Topic 3.5

How can we assess present climate change and reduce our impact?

Key Concepts

- Studying past climates helps us understand how climate changes over time.
- We use various instruments to collect data to help us assess present climate change.
- We use computer models and projections to estimate future climate change.
- We can use our ingenuity to reduce our impact on climate change.
- We can make personal choices that reduce our impact on climate change.

Key Skills

Inquiry
Literacy
Numeracy
Research

Key Terms

global climate model
carbon footprint

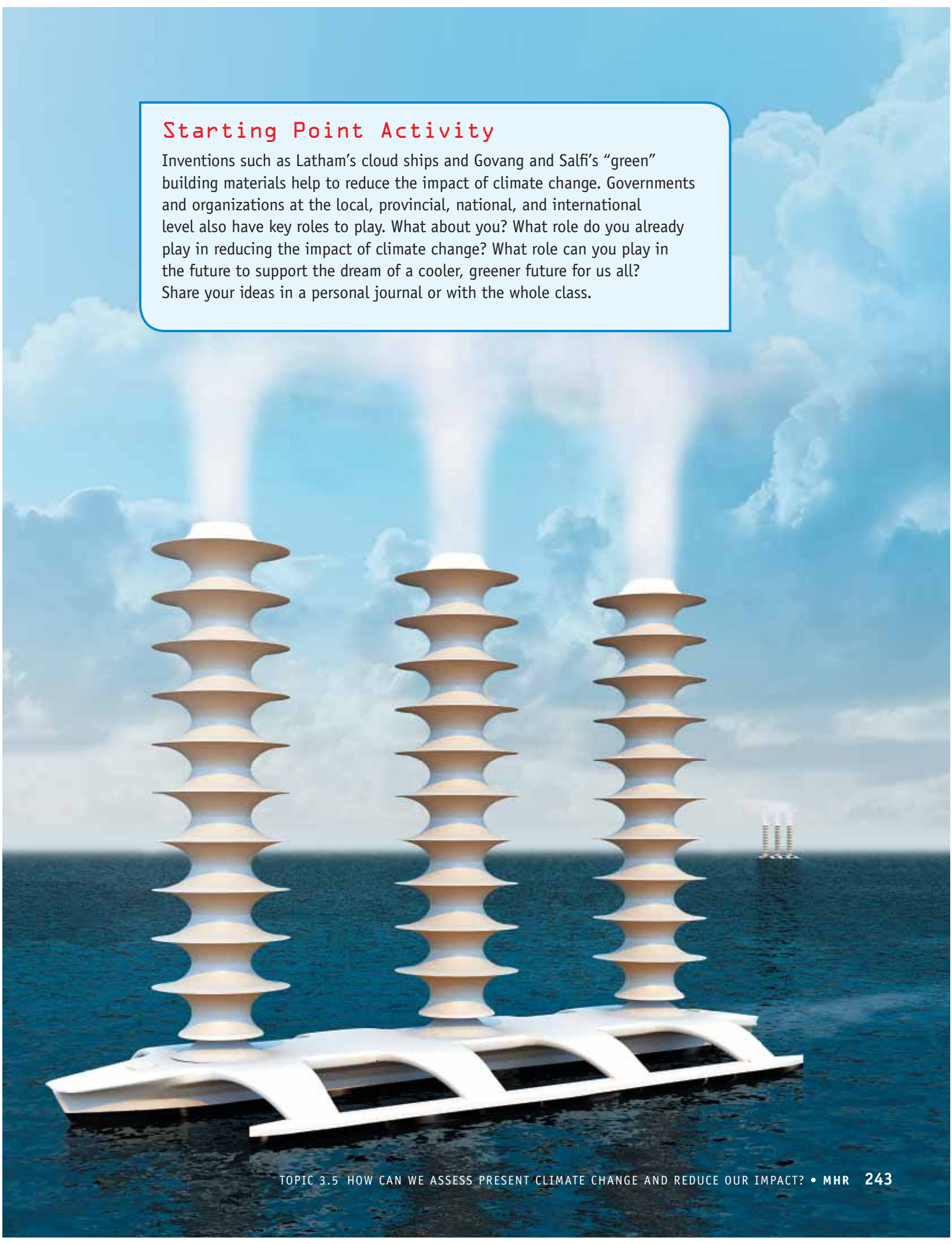
Atmospheric scientist John Latham has a dream. He imagines a day when a fleet of ships will spew ocean water into the atmosphere out of tall funnels. The idea is to enhance Earth's natural light-reflectors: clouds. Clouds in the lower atmosphere reflect a lot of sunlight. So the hypothesis is that more clouds will reflect more sunlight back into space. But what does that have to do with these strange-shaped water-spewing ships?

Clouds over oceans form, in part, around very tiny salt particles that are sprayed into the air due to the natural churning action of waves. When these tiny particles are sprayed into the atmosphere, water droplets in the air form around them, and clouds result. Latham's ships would spray tonnes of additional cloud-forming saltwater particles into the air. This would enhance their ability to reflect solar energy. As a result, more solar energy would be reflected and less heat would be trapped by greenhouse gases.

Patrick Govang and Jason Salfi are also dreaming of a fleet—a fleet of skateboards. Not just any skateboards, though. Most skateboards are made from materials that come from petroleum products—a source of greenhouse gases. To solve this problem, these two innovators produce skateboards, furniture, doors, and other products that are made from biodegradable, sustainable materials. As a result, fewer greenhouse gases are emitted into the atmosphere.

