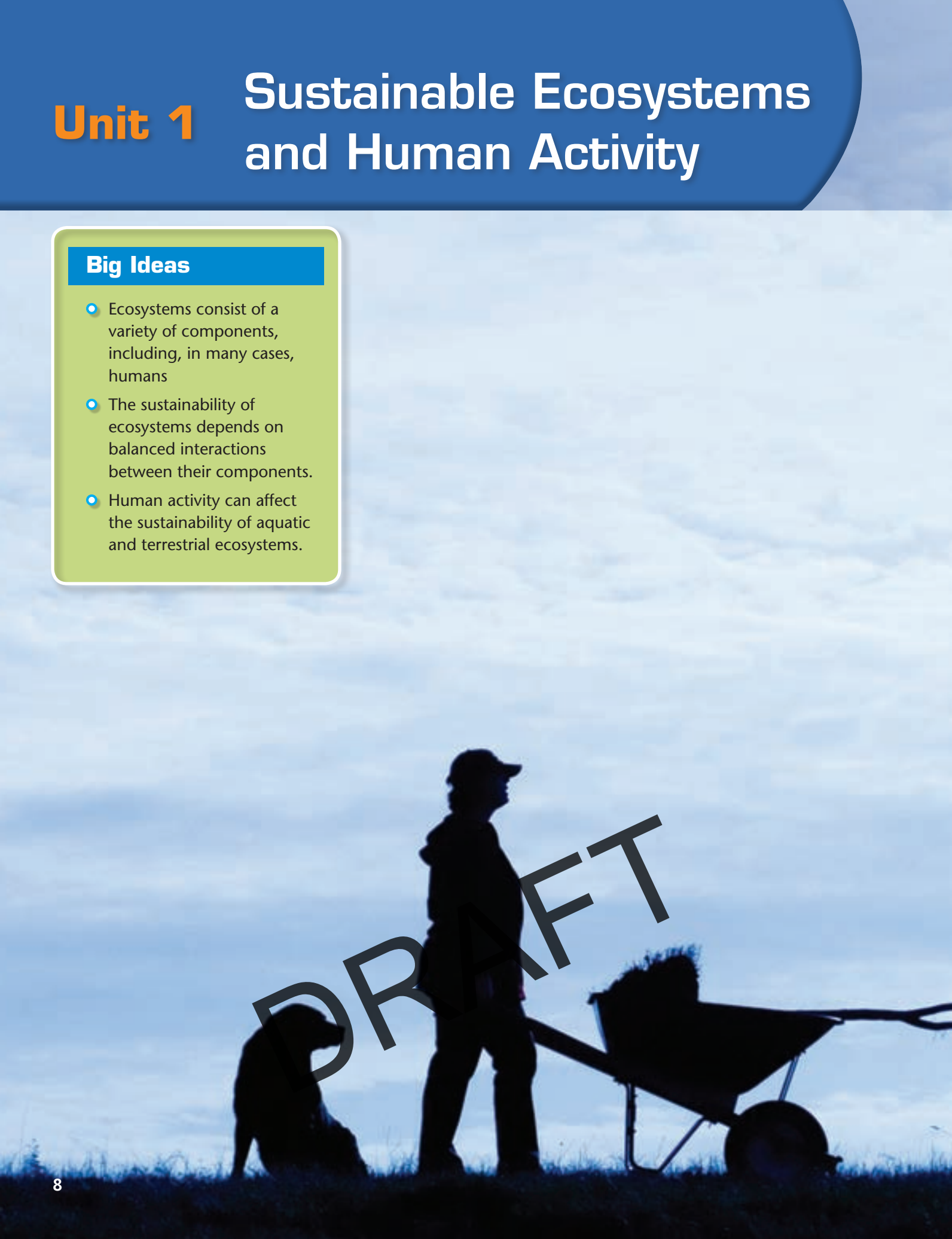
Unit 1 Sustainable Ecosystems and Human Activity

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 aquatic and terrestrial ecosystems.



From "Waiting On The World To Change" by musician John Mayer © 2006

Me and all my friends
We're all misunderstood
They say we stand for nothing and
There's no way we ever could

Now we see everything that's going wrong
With the world and those who lead it
We just feel like we don't have the means
To rise above and beat it

So we keep waiting
Waiting on the world to change
We keep on waiting
Waiting on the world to change

It's hard to beat the system
When we're standing at a distance
So we keep waiting
Waiting on the world to change.

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

HOW is the person in the photo serving as an agent of change in the world?

Unit 1 At a Glance

In this unit you will learn the characteristics of terrestrial and aquatic ecosystems. You will also learn about the interdependencies within and between these two types of ecosystems. You will analyze the impact of human activity on these ecosystems, and you will assess the effectiveness of selected initiatives on their sustainability.

***Think** about answers to each question as you work through the topic.*

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

Key Concepts

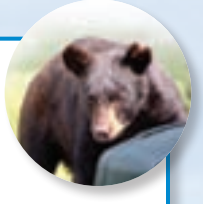
- Ecosystems are about connections.
- Ecosystems are made up of biotic (alive) and abiotic (not alive) parts that interact.
- Interactions between terrestrial (land) ecosystems and aquatic (water) ecosystems keep all ecosystems healthy.

Sustainable Ecosystems and Human Activity

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.



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 sustain the carbon nutrient cycle.
- Human activities can affect ecosystems by affecting nutrient cycles.

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.

Topic 1.5: How do human activities affect ecosystems?

Key Concepts

- We sometimes forget that our actions have consequences for ecosystem health.
- Introduced species can affect the health of ecosystems.
- Pollutants from human activities can travel within and between ecosystems.

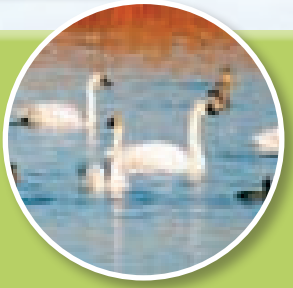
Topic 1.6: How can our actions promote sustainable ecosystems?

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 for the future.

Looking Ahead to the Unit 1 Project

At the end of this unit you will have the opportunity to apply what you have learned. In your unit project, you will take on the role of an environmental inspector investigating how common substances affect the sustainability of an ecosystem. You will produce recommendations on how to reduce the threat to that ecosystem.



Topic 1.3

How do interactions in ecosystems cycle matter?

Key Concepts

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

Skills Focus

Literacy

- Interpreting Diagrams

Inquiry

- Inferring

Key Terms

nutrient
nutrient cycle

Day changes to night, which changes to day. Spring leads to Summer, then to Autumn, to Winter, and back to Spring. These examples of changes whose ending leads back to where they begin are known as cycles. Another cycle that plays a major role in your life is the yearly celebration of the date of your birth. In fact, all calendar systems—Julian, Gregorian, Islamic, Jewish, Chinese, Indian, Mayan, Bahá'i, Aboriginal, or any other—involve cycles.

