are major limiting factors for growing crops. Human-made fertilizers provide nutrients, but their production and use pollutes ecosystems and the air. Composting may offer a partial solution to this problem. Through composting, food waste is changed into rich organic matter that provides nutrients for plant growth. Does compost provide enough of the nutrients plants need to thrive?

Inquiry Question
How does a plant grown with compost compare with one grown with synthetic fertilizer?

Initiate and Plan

1. Design a test to answer the Inquiry Question above. Include:
   - a hypothesis
   - a list of equipment and materials
   - a step-by-step testing method (show how you will control variables such as amount of light and water)
   - a list of dependent, independent, and controlled variables
   - safety precautions
   - a way to measure your results
   - a method for recording your results
2. Have your teacher approve your design.

Perform and Record

3. Carry out your test.
4. Summarize the growth results with a graph.

Analyze and Interpret

1. Which plant grew the most and was the healthiest during your investigation?
2. Did your results support your hypothesis? Why or why not?
3. Explain any sources of error, and list changes you would make if you were going to repeat the investigation.
4. Explain how the application of fertilizer (synthetic and compost) might affect nutrient cycles in ecosystems.

Communicate Your Findings

5. Present your results in a brief report that discusses the use of compost for growing food a) on farms and b) in home gardens.

Assessment Checklist

Review your project when you complete it. Did you…

- ☑ generate a hypothesis? T/I
- ☑ make a list of necessary equipment and materials? T/I
- ☑ include a step-by-step testing method? T/I
- ☑ list the dependent, independent, and controlled variables? K/U
- ☑ record your results in an appropriate table and summarize them using a graph? C
- ☑ present your results in a report that discusses the possible use of compost for growing food? A

An Issue to Analyze: Going Greener

You have learned how humans have an impact on the environment. You could probably make some changes in your lifestyle that would help protect nature.

Issue

What lifestyle changes could you make—in terms of the food you eat, how you get from place to place, or how you use heat and electricity—that would reduce your environmental impact? Are you willing to make those changes?

Initiate and Plan

1. Dr. David Suzuki has prepared a list of ten possible changes you could make, relating to food, transportation, and housing. Study the list provided by your teacher and Think/Pair/Share with a partner to choose two lifestyle changes that would reduce your environmental impact. Plan to try them for two weeks.
2. Research information that shows how your planned changes reduce your impact on the environment.
3. Set up a daily journal so you can record your experiences. Consider including the following:
   - the date
   - the change you are referring to
   - how often the change affected your activity
   - how easy or difficult it was to maintain the change
   - how you felt about making the change
4. Ask your teacher to review your ideas.

Perform and Record

5. Begin your lifestyle changes and your journal entries for two weeks.

Analyze and Interpret

1. At the end of two weeks, review your journal. Was it a struggle to make the lifestyle changes or are they becoming new habits?
2. Consider your lifestyle changes and prepare a cause-and-effect map to illustrate how your changes affect the environment.
3. Review your experience and compare it to the positive impact on the environment.

Communicate Your Findings

4. Make a decision about whether to continue the lifestyle changes and write two or three paragraphs summarizing and justifying your decision.

Assessment Checklist

Review your project when you complete it.
Did you…

- ☑ select two different lifestyle changes to reduce your environmental impact? K/U
- ☑ use a variety of sources to research how these changes will reduce your impact on the environment? T/I
- ☑ keep a journal about your experience? C
- ☑ prepare a cause-and-effect map to evaluate how your changes affect the environment? A