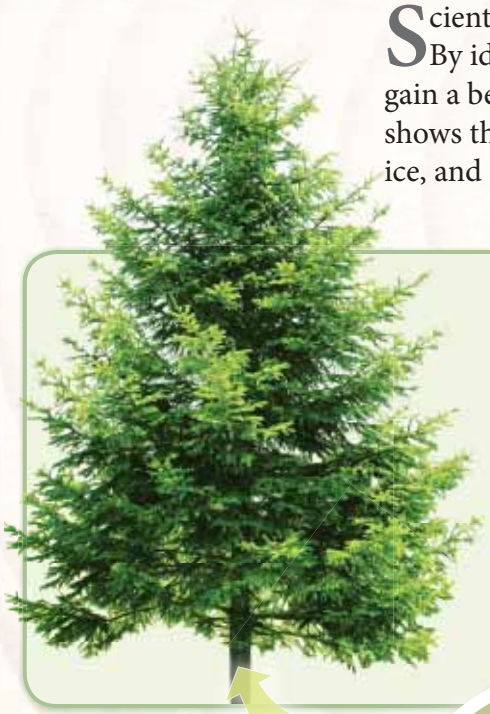
Starting Point Activity

Inventions such as Latham's cloud ships and Govang and Salfi's "green" building materials help to reduce the impact of climate change. Governments and organizations at the local, provincial, national, and international level also have key roles to play. What about you? What role do you already play in reducing the impact of climate change? What role can you play in the future to support the dream of a cooler, greener future for us all? Share your ideas in a personal journal or with the whole class.



Studying past climates helps us understand how climate changes over time.

Scientists often look to the past to help them understand today's climate. By identifying how and when Earth's climate changed in the past, they gain a better idea of how today's climate responds to change. **Figure 3.19** shows three of the best sources of information about past climates: trees, ice, and rock.



1. Tree Rings Tree rings help scientists piece together climate events in the past such as drought, flooding, and forest fires. As a tree grows, it adds two new layers of wood under its bark each year. These layers of wood are visible to us as tree rings. The light-coloured ring represents rapid spring growth, when growing conditions are more favourable. The dark-coloured ring represents slower summer growth, when conditions are drier and hotter. A skilled observer can "read" the size, shape, and colour of the rings to infer what was happening in the environment as the tree was growing. Since trees can be hundreds (and sometimes thousands) of years old, tree rings are a valuable source of information about the recent past.

3. Fossils The oldest ice on Earth is about one million years old. To learn what Earth's climate was like farther in the past, scientists can use the remains or traces of ancient organisms: fossils. Because all organisms are adapted to their environment, the type of fossil in a certain place tells scientists what the climate must have been like there during that period. For example, a fossil of a tropical fish found in the rock of an Arctic island would tell scientists that climate for that island in the past was much warmer than it is now. Even the layers of the rock in which fossils are found provide a record of climate change, because climate affects the way that some rocks form.

LEARNING CHECK

1. Explain how and why scientists can infer information about Earth's past climate from each of the following: a) tree rings, b) ice cores, and c) fossils.
2. What would a fossil of a palm leaf found on an Arctic island tell you about past climate in that region?

ACTIVITY LINK
Activity 3.14, on page 254

2. Ice Cores If researchers want to know what Earth's climate was like 100 000 years ago, trees can't help. Instead, they need to head to Earth's polar regions. Permanent ice fields in the Arctic and Antarctica have existed for hundreds of thousands of years. Each year, a new thin layer of ice is deposited. Each ice layer holds a record of what the atmosphere was like when the ice formed. This record of the past can be retrieved with special drills that take core samples from the ice. Dust and ash trapped in the ice indicate events such as volcanic eruptions and forest fires. Plant pollen tells the species of plants alive at the time. Temperature and humidity can be inferred from the size and shape of the ice crystals. Air bubbles trapped in the ice can be analyzed to show how much oxygen, carbon dioxide, and other gases were in the atmosphere at the time the ice formed.

Figure 3.19 Tree rings, ice cores, and fossils provide a record of events and conditions of Earth's climate in the past.

Go to **scienceontario** to find out more

We use various tools to collect data to help us assess present climate change.

Scientists use many tools to record the daily state of the hydrosphere, atmosphere, and other parts of Earth's climate. Direct measurements of temperature, humidity, precipitation, and other data have been collected for about 200 years. All of these data are compared with present data that are collected from tools that include weather balloons, radar, and satellites.

Weather Balloons

Weather balloons such as the one shown in **Figure 3.20** carry mini weather stations. They measure the temperature, pressure, and humidity at different heights up to about 30 000 m. A small radio transmits the collected data back to the ground. Tracking the balloon provides information about wind direction and speed at different altitudes.

Radar

The main function of weather radar is to detect precipitation that is forming inside clouds and, thus, to track storms. Radar works by emitting short pulses of microwaves. The pulses strike water droplets and ice crystals in the atmosphere. They then bounce back to a receiver that feeds the data to computers. The data are used to create an image of cloud cover and precipitation.

◀ **Figure 3.20** Weather balloons are useful tools for collecting weather-related data over many years to observe climate patterns. When the balloons get too high, they burst. A small parachute carries their instruments back to the ground.

Research Focus

Activity 3.11

YOU CAN HELP ASSESS CLIMATE CHANGE

Did you know that a network of Canadians of all ages is helping to assess climate change in Canada? They collect data such as the time that certain types of plants flower and the dates when lakes and rivers freeze and thaw. Do research to find out how you could become involved in IceWatch, PlantWatch, and similar efforts.