You know other cycles from science class, too. There are life cycles of frogs, moths, and other animals. There are product life cycles, which depend on you and your commitment to recycling. There are also cycles that involve substances in nature. Water is one example. A simple diagram of the water cycle is shown here.

Starting Point Activity

1. A cycle is a pattern of change that repeats itself forever. In what way does the water cycle demonstrate the features of a cycle?
2. On a map of Canada or Ontario, locate Toronto and Thunder Bay. The distance between these two cities is nearly 1400 km. Now picture a ball with a diameter of 1400 km. (In other words, the ball is 1400 km across.) All the water on Earth could fit into that ball. Do you think that is a lot or not? Explain.
3. During a drought (lack of rain for a long time), the amount of water in a body of water can drop a great deal. What happens to this missing water? Is it really missing? Explain.
4. The water cycle ensures that Earth will never run out of water. In fact, the total amount of water on Earth (the amount in that 1400 km-diameter ball) always stays the same. So why are we concerned about conserving water resources? (Hint: What is the difference between the total amount of water on Earth and the amount of water that is available in any one place at any one time?)

Figure 1 The total amount of water on Earth is mind-numbingly staggering: 1386 quadrillion litres. (That's the number 1386 followed by fifteen zeroes.) This water is renewed over and over in a never-ending cycle that involves water vapour in the air, water on the ground, and water underground.

Abiotic and biotic interactions cycle matter in terrestrial and aquatic ecosystems.

Some people love searching the soil for bugs and worms and all manner of "creepy-crawlies." For other people, these organisms really do give them "the creeps." But you and all other living things owe your lives to these organisms. They are a group of consumers called **decomposers**.

decomposer: organism that obtains energy by consuming dead plant and animal matter

In addition to soil insects and earthworms, other decomposers include moulds, mushrooms, and certain kinds of bacteria. They get their food energy by digesting wastes such as urine, feces, and the bodies of dead organisms. As decomposers digest these wastes, some of the chemical substances that make up the wastes enter the soil, water, and air. These substances include carbon, nitrogen, iron, and other chemicals that living things need and use as nutrients. A **nutrient** is any substance that a living thing needs to sustain its life.

nutrient: any substance that a living thing needs to sustain its life

All producers and consumers use nutrients to grow and build their bodies and to help them carry out their life functions. When producers and consumers die, decomposers return the nutrients to the environment. Then the nutrients are available to be used once again by living things. This pattern of use and reuse of nutrients has been taking place for millions of years in all ecosystems, all over the Earth. The pattern of continual use and reuse of the nutrients that living things need is called a **nutrient cycle**.

nutrient cycle: the pattern of continual use and reuse of a nutrient

LEARNING CHECK

1. Use pictures, words, or a graphic organizer to explain the following terms: nutrient, nutrient cycle.
2. What role do decomposers play in nutrient cycles?
3. Explain what is meant by the statement "You and all other living things owe your lives to decomposers."
4. The living things that decompose plants and animals link the biotic and abiotic parts of ecosystems. How do they do this?

Activity 1.8

INTERACTIONS AND NUTRIENT CYCLES

What To Do

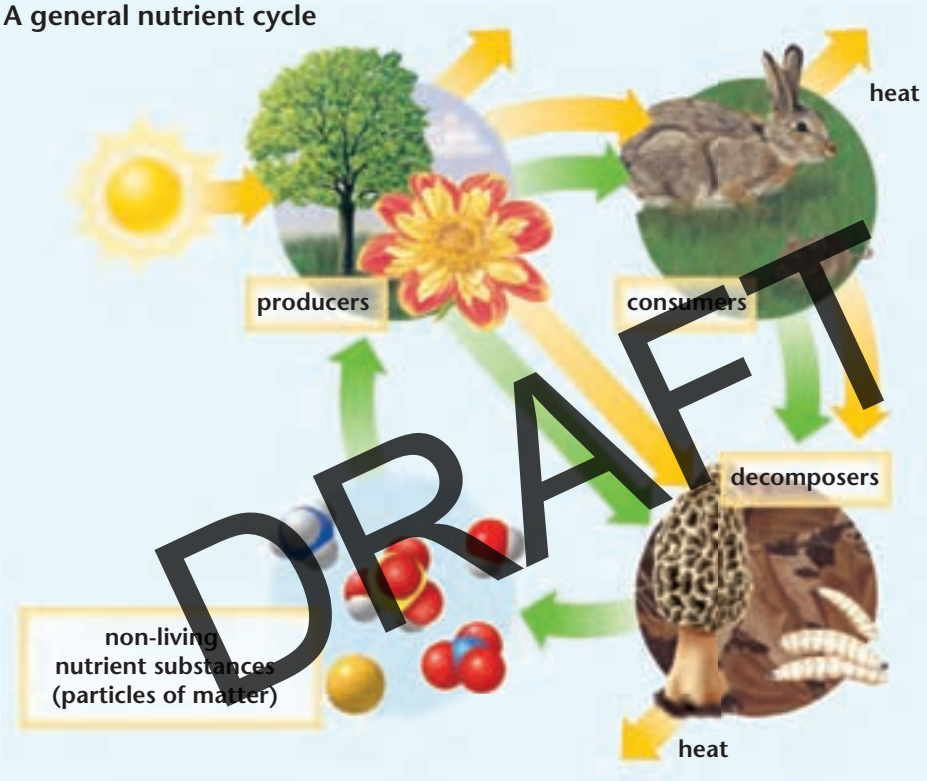
This diagram is a general nutrient cycle. It shows the path of energy and matter in an ecosystem. Use the questions to interpret what the diagram shows.

1. What path does energy follow in the diagram?
2. What path does matter follow in the diagram?
3. Which part of the diagram shows where photosynthesis takes place?
4. Which part of the diagram shows is where cellular respiration takes place?
5. How does the diagram show that a constant flow of energy is needed for living things?

What Did You Find Out?

1. Use the diagram to show how you know that these two statements are true.
   - Statement 1: The biotic parts and the abiotic parts of an ecosystem work together in a nutrient cycle.
   - Statement 2: Decomposers link the biotic parts of an ecosystem with the abiotic parts of an ecosystem.