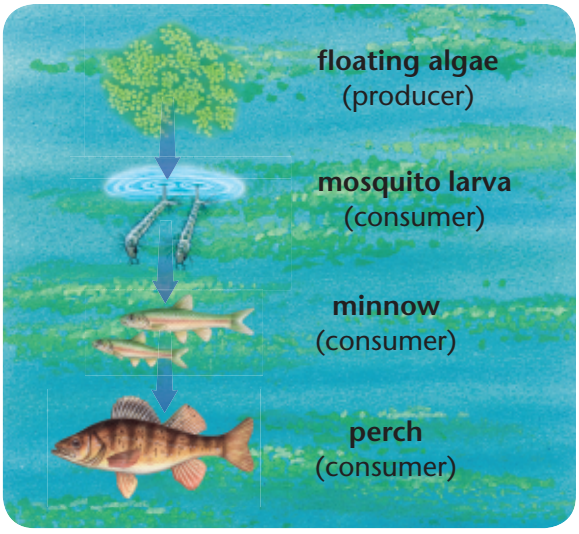
Unit 1 Review

Connect to the Big Ideas

1. Ecosystems consist of a variety of components, including, in many cases, humans. Dr. Fritjof Capra, founding director of the Center for Ecoliteracy, wrote, "Humans are part of the web of life, not separate from it." Use words, pictures or a graphic organizer to explain this statement.
2. The sustainability of ecosystems depends on balanced interactions between their components. Choose any ecosystem and create a graphic organizer, such as a main idea web, to summarize the interactions that make the ecosystem sustainable. Be sure to include interactions between biotic parts, abiotic and biotic parts, and terrestrial and aquatic ecosystems where applicable.
3. Human activity can affect the sustainability of aquatic and terrestrial ecosystems. Imagine you are a member of a town council. A local business has requested permission to expand its buildings onto a nearby wetland. The wetland contains a large pond that is home to many species of birds, fish, and plants such as cattails. The wetland would be drained and a hotel would be constructed in the drained area. The expansion of the business would mean more jobs for the community. How would you vote on this proposal? Explain what factors you would consider when making your decision.

Knowledge and Understanding K/U

4. Create a table with three columns. In the first column, list all the key terms from this unit. In the second column, record a definition for each term, written in your own words. In the third column, sketch or draw a small picture that will help you remember the key term.
5. In a t-chart, provide five examples of terrestrial ecosystems and five examples of aquatic ecosystems. Include examples from this unit or examples of your own, and include both small and large ecosystems.
6. Create a cause-and-effect map showing how human impact on a terrestrial ecosystem can also affect an aquatic ecosystem.
7. In what ways do consumers rely on the Sun for their food?
8. Refer to the diagram below. What happens to the amount of energy available to a consumer that is farther along a food chain compared to the other consumers in the food chain?



9. Summarize how photosynthesis and cellular respiration are essential for you to live.
10. Use a Venn diagram to compare these two models of energy flow in ecosystems: food chains and food webs.
11. Wolverines are strict carnivores (they don't eat plant material at all). Explain how the nutrients in a living plant might become part of the body tissue of a wolverine.
12. Some people describe cellular respiration as the reverse of photosynthesis. Explain why this is incorrect.

13. Make a drawing that shows the biotic and abiotic limiting factors in an ecosystem near your home.

14. Make a t-chart. In one column, list natural processes and human activities that add carbon dioxide to the atmosphere. In the second column, list natural processes and human activities that remove carbon dioxide from the atmosphere.

15. Explain how fertilizer run-off in a watershed could affect the biodiversity of an ecosystem.

16. Explain how the introduction of purple loosestrife to a wetland ecosystem can threaten the sustainability of that ecosystem.

Thinking and Investigation T/I

17. A pond supports a large population of minnows, which is a species of very small fish. A predatory fish population is introduced to the pond.

a) Predict how the introduction of the predatory fish population will affect the carrying capacity of the minnow population.

b) Do you think the introduction of the predatory fish population will affect the carrying capacity of any other populations in the pond? Justify your answer.

18. Plan (but do not actually conduct) an investigation to find answers to one of the questions below. Be sure to identify all variables, the data you will need to collect, and what method you will use to collect your data. Decide which format you will use to record your findings—for example, a chart.

a) What are the abiotic and biotic parts of your schoolyard ecosystem?

b) How do the abiotic and biotic parts interact with each other?

c) What human activities have had an impact on the ecosystem?

19. Imagine you are an ecologist who has been called to investigate the reasons why the population of fish in a local stream has been declining. What tests could you do to determine if fertilizer run-off was the cause of the decline in the fish population?

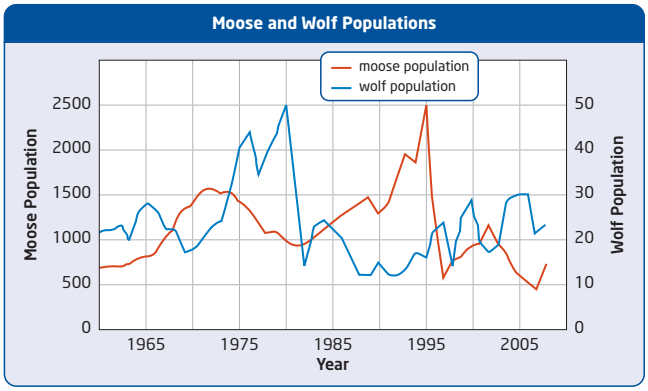
20. Food and water are the limiting factors that usually have the greatest effect on population size. Hypothesize a possible reason or reasons for this relationship.

21. Use the information in the graph below to answer the following questions.

a) Explain what happened to the moose and wolf populations between 1975 and 1980, and between 1990 and 1995.

b) Explain why predation by wolves might be a limiting factor for moose.

c) What other factors could influence the moose population?



Communication C

22. If a vegetarian diet is more "environmentally friendly" than a meat-based diet, should we all be forced to become vegetarians? Explain your opinion.