Satellites

In 1997, a joint program between the United States, Canada, and Japan launched the first of a series of climate-related satellites into space. These satellites are part of the Earth Observing System (EOS). Today EOS satellites such as those shown in **Figure 3.21** monitor changing conditions on land and in the atmosphere and oceans.

QuickSCAT (wind)

Aqua (water cycle)

TOPEX/Poseidon (ocean-surface mapping)

SORCE (solar energy)

SeaWIFS (ocean-atmosphere interactions)

Aura (ozone and air quality)

ICESat (ice-atmosphere interactions)

SAGE III/METEOR-3M (atmospheric particles and gases)

TRMM (tropical rainfall)

Terra (Sun-land-air interactions)

Landsat (remote sensing and land mapping)

▲ **Figure 3.21** Satellites, including those from the EOS program shown here, can make detailed observations of the whole planet in a single day.

LEARNING CHECK

1. Scientists take many measurements from as many different places as possible to assess climate conditions. Why do you think this is the case?
2. Use a PMI chart to compare the advantages and disadvantages of weather balloons, radar, and satellites for collecting climate-related data.

We use models and projections to estimate future climate change.

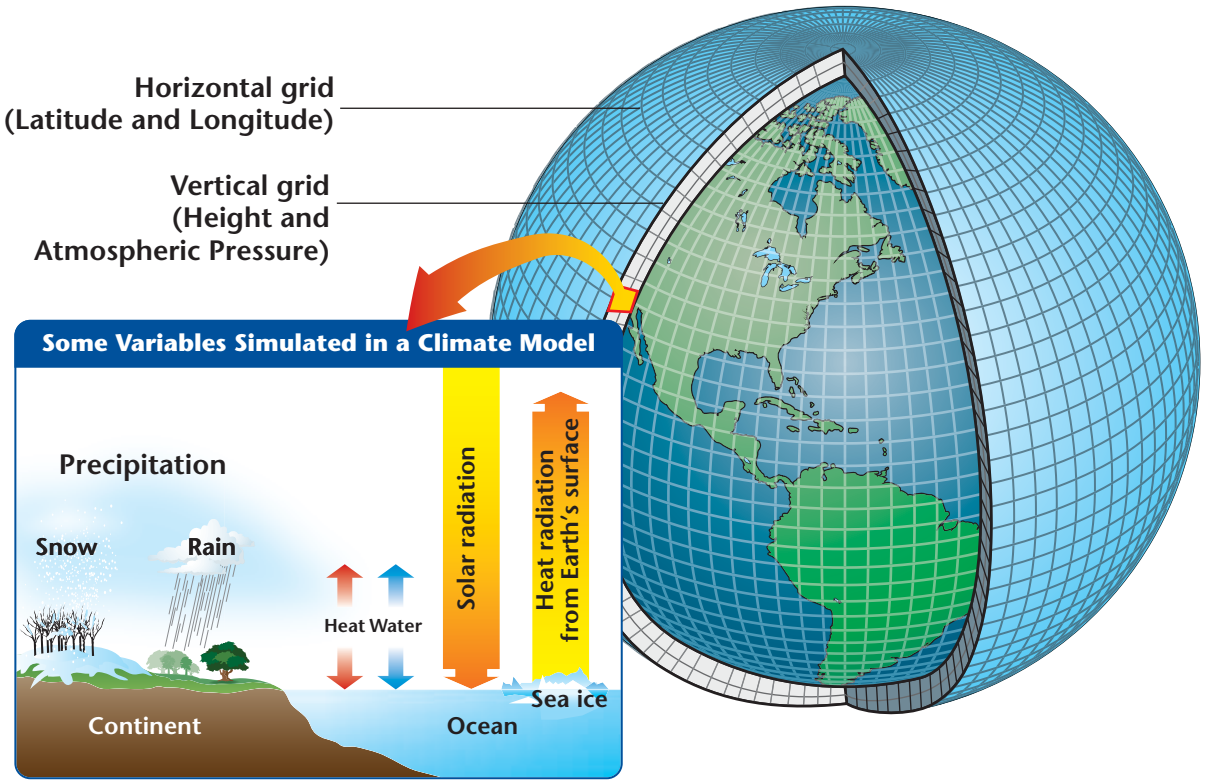
Climate scientists depend on computer models to help them understand trends in global climate change. The data collected by weather balloons, radar, satellites, small weather stations, and committed volunteers are fed into computer programs known as global climate models.

global climate model: a computer program that uses mathematical equations to help scientists understand and estimate changes in Earth's climate

Global Climate Models

A **global climate model** like the one represented in **Figure 3.22** uses mathematical equations to help scientists understand and estimate changes in Earth's climate. To do this, global climate models take into account many factors, including those that you learned about in Topic 3.3 and 3.4.

Global climate models also help scientists estimate how climate may change in the future. Such an estimate is called a climate projection. Climate projections can be communicated in different ways. One way is to create a bioclimate profile for a region. A bioclimate profile is a graph of temperature and moisture conditions of a particular site over a period of time. This method for communicating climate-projection information was developed initially by the Ontario Ministry of Natural Resources and further developed by Environment Canada.



▼ **Figure 3.22** A simple global climate model divides the globe into a three-dimension grid system that extends from the ocean floor to the outer edge of the atmosphere. The model considers interactions of winds, temperature, humidity and other climate-related factors.

Uncertainties in Climate Models

Using global climate models to make climate projections can be tricky due to the uncertainties involved. For example, it is uncertain how natural systems will respond to change. Making projections that take every climate variable into account is impossible. So the certainty of the projections made by global climate models depends, in part, on the ways that programmers work with the many variables involved.