A general nutrient cycle

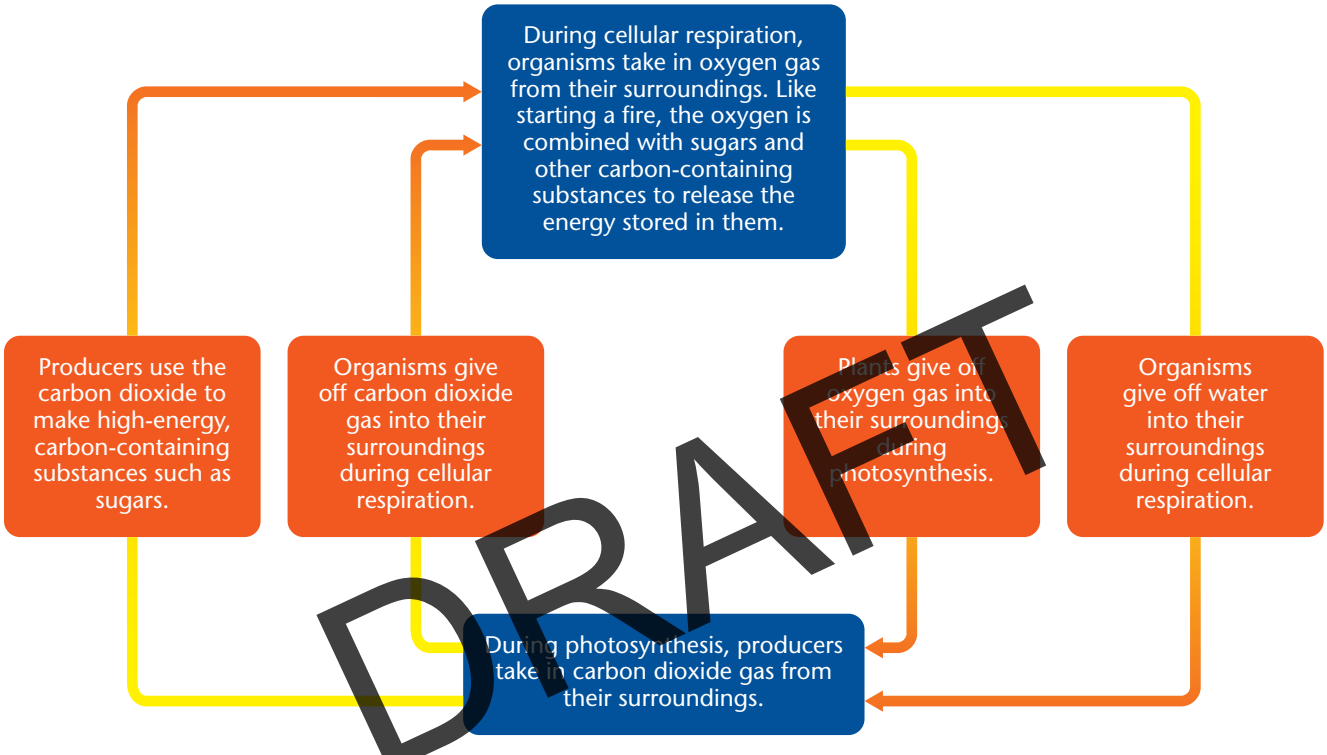


Photosynthesis and cellular respiration cycle carbon and oxygen in ecosystems.

In Topic 1.2, on page xx, you learned the role that photosynthesis and cellular respiration play in the transfer of energy through ecosystems. These two processes also play a key role in the cycling of matter such as carbon and oxygen in ecosystems. Scan the large cycle picture shown in Figure 2. The labels will help you see how photosynthesis and cellular respiration are complementary processes for the cycling of carbon and oxygen. Because this is a cycle picture, you can start reading it anywhere and follow the arrows.

LEARNING CHECK

1. What substances do plants require to carry out photosynthesis?
2. What substances are released by all organisms—plants and animals—during cellular respiration?
3. Photosynthesis and cellular respiration are complementary processes. Use specific examples from Figure 2 to support this statement.



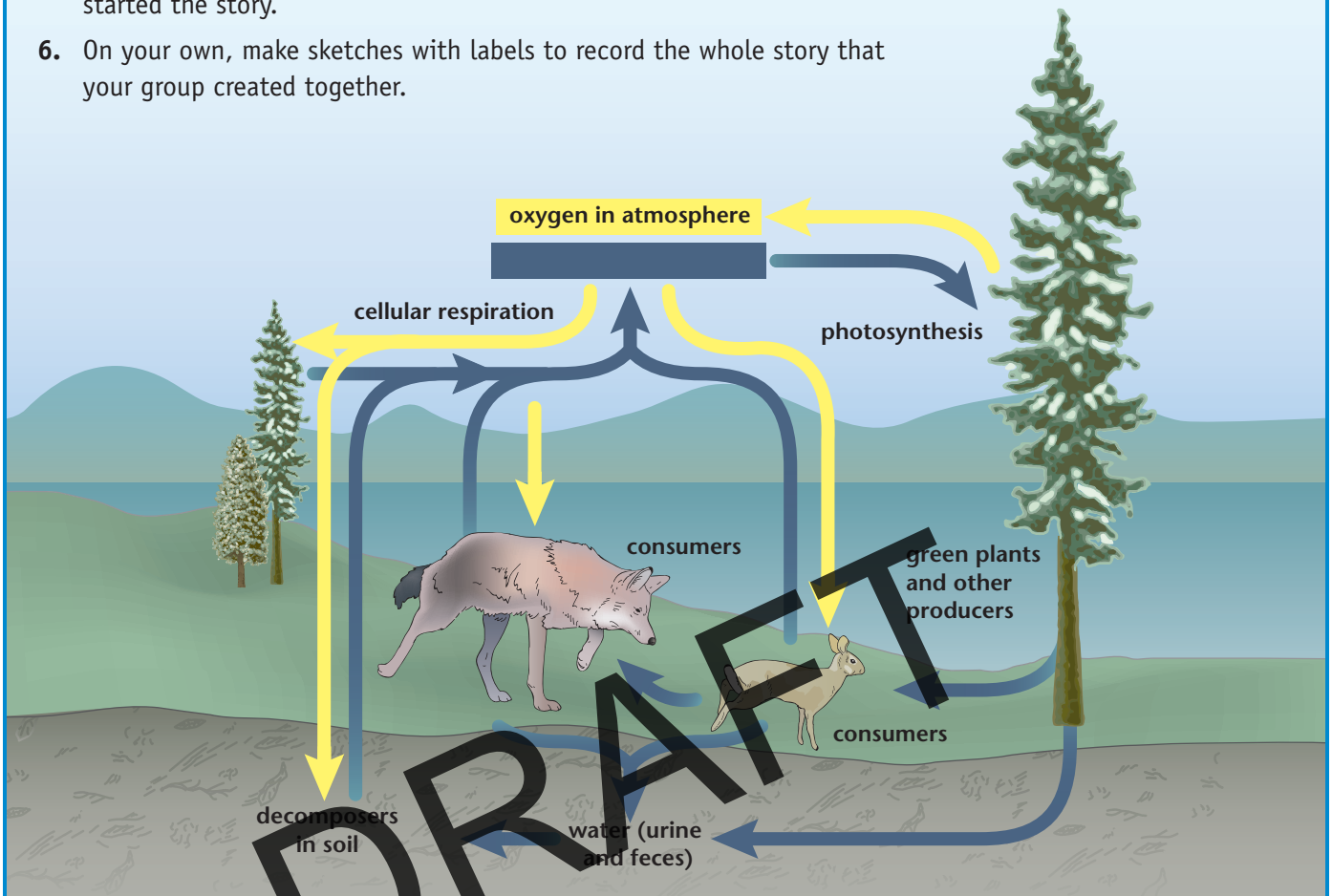
▲ **Figure 2** Photosynthesis and cellular respiration interact with each other as part of a cycle that uses and reuses carbon and oxygen. This interaction takes place in both terrestrial and aquatic ecosystems.

