Section 7.2 Describing Climates

Specific Expectations

- **D1.1** analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems
- **D2.4** investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change, using simulations and/or time-trend data that model climate profiles
- **D2.8** classify the climate of their local region using various tools or systems (e.g., Ecoregions of Canada, bioclimate profiles), and compare their region to other regions in Ontario, Canada, and the world
- **D3.1** describe the principal components of Earth's climate system and how the system works
- **D3.4** identify natural phenomena and human activities known to affect climate, and describe the role of both in Canada's contribution to climate change

In this section, students learn how areas of Earth are divided into climate zones, a classification based on latitude and other factors such as precipitation and temperature. They will use and create climatographs, and explore Earth's biomes, ecozones, and ecoregions.

Common Misconceptions

- Students may believe that distance from the equator is the only factor affecting climate. Draw their attention to the importance of precipitation in determining climate.
- Students may think that biomes and other climate categories have clear boundaries, as shown on maps. There is always a transition zone from one biome to another. These may not be as obvious as transition zones students are familiar with in their own neighbourhoods (e.g., parks, lawns, etc.). In natural settings, transition and change are rarely abrupt.
- Students may believe that biomes include only land area. They may not realize that biomes also include animals. Biomes have characteristic animals that live in them (and only in them). The presence of an animal may indicate the biome of the area. For example, students may confuse the Arctic and the Antarctic; however these two locations can be quickly differentiated based on the presence of penguins (Antarctic) and polar bears (Arctic).

Background Knowledge

Wladimir Köppen was the director of the meteorological section at the naval observatory in Hamburg, Germany. He kept detailed daily reports of the weather. These reports were combined into his overall climate studies. Köppen's original maps have been modified many times and refined with the addition of new data.

There are many ways of classifying climate. Most atlases show temperature and precipitation, and also include atmospheric pressure, prevailing winds, ocean currents and extent of sea ice. More detailed classifications are usually available at the country or region level, and provide information such as average dates of first and last killing frost or the number of days below freezing or a particular degree-day (e.g., 18°C).

Bioclimate profiles (BCPs) have been developed to increase knowledge of particular climates and to assist in studying past and future climates. Originally, BCPs were developed for Ontario by the Ministry of Natural Resources. These BCPs were further developed and expanded by Environment Canada. In 2002, the Canadian Climate Impact Scenarios Project developed BCPs for future climates. BCPs are available graphically on the Climate Change Scenarios Network (CCSN) website for both historical and future time periods. BCPs have been developed for over 500 locations across Canada.

Canada is so large that it is best to classify its ecological systems in nested levels. This means that a relatively small number of categories exist in the country, but smaller regions in the country can be broken down into smaller categories. The National Ecological Framework for Canada classifies Canada into 15 terrestrial and five marine ecozones. These areas are so large that the Atlantic Maritime ecozone contains all of the maritime provinces. Ecozones are further subdivided into ecoregions. Inside ecoregions are ecodistricts. Each smaller-scale classification nests into the classification above it. There are over 200 ecoregions in Canada and even more ecodistricts.

Literacy Support

Using the Text

As a class, discuss how to approach the dense information contained in this section's many maps and graphs. Skim and scan the visuals and section headings. Survey the types of visuals in the section and make inferences about the focus of the narrative. What clues do the figures give about the text?

Before Reading

- Have students look at the headings to determine the main ideas. This will help students identify the most important information in the text. Students can use this information to organize their learning.
- Before students read the section on biomes, have them complete **BLM G-44 K-W-L Chart** to identify previous knowledge and questions they have about biomes.

During Reading

- ELL English language learners can be encouraged to make study notes in their first language and then create an English translation.
- Have students work in pairs and check each other's comprehension. Have them stop at every subsection and ask each other two questions about the content. Once they agree on the best answer for each question, they can proceed to the next subsection of text.

After Reading

- Have students create graphic organizers that represent the content. They can "nest" the different classification schemes as appropriate and also show which classifications are complementary and which (if any) are conflicting.

Using the Images

- Before students read this section, have students look at the photographs and illustrations and relate them to their own experiences. Students may have travelled to or be familiar with some of the biomes shown in the section.
- Discuss the implied differences between smooth and spiky lines on line graphs. What do bar graphs imply by their structure, as opposed to circle graphs or scatter graphs?
- Explore the many maps, noting the variety and nature of information they provide.
- Have students use the first map, Figure 7.14 on page 279 of the student textbook, to identify where they or their parents were born. Have them connect their personal knowledge of that place with the climate zones shown in the figure.
- Have students read the graphic text represented in the climatographs. They may need to review the organization of graphs and the functions of the axes. They also can work to relate the title and the caption to the photographs of the biomes. Refer students to the Study Toolkit section on Interpreting Climatographs on page 268 of the student textbook.