Another uncertainty is how humans will behave in the future. For this, scientists can only create "if-then" scenarios—*if* people act a certain way, *then* we can expect to see this effect or that effect. Climate scientists can use the best of their knowledge to deal with the first uncertainty. The second uncertainty is more difficult to take into account reliably.

LEARNING CHECK

1. What is a global climate model?
2. Why is it difficult to predict Earth's future climate using global climate models?

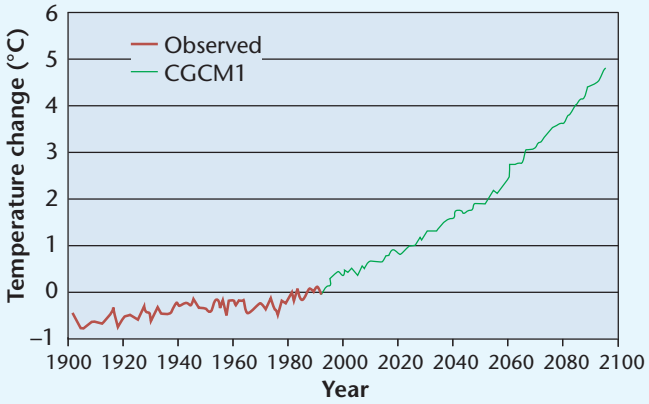
ACTIVITY LINK
Activity 3.15, on page 255

Numeracy Focus

Activity 3.12

PROJECTING EARTH'S FUTURE CLIMATE

The graph shows changes in average global surface temperature since 1900. The red line shows observed temperature from 1900 to 1997. The green line shows projected temperature from 1997 to 2100 by the Canadian Global Climate Model 1 (CGCM1).



Data from Environment Canada, 2000

1. According to the CGCM1 projection, what will the average global surface temperature be in 2100?
2. Climate projections have uncertainties. For each of the four scenarios below, explain how the projection shown in the graph might change. Give reasons in each case.
   - **a)** Anthropogenic greenhouse gas emissions increase 50 percent more than predicted by 2100.
   - **b)** Due to famine in many parts of the world, the global population only increases half as much as predicted by 2100.
   - **c)** Sustainable energy technology is less advanced by 2100 than expected.
   - **d)** By 2100, government regulations reduce greenhouse gas emissions 25 percent more than expected.

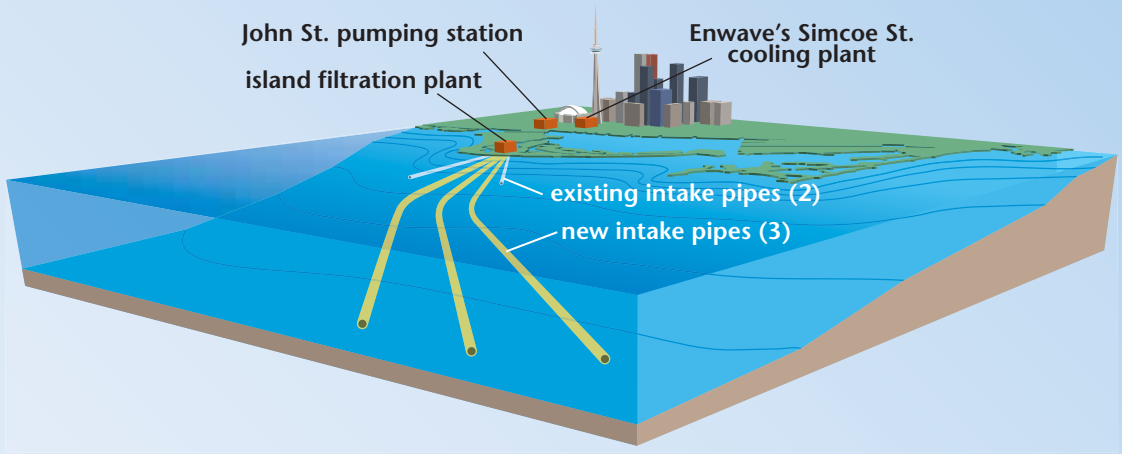
We can use our ingenuity to reduce our impact on climate change.

On the opening two pages of Topic 3.5, you saw examples of human ingenuity being used to solve the problem of climate change. Will the idea of ocean-spray ships work? Will enough people buy products made with fully biodegradable and sustainable materials? Only time will tell. The same is true for other innovations that have been proposed and invented, including those shown on these two pages.

In Quebec, Canadian scientist Dr. Sylvie Fradette is using a protein produced by a type of bacteria found in the human colon to keep Earth cool. The bacteria capture carbon dioxide from industrial smokestacks. The protein helps transform carbon dioxide into calcium carbonate. The calcium carbonate can be collected from a filter in the smokestack and used in other industrial processes.

Artificial trees (the paddle-shaped structures in this photo) would remove carbon dioxide from the atmosphere, faster and in larger amounts than real trees do. Once captured, what do we do with all this carbon dioxide? Burying it may be the answer. It's already being dealt with this way in Saskatchewan, where 30 millions tonnes are buried each year.

Riverdale NetZero is a house in Edmonton, Alberta that is completely self-sufficient. It's called a NetZero house, because it produces all the energy that it needs—even more, in fact—mainly through solar power generation. The house is built with local materials that are renewable.



The Deep Lake Water Cooling Project draws deep, icy water from Lake Ontario and pipes it back to shore. The cold water is used to cool city buildings. The end result is a 90 percent reduction in energy use in summer.