Activity 1.9

CYCLE IT

What To Do

1. Work in a small group. Arrange yourselves so you are sitting in a circle.
2. With your group, examine the picture of interactions that are involved in the cycling of carbon and oxygen. Follow the coloured arrows for oxygen to see how it is cycled. Then do the same with carbon.
3. Help each other understand what happens to oxygen and to carbon as they cycle in an ecosystem. To do this, choose one group member to start the story of how oxygen or carbon cycles through the ecosystem you have chosen. This person will describe how the nutrient leaves the environment and enters a producer.
4. Each person in turn will describe what happens to the nutrient next.
5. End the story when the nutrient has returned to the person who started the story.
6. On your own, make sketches with labels to record the whole story that your group created together.



This picture shows interactions that are involved with the cycling of oxygen and carbon.

Human activities can affect ecosystems by affecting nutrient cycles.

Not all the carbon involved in the carbon cycle is used immediately by living things. Some is stored in the woody tissues of long-living trees. Some is stored in the slowly decomposing remains of organisms in the soil. With the passage of time, some of this stored carbon will eventually be transformed into the carbon-rich fuels that we know as coal, oil, and natural gas. This is what happened about 300 million years ago to form the coal, oil, and natural gas that we use today.

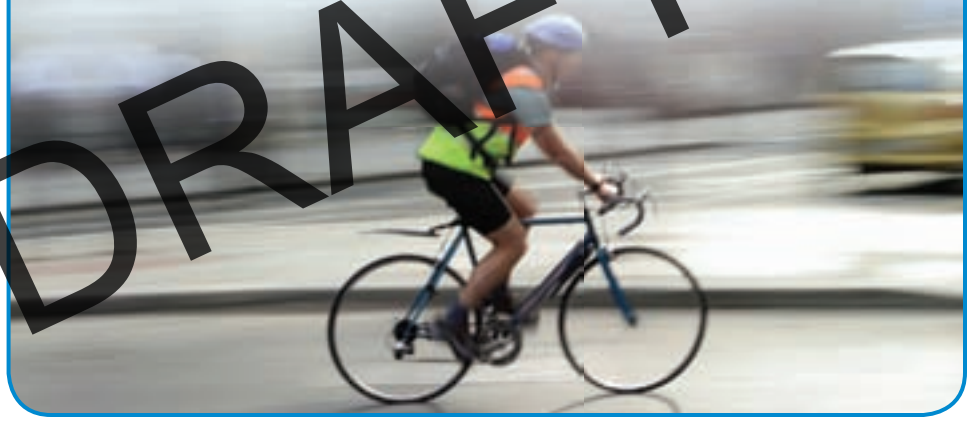
The amount of carbon dioxide that is used by photosynthesis and given off by cellular respiration is nearly the same. In other words, the amount of carbon dioxide is balanced. When we burn trees, coal, oil, and natural gas for fuel, the carbon stored long ago is released into the air in the form of carbon dioxide. So we upset that balance. As well, human activities have removed huge numbers of trees to make space for homes, buildings, and farmland, and to make products such as furniture and paper. So there are fewer trees available to take in the extra carbon dioxide. As a result, the extra carbon dioxide builds up in the air and helps to trap heat in the atmosphere. This is one of the sources of the extra carbon dioxide that adds to the event known as global warming.

Inquiry Focus: Inferring

Activity 1.10

HELPING TO RESTORE BALANCE

1. The amount of carbon dioxide used by producers and given off by producers and consumers is balanced. Name two ways that human activities upset that balance.
2. Identify at least three human activities that could help to restore this balance. Explain why in each case.



Other Effects on Nutrient Cycles

Nitrogen is another nutrient that cycles in ecosystems. It is vital for all living things. It is a major part of all cells and a key building block for proteins, which all cells need and use. Nitrogen makes up 78 percent of the air you breathe. However, most living things cannot use nitrogen from the air. Instead, they depend on the action of certain kinds of bacteria in the soil and in water. The bacteria change the nitrogen into forms that plants can use.

Many human activities affect the nitrogen cycle. For instance, nitrogen is a key part of fertilizers. Farmers and gardeners use fertilizers to enhance the growth of their plants. Not all the nitrogen in the fertilizers is used by the plants, though. Some stays in the soil. When it rains, or when fields are watered, some of the nitrogen is carried into aquatic ecosystems. This excess nitrogen can cause an overgrowth of algae called an algal bloom. Figure 3 shows how an algal bloom can affect an aquatic ecosystem.

LEARNING CHECK

1. How does burning wood, coal, oil, and natural gas upset the balance of carbon dioxide?
2. Why is nitrogen vital for all living things?

Figure 3 An algal bloom is caused by too much of a nutrient, such as nitrogen, entering an aquatic ecosystem. As a result, some organisms get too well-fed and others then starve and suffocate.

A: Rain carries nitrogen-containing substances from farms, gardens, and lawns into aquatic ecosystems.

B: Algae and other plants growing at the water's surface grow quickly. This blocks sunlight from reaching deeper water.

C: Deep-water plants get no sunlight. They cannot carry out photosynthesis, so they no longer give off oxygen, and they soon starve to death.

D: When the plants die, decomposers have lots of food. The number of decomposers increases quickly. They use up the oxygen in the water as they carry out cellular respiration.

E: As the oxygen in the water is used up, fish and other aquatic organisms that need the oxygen suffocate and die.