Assessment FOR Learning		
Tool	**Evidence of Student Understanding**	**Supporting Learners**
Activity 7-3 How to Make a Climatograph, page 281	Students link climate data to Windsor, the more southern city.	As a class, locate Thunder Bay and Windsor on a map. Ask the class for personal experiences of each place, relating to climate. Prompt students to compare their climatographs to those on pages 284 to 285 of the student textbook.
Learning Check questions, page 283	Venn diagrams have at least one point in each of the sections comparing *climates* and *biomes.*	Use a think-pair-share strategy, assigning climate or biome to each partner. Provide **BLM G-43 Venn Diagram** for them to combine the points.
Section 7.2 Review, page 289	Climatic regions across Canada are linked to growing seasons.	Have students work in small groups to develop a presentation about the biomes represented in Canada.

Instructional Strategies

- DI Spatial and logical-mathematical learners will likely enjoy this section. If possible, in any group activities, ensure that there are at least one of these types of learners in each group.
- ELL Students may have personal experience with different biomes identified in the section. Allow them to demonstrate their knowledge in an alternative way, such as bringing photos, drawing pictures, creating a collage, etc. and have them share their knowledge with the class.
- ELL Create a picture dictionary of the different biomes and Canadian ecozones. Post this in the class in an accessible location for students' reference.
- Chunk the reading into smaller, manageable parts. Do each type of classification system individually and provide structured directions to help students proceed through each chunk. You may wish to use Section 7.2 Review question 4 to help students organize their notes.

Activity 7-3 How to Make a Climatograph (Student textbook page 281)

Pedagogical Purpose

This activity has students create original climatographs from real data, encouraging them to note the relationship between precipitation, temperature, and climate.

Planning	
Materials	Red and blue pencils Rulers **BLM 7-8 How to Make a Climatograph** (optional) Graph paper Have enough materials to allow students to work in pairs.
Time	25 min

Background

Climatographs allow an easy comparison of different climates. Climatographs can be expanded to include other data. For example a bioclimatograph superimposes biological data (for example, insect counts or fungal spore counts) on top of a climatograph to show the relationship between a biological factor and the climate in an area.

Activity Notes and Troubleshooting

- Have students work with a partner.
- Have students refer to Figure 7.15 so they know what their climatograph should look like in terms of labels, axes, and title.
- Have extra coloured pencils, graph paper, and rulers available.
- Students may get confused with the single letter representing each month. You may wish to re-do the chart with the months spelled out, and post it at the front of the room.

Additional Support

- DI This activity is excellent for visual, spatial, and logical-mathematical learners.
- ELL Ensure all students and particularly English language learners are familiar with the terms *horizontal axis* and *vertical axis.*
- Enrichment—Ask students to research local climate data, then construct a climatograph.
- Allow students to make climatographs using spreadsheet software.
- To assess students' climatographs, use **BLM A-19 Graph from Data Checklist.**

Answers

1. January has the lowest average temperature.
2. January was the driest month; August was the wettest.
3. Plants can grow for nine months in this location.
4. The growing season would last for 11 months.
5. Windsor, because the others have a greater number of colder months.

Learning Check Answers (Student textbook page 283)

1. Because of the curvature of Earth's surface, polar regions receive less direct solar energy (heat) than tropical regions.
2. Average monthly temperature and average monthly precipitation.
3. Venn diagrams should indicate that biomes differ from climates because biomes are based in large part on the living things in a region, whereas climate is based on abiotic factors.
4. Desert plants (e.g., cacti) that do not require a lot of water.