Not all innovations are high-tech, and not all need to be invented. Here's a simple, old device that's reducing greenhouse gas emissions in backyards and off balconies across Canada—the old fashioned clothesline.

Painting the roofs of houses and apartments white and using reflective pavement in the world's 100 largest cities could drop Earth's temperature several degrees. How does it work? White roofs reflect solar energy, cooling the planet. As an added plus, the cooling effect of white roofs cuts down on air conditioning too, reducing greenhouse gas production.

LEARNING CHECK

1. Explain how Canadian scientist Dr. Sylvie Fradette is using gut bacteria to keep Earth cool.
2. Describe how white roofs help reduce our impact on climate.
3. Riverdale NetZero generates its own electricity. What problem do you see with converting existing homes into NetZero houses?
4. What other existing or new innovation can you think of that could help to reduce our impact on climate?

ACTIVITY LINK
Activity 3.16, on page 257

We can make personal choices that reduce our impact on climate change.

Throughout this unit you've learned how human choices are having an impact on Earth's climate. Fortunately, when it comes to climate change, choice is a two way street. We can choose to act in ways that harm our environment, and we can also choose to act in ways that heal it. The choice is up to you.

You can choose to walk lightly on our planet.

Living on Earth is a bit like walking on a sandy beach—you leave footprints behind. In the case of climate change, your footprint is shaped by your choices and actions. A **carbon footprint** is the total amount of greenhouse gas emissions caused by an individual, company, or organization.

carbon footprint: the total amount of greenhouse gas emissions caused by an individual, company, or organization.

These emissions can be caused directly or indirectly. For example, if you choose to turn up the natural gas heat rather than put on a sweater, you are directly increasing your greenhouse gas emissions. However, if you decide to buy a sweater, the greenhouse gases emitted during the production of that sweater also affect your carbon footprint, albeit indirectly.

What choices can you make to reduce your carbon footprint? How can you live, work, and play in a more climate-friendly way?

INVESTIGATION LINK
Investigation 3D, on page 256

You can choose to educate yourself as a consumer.

Each time you buy something, you make a choice. You can choose to find out about the greenhouse gases generated by producing and packaging the goods you purchase. And you can use what you learn to make choices about the products that you will and will not buy. In this way, you influence companies, through your buying habits, to offer products that are better for our climate.

What choices can you make to be a more climate-friendly consumer?

You can choose to act as a responsible global citizen.

As part of the international community, you are a global citizen. Climate change is a problem that has no borders. This means that effective solutions can only come from international agreements that involve the cooperation of all nations. Many such agreements are already in place. They are being enacted in Canada and around the world by governments and organizations at the local, provincial, national, and international level. You can choose to get involved at any or all of these levels. You have the power to make a difference.

Inquiry Focus

Activity 3.13

CLIMATE CHANGE ON PRIME TIME

Congratulations! Your production team has just scored a job to produce a 5-minute segment about climate change on a local news show. Your segment, "Cool Ways to Help a Hot Planet", will address how individuals can make a difference. The format is up to you. Working with your team members, create a script to fill your 5 minutes of air time.

Go to **scienceontario** to find out more

Inquiry Focus

Activity 3.14

ANALYZE TREE RINGS

Studying tree rings help you learn what climate was like in your region in the recent past.

What You Need

- tree cross-section with visible rings
- hand lens
- ruler

What To Do

1. Read the following information about tree rings. The following points will help you analyze your local climate by examining tree rings.
   - Tree growth begins at the centre and moves outward. Each pair of light and dark rings represents one year of growth.
   - The size and colour of the rings indicate the amount the tree grew during one year. The light rings show faster growth in spring when conditions are cool and wet while the dark rings show slower growth later in the summer when conditions are hotter and drier.
   - Unusual marks that look like scars may be a sign of insect invasion.
   - Burn marks may indicate a forest fire or lightning strike.
   - Ring growth that becomes thinner on one side indicates the tree was leaning over as it grew. This is often due to strong winds.
2. Your teacher will give you a real tree cross-section or a diagram of one to analyze. Read the rest of the steps and design a table to record your observations.
3. Determine the tree's age. Record this number in your science journal. Hint: 1 light ring + 1 dark ring = 1 year of growth.
4. Measure the width of each pair of light and dark rings. Record your measurements in your table.
5. Use the hand lens to observe each tree ring carefully for unusual markings. Record your observations in your table.

What Did You Find Out?

1. **a)** In which year of tree growth were climate conditions the most favourable for growth? Explain your reasoning.
   b) In which year of tree growth were climate conditions the least favourable for growth? How do you know this was the case?
2. Explain what the following observations might mean when examining tree rings:
   a) an extremely narrow, dark ring
   b) an extremely wide, light ring
   c) burn marks around a dark ring
3. Most global climate models project that climate change will result in wetter winters and drier summers in Ontario. How do you think tree rings will reflect these changes in climate?

Literacy Focus

Activity 3.15

ASSESSING CLIMATE CHANGE ARTICLES

In this activity, you will compare scientific and non-scientific media on climate change issues in terms of bias, accuracy, and methods of persuasion. You will find more information on how to assess these factors in the Skills Section at the back of this book.