Inquiry Focus: Inferring

Activity 1.11

RECYCLING ON MARS

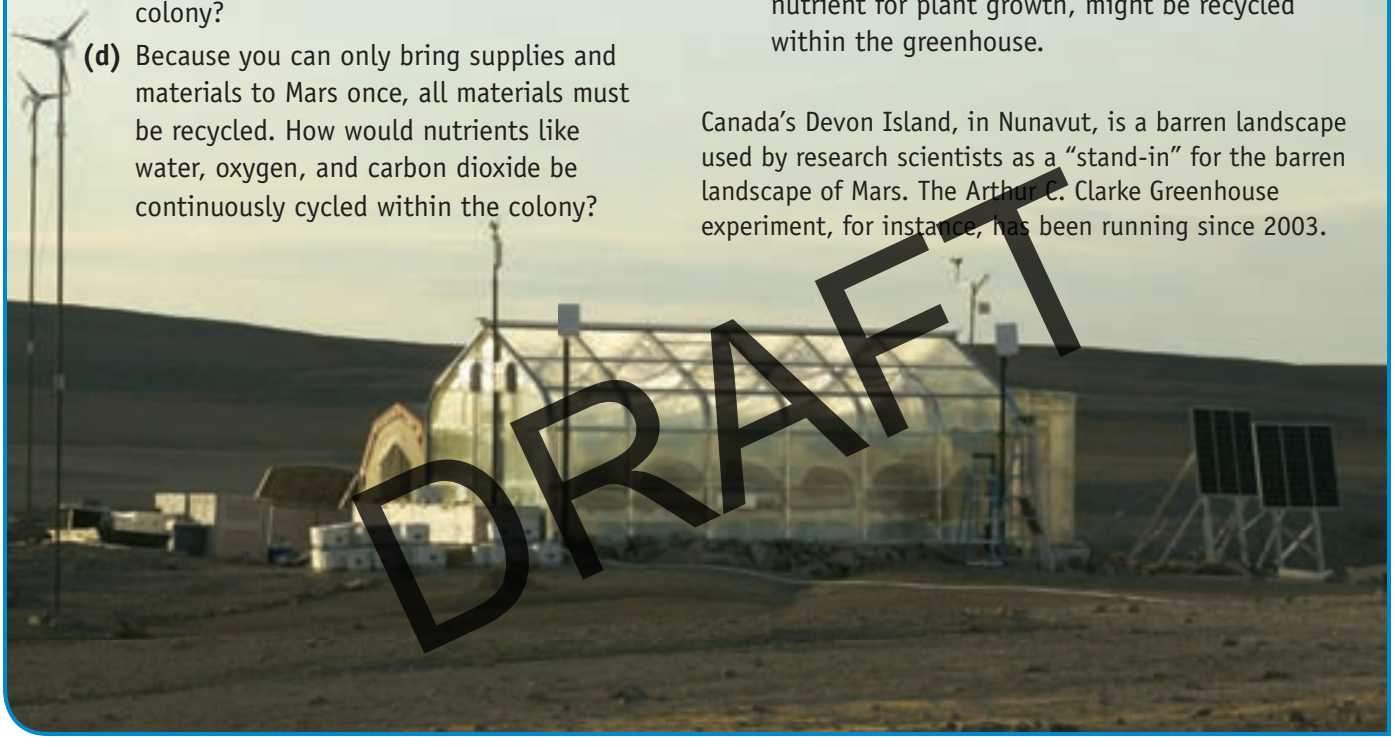
If humans ever colonize another planet, Mars is a good choice. Tts conditions are more Earth-like than on any other planet. To live on Mars, we would have to create ecosystems that can sustain themselves for long periods of time, just as they do on Earth. For instance, a Mars colony would have to recycle and re-use all its materials. This includes nutrients such as water, carbon, oxygen, and nitrogen. In this activity, you will consider some of the factors that would be needed for a self-sustaining Mars colony.

What You Need

1. With your group, make a list of the things that a Mars colony would need and how you could maintain them over time. Use the following questions to help you:
   - **(a)** Mars has a maximum temperature of 20° C and a minimum temperature of –140° C. How could your colony maintain temperatures that are friendlier to life?
   - **(b)** How would your colony deal with food production and waste disposal?
   - **(c)** How would you generate energy for your colony?
   - **(d)** Because you can only bring supplies and materials to Mars once, all materials must be recycled. How would nutrients like water, oxygen, and carbon dioxide be continuously cycled within the colony?

What Did You Find Out?

1. How is the colony you created like an ecosystem? How does it differ?
2. **(a)** What cycles would have to be maintained to sustain a colony on Mars?
   (b) How might the colony be affected if one of these cycles were to become disrupted?
   (c) Which nutrient is the most difficult to cycle in your colony and why?
3. You have learned that photosynthesis and cellular respiration are complementary processes. Did this knowledge help you cycle oxygen and carbon in your colony? Explain.
4. On Mars, large amounts of water are frozen in the polar ice caps and under the surface. How could this water be used to sustain your colony?
5. We don't know yet if the soil on Mars can be used to grow crops. One solution to this problem is to grow crops in greenhouses like the one below, which uses hydroponics. This technology uses nutrient-enriched water to grow plants. Suggest a way that nitrogen, an important nutrient for plant growth, might be recycled within the greenhouse.



Canada's Devon Island, in Nunavut, is a barren landscape used by research scientists as a "stand-in" for the barren landscape of Mars. The Arthur C. Clarke Greenhouse experiment, for instance, has been running since 2003.

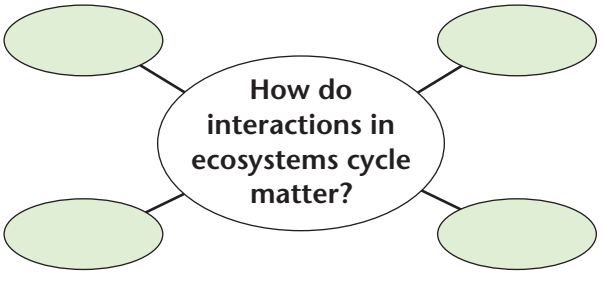
Topic 1.3 Review

Key Concept Summary

- 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.

Review the Key Concepts

1. 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. A What are some ways in which you and your family and friends affect nutrient cycles? Use a graphic organizer to demonstrate the cause-and-effect relationships involved in the examples you provide.

3. C In Activity 1.10, you identified three human activities that could restore the balance of carbon dioxide. Select one activity and and write a letter to a classmate explaining why you would choose to do that activity.

4. K/U Water and chemical nutrients such as carbon and nitrogen are recycled through ecosystems. Explain why this recycling is necessary.

5. K/U Create a t-chart to list the ways in which biotic and abiotic interactions cycle matter in ecosystems. Give the first column in your t-chart the heading "Biotic Interactions." Give the second column the heading "Abiotic Interactions."