Section 7.2 Review Answers (Student textbook page 289)

Please also see **BLM 7-10 Section 7.2 Review (Alternative Format).**

1. Earth's surface was divided into tropical, temperate, and polar zones.
2. Climatographs allow scientists to view how temperature and precipitation change throughout the year and to compare the weather patterns of distant locations.
3. To understand how and why climates vary around the world, and how climates affect other parts of the environment, such as plants and animals.
4. Advantages and Disadvantages of Climate Classification Systems

Tool/System	Description	Advantages	Disadvantages
Climatographs	• graph region's average monthly temperature and precipitation taken over several years	• used to compare climates and weather patterns of different regions • allow scientists to see how temperature and precipitation change throughout year	• provides information about temperature and precipitation only • does not include biotic components of region
Köppen Climate Classification System	• five major zones based on average monthly temperature and precipitation and annual precipitation	• based on observable features • can be further subdivided based on seasonal patterns	• categories are overly broad and based only on abiotic components
Biomes	• group regions with similar climate, plants, and animals	• include both biotic and abiotic components	• biomes are very large so include a lot of variability
Bioclimate Profiles	• compare conditions (temperature, frost probability, monthly precipitation, water surplus and deficit) in different locations over several years	• can be used to project changes in climate to help governments and industries plan	• based only on abiotic factors
Ecozones	• combine data on climate, geology, landscape, soil, vegetation, wildlife, water, and human factors	• holistic; uses abiotic and biotic factors	• broad categories

5. Some scientists have criticized the Köppen climate classification system for having overly broad categories within the dry climate category and the moist mid-latitude climate categories.
6. With information about the monthly average temperature and precipitation, I could create a climatograph and assign the region to a category of the Köppen climate classification system.
7. A biome is a division of Earth containing similar biotic components and climate, whereas an ecoregion is characterized by local landforms alone.
8. Example: The growing season for crops may last longer, which could lead to a surplus of food produced by Canada.

Section 7.3 Indicators and Effects of Climate Change

Specific Expectations

- **D1.1** analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems
- **D1.2** assess, on the basis of research, the effectiveness of some current individual, regional, national, or international initiatives that address the issue of climate change, and propose a further course of action related to one of these initiatives
- **D2.4** investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change, using simulations and/or time-trend data that model climate profiles
- **D3.8** identify and describe indicators of global climate change

In this section, students will learn about indicators that show Earth's climate is changing. The most significant of these is global warming, which in turn affects many other features such as polar ice caps and atmospheric temperatures. Students will learn about the impacts of these changes will be introduced to programs designed to address climate change.

Common Misconceptions

- Students may confuse the terms *global warming* and *climate change*. Global warming is, in fact, an indicator of the long-lasting changes to climate that are occurring on a global scale.
- Students may think that effects such as global warming and rising sea levels occur in isolation. In fact they strongly influence each other. Students will learn about such feedback loops in Chapter 8.
- Students may believe that global warming is irreversible and that humankind has gone beyond the point of no return. Students need to be aware that the fight is not over and there is still (and will always be) time to change.
- Students may feel that the melting of the polar ice caps is not a big deal to them because the ice caps are far away and Ontario is not a coastal province. Emphasize the interrelatedness of global changes.
- Students may feel that global warming is good, considering how cold Canada is in winter. While there will be opportunities for Canada (for example, in agriculture) to take advantage of warmer weather, the global scale of the changes means that everything will change (e.g., water levels, immigration, etc.), not just winters.

Background Knowledge

The globally averaged surface air temperature is estimated to increase between 1.4°C and 5.8°C by 2100 from 1990 averages. The challenges of determining a "global" average, coupled with the inherent uncertainty of models (because of assumptions and representations of complex processes), makes it difficult for more precise forecasts. However, the magnitude of this increase over this short span of time is unprecedented during the last 10 000 years. Most models agree on the following predictions:

- more hot days and higher daily maximum temperatures in all land areas,
- higher minimum temperatures and fewer frost days in all land areas,
- more frequent intense precipitation events over the Northern Hemisphere, and
- increased continental drying and likelihood of drought.

The melting of large ice sheets is not the only cause of sea-level rise. In fact, a significant amount of sea-level rise is caused by the thermal expansion of ocean water as the temperature increases. Huge floating ice sheets will not cause any change in sea levels as they melt, because floating ice displaces the same volume of water as it does when it melts. One of the key concerns is about large pieces of ice breaking off the land-based Greenland and Antarctic ice shelves.

The rising acidity of the world's oceans is having a significant effect on ocean biodiversity. Tiny, shelled amoeba-like animals called foraminifera play a major role in trapping carbon dioxide, which is a component of their shells. They transport the carbon dioxide in their shells to the ocean depths when they die and sink to the bottom. The carbon dioxide gets locked away for decades, centuries, or even longer. Scientists have compared the shell weights of today's foraminifera to data from 50 000-year old specimens and have shown a 30 to 35 percent reduction in shell weight, meaning less carbon dioxide is being captured to make their shells.