What You Need

magazines and newspapers with scientific and non-scientific articles about climate change

What To Do

1. Your teacher will provide you with a variety of scientific and non-scientific publications with articles about climate change.
2. Choose one scientific and one non-scientific article.
3. Examine the titles and headings of each article. Answer the following questions.
   - **a)** What overall impression does the title of each article leave you with?
   - **b)** What do the size and colour of the font used in each title communicate to you?
4. Read both articles. Answer the following questions.
   - **a)** What is the main message that each article communicates?
   - **b)** Is the text easy to understand or is it confusing?
   - **c)** Are the facts presented in a way that is supported by evidence?
   - **d)** Does the author seem to be trying to influence your opinion in a certain way?
   - **e)** Does the author represent a certain group that may be biasing his or her delivery of the facts?
   - **f)** Does the article have a resources section that tells you the source of the data cited?
   - **g)** Has the data been subjected to rigorous scientific standards and review by scientists?
5. Examine the images associated with each article. For each article, try to answer the following questions.
   - **a)** Do the images support the text of the article or do they seem to have another purpose?
   - **b)** What emotions do the images make you feel?
   - **c)** Do diagrams shown in the article accurately represent the facts?

What Did You Find Out?

1. Write a brief paragraph summarizing your opinion of each article and its images. Be sure to assess each article for bias, persuasion, and accuracy.
2. Would you recommend these articles to a friend or peer? Why or why not?

Investigation 3D

Skills

initiating and planning

✓ **performing and recording**

✓ **analyzing and interpreting**

communicating

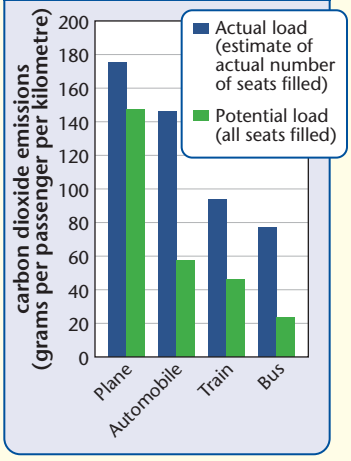
Transportation Choices and Your Carbon Footprint

Transportation accounts for 27 percent of all anthropogenic greenhouse gas emissions in Canada. In this investigation, you will explore how your transportation choices affect your carbon footprint.

What To Do

1. Use the graph and the paragraph below to answer the questions.

Carbon Dioxide Emissions for Different Modes of Trasportation



Different modes of transportation produce different levels of greenhouse gases. The graph compares the carbon dioxide emissions per person for several modes of transportation. This value varies depending on whether the vehicle is full or not.

- *Potential capacity* refers to the amount of carbon dioxide emitted per person when all the seats are filled in a vehicle.
- *Actual load* refers to carbon dioxide emissions per person for a vehicle based on how many seats are filled in an average trip. On most trips, the vehicle you travel in will have some empty seats.

Carbon dioxide emissions are always lower when a vehicle is filled to potential capacity. This is because the same emissions are divided among more people.

What Did You Find Out?

1. Which mode of transportation has the highest carbon dioxide emissions? Which has the lowest?

2. **a)** Explain why the potential capacity of carbon dioxide emissions is so much lower than the actual load emissions.

b) Why do you think this is especially true for automobiles, trains, and buses, but not for airplanes?

c) Explain how it is possible for carbon dioxide emissions to be lower for travel by automobile than by bus.

3. To travel to an after-school job, you can either take a bus that is only partly filled (actual load) or get a ride in a full car with three other employees (potential load). In which case would your carbon footprint be smaller?

4. With a partner, brainstorm ways that your carbon footprint is affected by transportation. Use these ideas to create a plan to reduce your carbon footprint. Hint: Think about the transportation-related choices you make each day. Even if you walk or bike everywhere, the food you eat and the goods you buy need to be transported to you.

Research Focus

Activity 3.16

RUN A CLIMATE-FRIENDLY BUSINESS

A growing number of Canadians start their own business each year. In a few years, you may be one of them. What steps could you take to make your business as climate-friendly as possible?