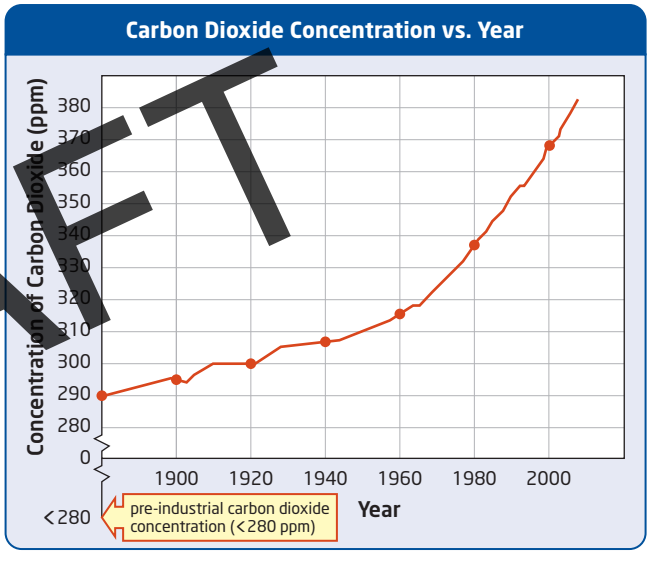
6. C Refer to **Figure 1.X**. Create your own flowchart to show the cycling of carbon dioxide and oxygen through photosynthesis and cellular respiration.

7. C Use words or diagrams to illustrate how a carbon atom that was part of a dinosaur 70 million years ago could be part of you today.

8. T/I The graph below shows the amount of carbon dioxide in the atmosphere over time. Use the graph to answer the following questions.

a. What patterns or trends do you notice?

b. Thinking about how human activities have changed over the last 200 years, create a hypothesis for the trends or patterns you identified.



Skill Check

- ✓ **initiating and planning**
- ✓ **performing and recording**
- ✓ **analyzing and interpreting**
- ✓ communicating

Investigating Limiting Factors for Algae Growth

Algae are microscopic plants that are commonly found in aquatic ecosystems. As is the case with all living things, the growth of an algae population is limited by abiotic and biotic factors. In this investigation, you will plan and conduct an experiment to explore how fertilizer affects the size of an algae population.

Safety

What You Need

5 Erlenmeyer flasks

fertilizer solutions (five different concentrations)

dropper

well-lit space or grow light

pond water (or other source of algae)

graph paper

What To Do

1. Design a procedure to determine how different concentrations of fertilizer solutions affect the growth of algae. Use this checklist to help you plan your procedure.

- ☑ Because algae are producers, they need light for photosynthesis. Ensure that the algae have enough light.
- ☑ You will need to design a way to describe and compare the amount of algae growth in each test tube.
- ☑ Be sure to consider safety precautions and proper clean-up and disposal in your procedure. Why must you not pour the material in your flasks down the sink?
- ☑ Ensure that you design an experiment to test only one variable. The variable that you choose to test is called the independent variable. It is the variable that you make changes to. The variable that responds to the changes you make is the responding, or dependent, variable. All of the other variables that you are not testing are called controlled variables. You keep all the controlled variables the same. Turn to the Skills section at the back of the book, on page xxx, to review variables and how to conduct an experiment.
- ☑ Ask yourself:
  - What is the independent variable (the one you are changing) in this experiment?
  - What is the dependent variable (the one that changes as a result)?
  - What are the controlled variables (the ones that must be kept the same)? Hint: Consider any factors that might affect the outcome of the experiment. Examples include air temperature, water temperature, amount of light, volume of pond water, and so forth.)

2. Create a table to record your observations. Give your table a suitable title.
3. Get your teacher to approve your procedure. Then carry it out.
4. When you have finished your observations, make a graph that compares the concentration of fertilizer solution to algae growth. Give your graph a suitable title. Turn to the Skills section at the back of the book, on page xxx, to help you decide which of your variables goes on the x-axis and which goes on the y-axis.

What Did You Find Out?

1. What was the limiting factor that you investigated? Was it biotic or abiotic?
2. Explain how you controlled your experiment. As part of your answer, state your independent variable and your dependent variable. Also state the variables that you controlled.
3. If you were able to design your experiment again, what would you do differently and why?
4. Using your graph, what can you conclude about the effect that different concentrations of fertilizer solution have on algae growth?
5. If algae have access to unlimited nutrients for growth, will an algae population keep growing forever? What other abiotic and biotic limiting factors might limit the growth of the population?
6. Human activity can cause more nutrients than usual to enter aquatic ecosystems. For instance, farmers and gardeners often use nutrient-rich fertilizers to enhance plant growth. But not all the nutrients are used by the plants. Some stay behind in the soil. These excess nutrients are then carried into lakes, ponds, and other aquatic ecosystems by rain or runoff from watering. The excess nutrients can cause an overgrowth of algae called an algal bloom. How do you think an algal bloom might affect other living things in an aquatic ecosystem? How might it affect the ecosystem as a whole? Give reasons for your opinions.

Investigate Further

Many people believe that organic fertilizers such as manure and compost are better for the environment than synthetic (human-made) fertilizers. Is there less risk of an algal bloom if farmers and gardeners use organic fertilizers instead of synthetic ones? Use print or electronic resources to find an answer.

Case Study Investigation: Solar Storms

Pittsburg Gazette

VOL. 6---NO. 22, PITTSBURG, MONDAY, AUGUST 29, 1859

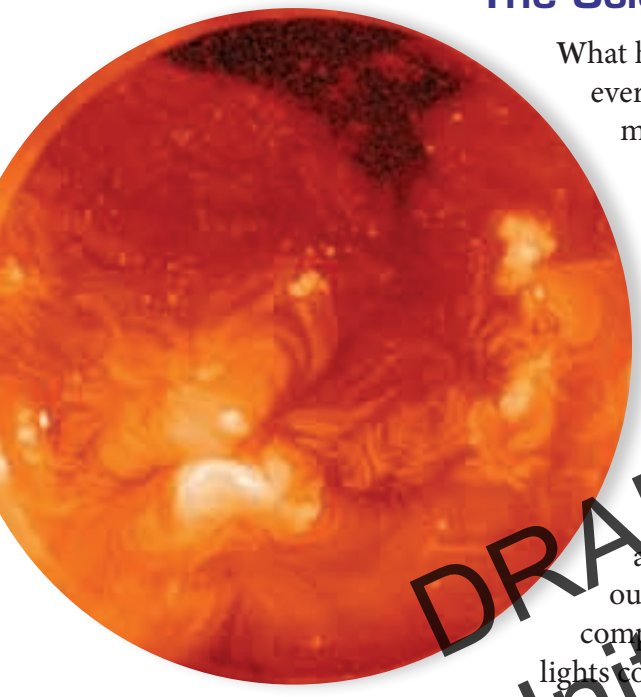
MYSTERIOUS FIRE RENDERS TELEGRAPH STATION USELESS

On the night of Sunday, August 28 fire mysteriously broke out at the Pittsburgh telegraph office, having left the entire telegraph station dead. E.W. Culgan, telegraph manager at the telegraph station in this city observed the following Sunday evening. On the night of August 28th, Culgan stated that he saw not only sparks, but also streams of fire that could not have been produced by the batteries. Much of the equipment became so hot that the hand could not be placed upon them. All lines were rendered useless. The reason for this extraordinary circumstance is not known. However, there is speculation that it may have been linked to an unusual display of coloured aurora observed in the sky that evening. This display caused dismay among many citizens.