23. Use a graphic organizer such as a Venn diagram to show the similarities and differences between photosynthesis and cellular respiration.

24. Decomposers are an essential part of the cycling of matter. Imagine that all of the decomposers on Earth became extinct. Write a story or draw a comic strip that describes the effects of this extinction on producers and consumers (including humans), as well as the effect on the balance of carbon and oxygen.

25. Draw a picture or a flowchart to show how oxygen and carbon might cycle through the biotic and abiotic parts of a pond ecosystem.

26. Draw a cartoon or a storybook for a class of Grade 3 students that shows the impact of one human activity on an ecosystem and that concludes with one action everyone can take to lessen that impact. Be creative.

27. The unit opener featured song lyrics by John Mayer. Many singers and other artists use their work to convey messages about societal and environmental issues. Write your own song, rap, or poem that communicates your ideas about the impact humans have on ecosystems.

Application A

28. A gardener left grass clippings on her lawn after mowing it. She discovered that the lawn looked healthier than it did when she raked up and removed the clippings. Using your knowledge of nutrient cycles, write or draw an explanation for the gardener.

29. Explain how driving a car in Ontario could affect ecosystems elsewhere in Canada.

30. Answer the following questions about your own community.

a) Is there new construction in or around your community? If so, how do you think this construction might affect an ecosystem near the area?

b) Choose a species that lives in your community. List the limiting factors that might regulate the population of this species.

31. In an effort to divert waste and reduce fertilizer use, many municipalities in Ontario have adopted composting initiatives. However, these initiatives cannot always extend to schools, businesses, or apartment buildings, which all generate large amounts of wastes that can be composted.

a) Create a graphic organizer that summarizes the pros and cons of a municipal composting initiative.

b) Write an email or a letter to your local politician with your assessment of a municipal composting initiative and provide some suggestions about how it might be improved.

32. A ban on pesticides took effect in Ontario in April 2009. The ban prohibits the sale and use of pesticides for cosmetic use on lawns and in gardens, parks, and schoolyards.

a) Research some effects that pesticides have on people and ecosystems.

b) Research alternative methods for getting rid of unwanted weeds.

c) Imagine that your neighbour was ignoring the ban and using pesticides to control dandelions on his lawn. Write a letter to your neighbourhood association or to the editor of your community newspaper explaining the impact of pesticides on people and ecosystems. Propose an alternative course of action that your neighbour could take.

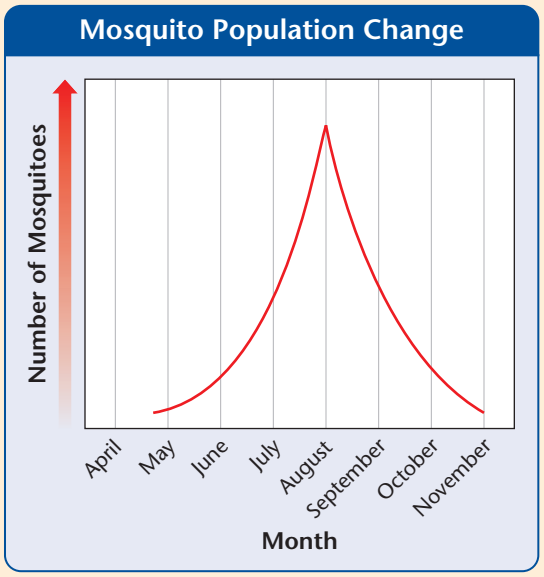
33. In the unit opener, you were asked to answer how the person in the picture was acting as an agent for change in the world. Considering everything you have learned in this unit, describe a way in which you might now act, or are already acting, as an agent of change in the world.

Literacy Test Prep

Read the selection below, and answer the questions that follow it.

Populations

Ecologists define a population as a group of individuals of the same species that live together in the same place at the same time. An individual is one member of a population. If you want to identify a population, you need to know three things: the species, where the species lives, and when the species exists or existed. Populations change in size with the passage of time. The graph below shows the growth curve of a population of mosquitoes.



Multiple Choice

In your notebook, choose and record the best or most correct answer.

34. To identify a population, you do not need to know
- **a)** the species
- **b)** why the species exists
- **c)** when the species exists or existed
- **d)** where the species lives

35. The term that is defined in the opening sentence of the paragraph is
- **a)** ecologists
- **b)** population
- **c)** individuals
- **d)** species

36. The graph shows that the mosquito population peaks:
- **a)** between May and June
- **b)** during July
- **c)** during August
- **d)** between August and September

37. According to the graph, there is a sharp decline in the mosquito population during:
- **a)** spring
- **b)** summer
- **c)** fall
- **d)** winter

Written Answer

38. Summarize this selection. Include the main idea and two relevant points that support it.