What To Do

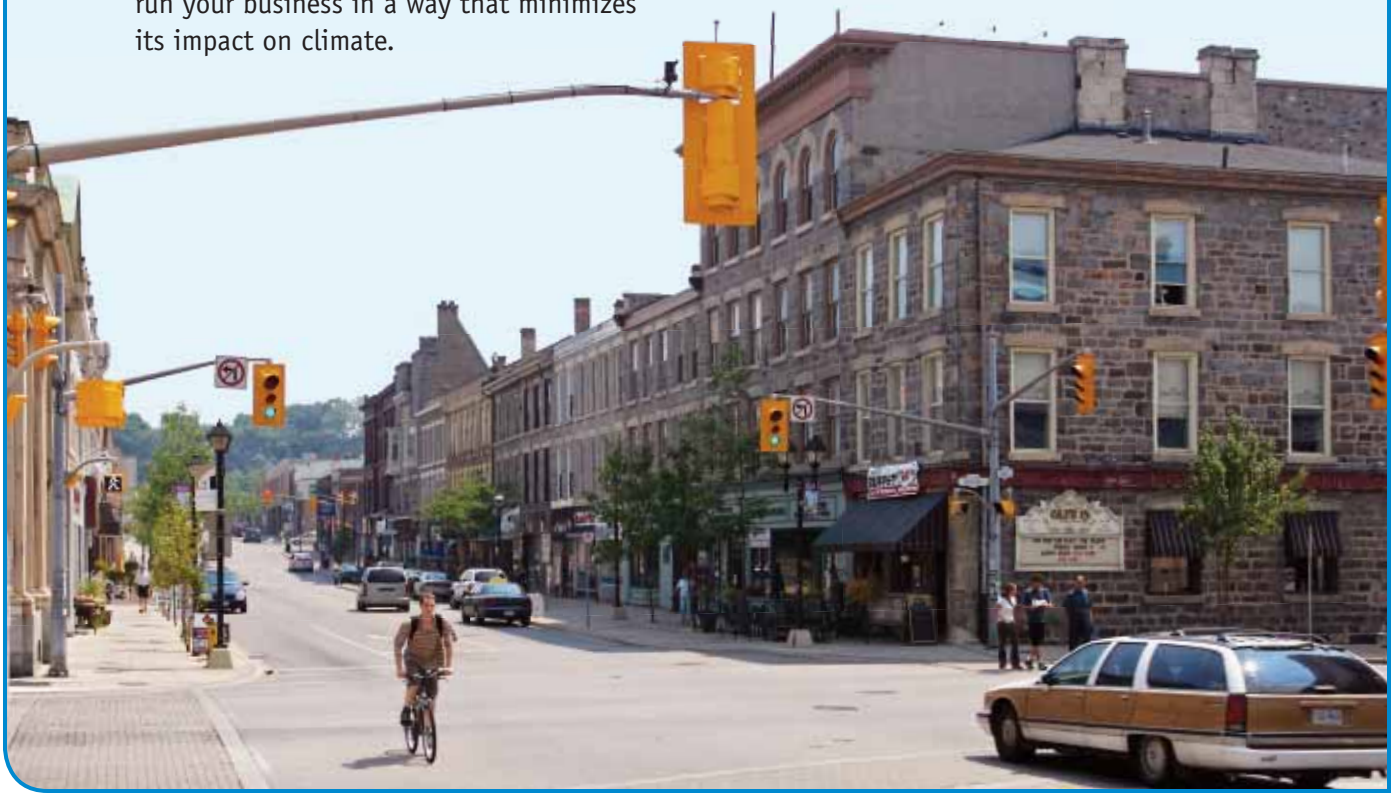
1. Choose a business you might be interested in starting. If you are not sure where your interests lie, your teacher will be able to give you a few ideas.
2. Complete a business plan for your business with the following headings:
   - **a)** Business Summary: Explain what product or service your business will provide.
   - **b)** Market Analysis: Explain who would buy your product or service and how much they might pay for it.
   - **c)** Financial analysis: Determine how much money you will need to start your business and keep it running.
   - **d)** Sustainability analysis: Explain how you will run your business in a way that minimizes its impact on climate.
3. Create a poster size print ad for your business that outlines your product or services, as well as your sustainable business practices.

What Did You Find Out?

1. **a)** Based on your business plan, describe three ways you hope to run your business in a way that minimizes its impact on climate.
   - **b)** For each option, consider the costs involved. Which method is most feasible if you still want to make a healthy profit?
   - **c)** What factors other than affordability will influence your decision to carry out each method?

Inquire Further

Research and summarize how a business near you is carrying out sustainable business practices to reduce its impact on climate. As a class, combine your summaries to create a "Go Green" business guide for your region.



Making a DIFFERENCE

When Asha Suppiah was 11, she visited her grandparents in India and noticed a shortage of clean drinking water. "I wondered why a tropical country, with an abundance of sunshine and an ocean surrounding it, couldn't use these two freely available resources to produce fresh water." So Asha read about solar desalination, which uses solar energy to remove salt from ocean water. Asha spent three years researching, designing models, and conducting experiments. Her final invention is currently patent pending.

Asha's advice is to "always believe in your dreams and to never take no for an answer. I found that when you are young, not everyone will take you and your ideas seriously, but if you truly believe in them and work towards your goals and dreams, anything is possible. I truly believe that the youth of today can really make a difference in the world."

Do you have any ideas for an invention that could help people meet their basic needs more easily?

While in Grade 9, Toronto student Colin Carter made a short film about global warming as an independent project. That short film served as the starting point for a longer 70-minute documentary that he wrote, directed, and produced. The film, *Fight for the Planet*, looks at the social and economic effects of climate change, the science behind climate change and green technologies, and the need for political and societal change. In 2009, when Colin was in Grade 11, the documentary premiered in Toronto. The original short film is posted on YouTube.

Colin thinks young people will play a key role in the years ahead. "I think the mindset people my age have is very different, and we see change as an opportunity, not as a threat," he says.

How could you use film, art, drama, or another creative medium to communicate your feelings about climate change?

Topic 3.5 Review

Key Concept Summary

- Studying past climates helps us understand how climate changes over time.
- We use various instruments to collect data to help us assess present climate change.
- We use computer models and projections to estimate future climate change.
- We can use our ingenuity to reduce our impact on climate change.
- We can make personal choices that reduce our impact on climate change.

Apply the 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. K/U Explain how radar is used to assess current climate change.

3. K/U Identify two variables that global climate models must take into account in order to make climate projections.

4. T/I You are a scientist studying *T. rex*, a dinosaur that roamed Earth more than 65 million years ago. To learn what the climate was like when *T. rex* was alive, would you analyze tree rings, ice cores, or the fossil record? Explain your reasoning.

5. T/I An ice core researcher finds a layer of ash in ice that formed 500 000 years ago. She also observes that the concentration of carbon dioxide in the air trapped in bubbles in the ice is twice as high as it is today.

a) What event likely happened 500 000 years ago?

b) Based on this ice core data, do you think Earth's climate warmed or cooled after this event occurred? Include your reasoning in your response.

6. C A friend emails you that humans will never change their ways. Only new technology that removes carbon dioxide from the atmosphere can cool our planet. Write your email response.