▲ An electrical telegraph machine. Sent along telegraph lines linking different stations, telegraph messages composed of Morse code electrical signals are an indispensable form of modern, long distance communication.

The Science Behind the Story

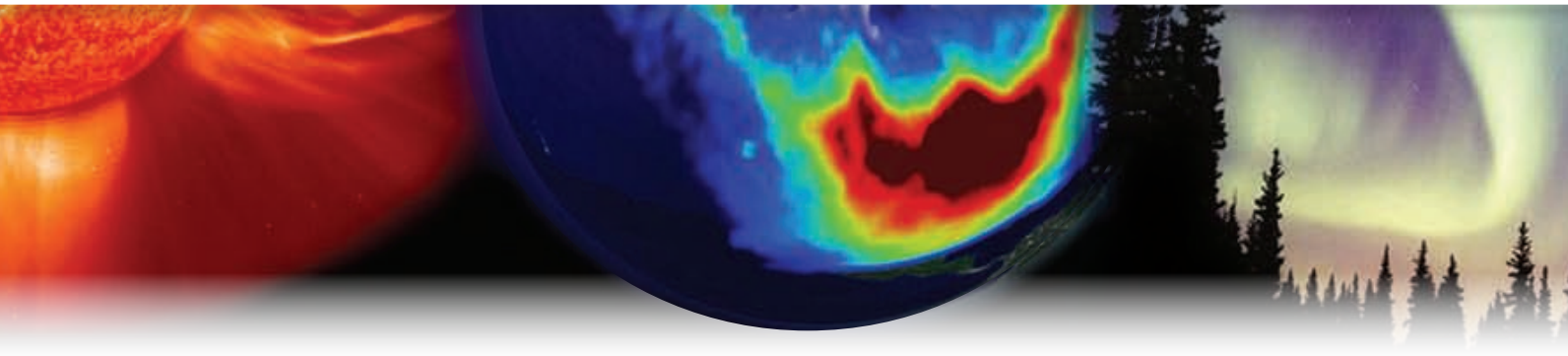
What happened on this mysterious night in August, 1859? What ever occurred, it shut down telegraph communications across much of the world. The first clue to what was going on came from scientific instruments recording Earth's magnetic field around the globe. The planet's magnetism had suddenly gone off the chart. The cause of this disturbance? A powerful storm raging on the Sun's surface. Explosions known as solar flares ejected super hot gases from the Sun's surface. Magnetic bubbles of matter burst from the Sun's upper layer, hurling magnetized solar particles toward Earth at millions of kilometres per hour. Lasting from August 28 to September 2, 1859, it was the fiercest magnetic storm in recorded history. Classified as a solar super storm, the magnetic storm of 1859 knocked out electrical communication around the globe. Magnetic compasses went haywire and became useless. Brilliant northern lights coloured the skies from Canada to the Caribbean.



▲ Large solar flares such as this one were observed during the 1859 solar super storm.

Pause and Reflect

1. Describe how the solar super storm of 1859 affected Earth.
2. Explain what occurs on the Sun's surface during a solar storm.



How would a solar storm affect Earth today?

▲ Caption Tie magna feugiam corper sit il elestisim nulluptat. Pat dio eui et, vel ulput ip

A solar storm of this size has not been seen since 1859. Since then, technology has advanced in leaps and bounds. How might a solar super storm affect modern telecommunications and global power grids? Would you believe you might not be able to send a text message, listen to the radio, or even flush your toilet? The following impacts are just a few ways a solar super storm could affect Earth today:

- **Communications Down:** Telecommunications could be knocked out as solar particles break down satellite solar panels and electronic equipment. In 2003, the Sun released the largest solar flare in history. If this flare had been aimed at Earth, it would have knocked out telecommunications worldwide.
- **Power Out:** Power grids across the world could be affected. In 1989, a small solar storm brought down the HydroQuebec power grid, plunging six million people into darkness. A solar super storm like the one that hit in 1859 could cause continent-wide black outs for a day or longer, affecting food storage, transportation, emergency services, and even the flow of water into your home.
- **Radio Disruption:** A solar super storm could interfere with radio signals. This would interfere with aircraft communications and the Global Positioning System (GPS). Flights around the world would be affected and many passengers would be stranded.

Pause and Reflect

3. Describe three ways a long-term power outage could affect your daily life.

Investigate Further

4. What are telecommunications? Choose one example of a telecommunications device and find out how it might be affected by a solar storm.

5. Learn more about the 1989 Quebec power outage and answer the following questions:
- Why did the power grid fail?
- For how long was the power out?
- How was the problem fixed?

6. Find out how airline travel could be affected by a solar storm.

7. Imagine that you are a reporter for a national newspaper when a solar super storm strikes. Write a news report covering the effects of this storm in today's world.

SCIENCE AT WORK

CANADIANS IN SCIENCE

▲ Jason Kolodziejczak is a digital compositor.

Jason Kolodziejczak has never been to Mars, but that didn't stop him from imagining the destructive power of a Martian dust storm if such storms happened on Earth. In the world of CGI (computer-generated images), anything is possible. Jason uses software to create visual effects for movies and television. His martian storm appeared in the Emmy-nominated documentary, *Planet Storm*, from The Discovery Channel. Jason also teachers visual effects at Seneca College of Applied Arts and Technology in Toronto. He studied 3-D animation at the Vancouver Film School.

What challenges do digital compositors face?

Digital compositors have to work well in teams and be open to constructive criticism, says Jason. The main challenge is figuring out how to get a shot done in a limited amount of time. "Sometimes you look at a shot and think, how on Earth am I going to pull this one off!" he says.

What do you find most rewarding about your job?

Jason says he finds the combination of art and problem solving very rewarding. "Being able to see your name at the end of the movie on the big screen!" also helps, he smiles.

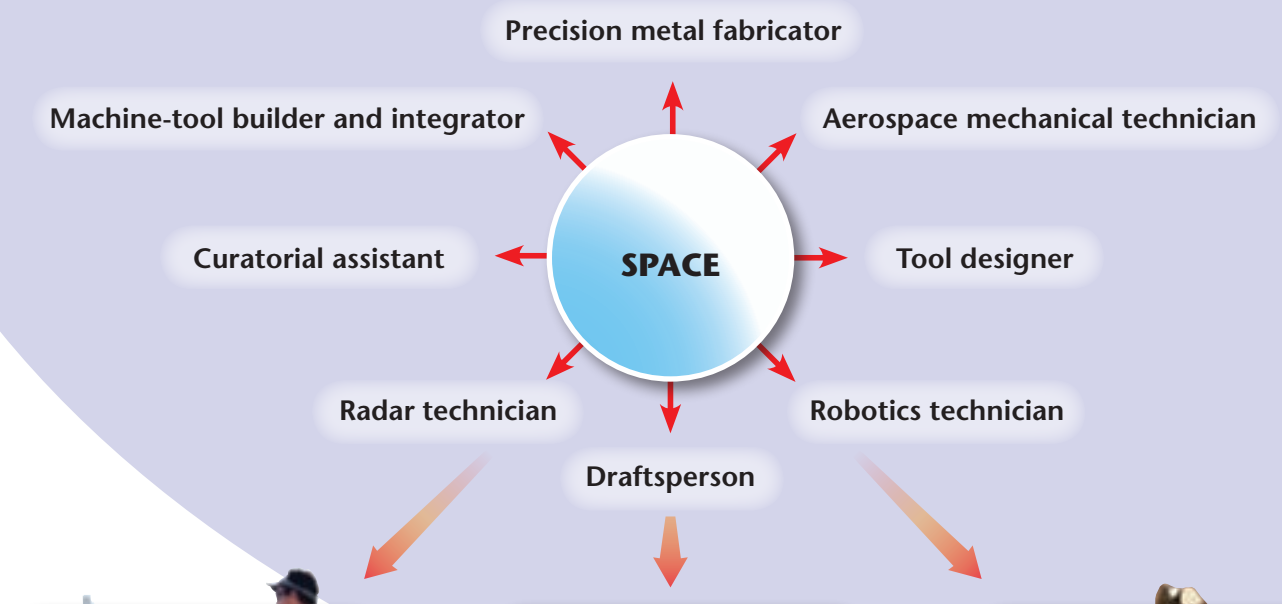
What advice would you give a student interested in a similar career?

Jason says students should keep in mind that math and science are part of the job. Digital compositors use complex computer programs, so strong problem-solving skills are a must. "As an artist, I don't necessarily see the underlying math of the program, but I do need to have a solid understanding of it to problem-solve."

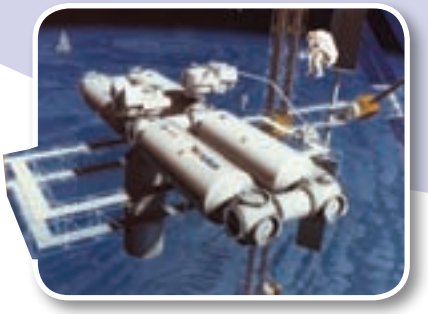
▼ This is a scene from Planet Storm.

Put Space Science To Work

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



▲ Radar technicians help design, test, operate, and maintain radar satellite equipment. Technicians usually work for companies that convert radar data into pictures.



▲ A draftsperson uses computers and information from engineers to create drawings and blueprints for satellites, space probes, and other space-exploring devices.

▲ Robotics technicians build and operate automated machines. Technicians often work with engineers to build robotic parts for spacecraft and other aerospace technologies.

Over To You

1. If you could interview Jason Kolodziejczak, what questions about his work would you ask him?
2. Why would it be important for a digital compositor to have good problem-solving skills?
3. Research a career involving space science that interests you. What essential skills are needed? What else could help you find a job in this field? e-LINK

Making a DIFFERENCE

In grade 9 Yvonne Su discovered that her Newmarket school was not recycling because it lacked the resources. Yvonne felt a responsibility to do something about this problem. She and some friends and teachers decided to tackle the recycling themselves. They started a recycling and environmental club. Yvonne has been engaged in environmental activities ever since.

"As grade nines, 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 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?

As captain of her high school's 2007 Envirothon team, Dayna Corelli helped develop an award-winning proposal that was reviewed by the city of Sudbury. Dayna's team was concerned that water was wasted during lawn watering and street cleaning. They were also concerned that the city's sewer pipe system could not handle heavy rainfall, causing storm sewers to overflow and dump raw sewage into the Great Lakes. Since reviewing the proposal, and recommendations from other groups, Sudbury has restricted lawn watering, made street cleaning more efficient, and improved the sewer system.

Dayna was also a member of her school's Environmental Club and coordinated its recycling program. She campaigns to promote recycling, energy efficiency, water conservation, and anti-idling. "I am committed to continuing to make my community more environmentally friendly," she says.

What changes could your municipality make to improve water quality and energy conservation?

Strange Tales

Skull-Diggery

He helped invent the method of science inquiry that scientists use today, and in his spare time he created a new type of mathematics. But after he died, some took his brain!

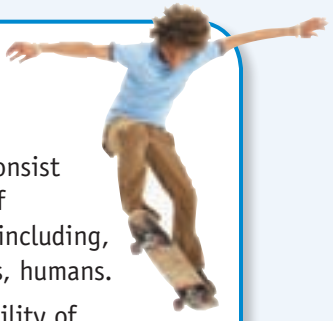
Um... okay, so they didn't take his brain, but they did take his skull, and much of the rest of his remains. Sixteen years after the celebrated French thinker, Rene Descartes, was buried in Denmark, far from his place of birth, someone dug up his coffin and made off to France with his head and bones.

So... What do you think?

1. Did someone really did up his head and bones?
2. Find out two things that Descarte did to help invent science inquiry.
3. Find out two other people who also helped invent science inquiry. Descarte, was buried far from his place of birth, someone dug up his coffin and made off to France with his head and bones.

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

biotic (page xx)

abiotic (page xx)

ecosystem (page xx)

terrestrial ecosystem (page xx)

aquatic ecosystem (page xx)

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 xx)

cellular respiration (page xx)

producer (page xx)

consumer (page xx)

food chain (page xx)

food web (page xx)

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

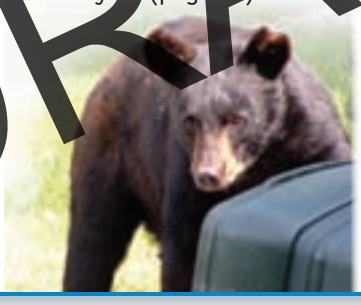
- Abiotic and biotic interactions cycle matter in terrestrial ecosystems and aquatic ecosystems.
- Photosynthesis and cellular respiration sustain the carbon nutrient cycle.
- Human activities can affect ecosystems by affecting nutrient cycles.

Key Terms

decomposers (page xx)

nutrient (page xx)

nutrient cycle (page xx)



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

carrying capacity (page xx)

limiting factor (page xx)

competition (page xx)

predation (page xx)

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 sometimes forget that our actions have consequences for ecosystem health.
- Introduced species can affect the health of ecosystems.
- Pollutants from human activities can travel within and between ecosystems.

Key Terms

introduced species (page xx)

species diversity (page xx)

pollutant (page xx)

watershed (page xx)

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 for the future.

Key Terms

sustainability (page xx)

biodiversity (page xx)

equilibrium (page xx)

Big Ideas

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