7. A Your teacher is going shopping for a new car.

a) Explain to your teacher how his or her choice of car can help reduce human impact on climate.

b) Identify two things your teacher might consider that could decrease his or her carbon footprint even before buying the car.

c) Hybrid cars are powered by gas and electrical energy. How would the source of electrical energy used in a hybrid car make a difference to a person's carbon footprint?

SCIENCE AT WORK

CANADIANS IN SCIENCE

▲ Joy Schmidt with a research module of Xero-Flor®'s standard green roofing material at the British Columbia Institute of Technology (BCIT) Green Roof Research Facility

Joy Schmidt is president of Xero Flor® Canada. This company markets and installs green roofing systems. Green roof systems begin with a blanket of mosses and can incorporate grasses, flowers, and even trees. A green roof like this can reduce a building's carbon footprint by lowering energy requirements for central heating and air-conditioning. It also replaces the vegetation removed during construction of a building.

Born and educated in Trinidad, Joy began her career as an executive secretary. She joined the accounting department at Xero Flor®'s head office in Germany and then moved into international sales. In 2002, she oversaw the installation of a huge, 4.2-hectare roof on the Ford Motor Company's Rouge Assembly Plant in Dearborn, Michigan. This entered the Guinness Book of World Records as the world's largest "living" roof. Shortly after, she established Xero Flor® Canada.

What kind of training do you need to become a green roofer?

We have a number of different jobs that are done at our company—field planting, installation, maintenance, and general contractor relations. It's better to have a general knowledge and be good in something that will equip you to do those jobs. You have to think logically. It helps if you can read a blueprint. You can study horticulture, but you won't necessarily learn which plants grow best in 15 cm of soil on a roof. You can study architecture, but that won't teach you that soil with a lot of organic matter in it will generate heat and create a fire risk. These are things you can only learn by working for someone who does green roofing.

What advice would you give someone interested in becoming a green roofer?

You have to be a hard worker who doesn't look at the clock. You have to be passionate about what you do. If you see your work as a service that you're providing, that passion will rub off on others.

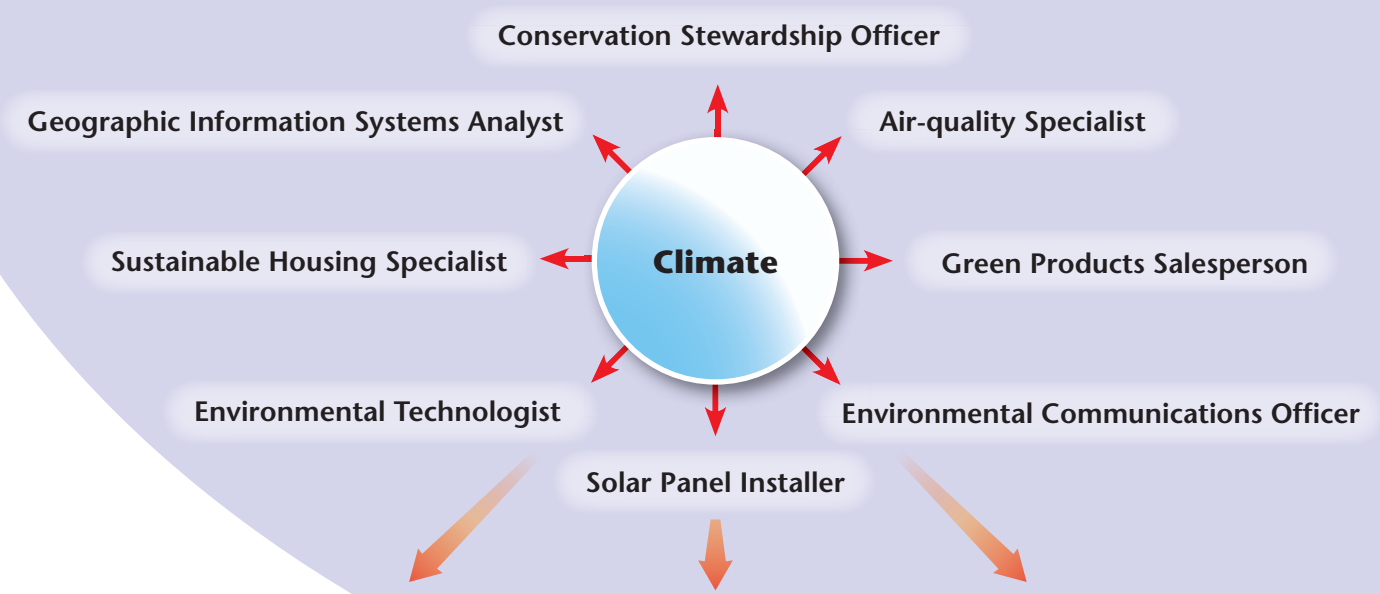
What is the most rewarding part of your job?

It's lots of fun to be on a roof and working—even though it gets pretty cold sometimes!

◀ Joy Schmidt on top of the world's largest green roof on the Ford Assembly Plant in Dearborn, Michigan

Put Science To Work

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



▲ Environmental technologists gather soil, air, and water samples, inspect pollution control systems, and check to see if companies are following environmental laws.

▲ Solar panel installers must train as residential electricians or as mechanical engineers or roofers. They must also know the regulations in Ontario's *Clean Energy Act*.

▲ Environmental communications officers use their written, verbal, and interpersonal skills to promote public awareness of environmental issues.

Over To You

1. If you could interview Joy Schmidt, what questions would you ask her about her work?
2. What is the role of on-the-job training at Joy Schmidt's company?
3. Research a career involving climate that interests you. If you wish, you may choose from the list above. What are the essential skills needed for this career?

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