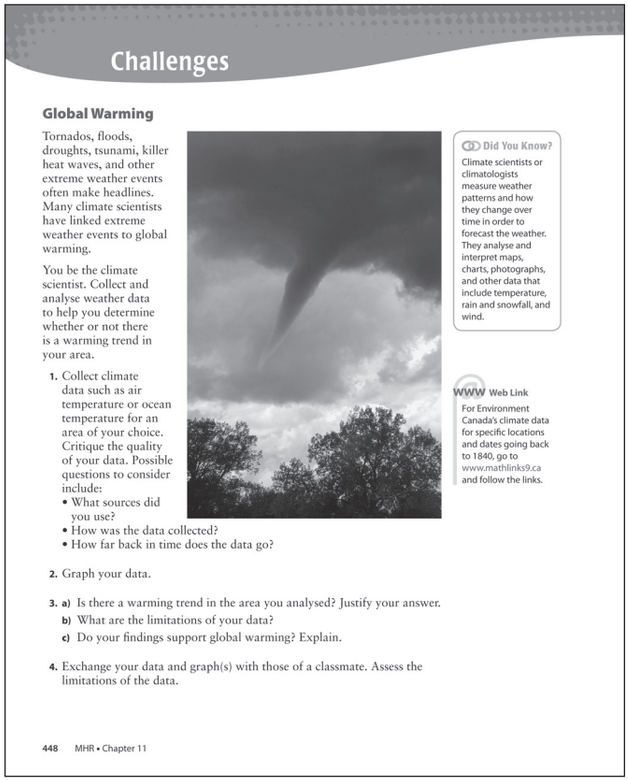
Challenges



Challenges

Global Warming

Tornados, floods, droughts, tsunami, killer heat waves, and other extreme weather events often make headlines. Many climate scientists have linked extreme weather events to global warming.

You be the climate scientist. Collect and analyse weather data to help you determine whether or not there is a warming trend in your area.

1. Collect climate data such as air temperature or ocean temperature for an area of your choice. Critique the quality of your data. Possible questions to consider include:
   - What sources did you use?
   - How was the data collected?
   - How far back in time does the data go?
2. Graph your data.
3. a) Is there a warming trend in the area you analysed? Justify your answer.
   b) What are the limitations of your data?
   c) Do your findings support global warming? Explain.
4. Exchange your data and graph(s) with those of a classmate. Assess the limitations of the data.

Did You Know?
Climate scientists or climatologists measure weather patterns and how they change over time in order to forecast the weather. They analyse and interpret maps, charts, photographs, and other data that include temperature, rain and snowfall, and wind.

WWW Web Link
For Environment Canada's climate data for specific locations and dates going back to 1840, go to www.mathlinks9.ca and follow the links.

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***MathLinks 9*, page 448**

Suggested Timing
80–100 minutes

Materials
- computer with Internet access
- spreadsheet software (optional)
- grid paper

Blackline Masters
Master 1 Project Rubric
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 11–16 Global Mean Temperature

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☑ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☑ Reasoning (R)
- ☑ Technology (T)
- ☑ Visualization (V)

Specific Outcomes
SP1 Describe the effect of:
- bias
- use of language
- ethics
- cost
- time and timing
- privacy
- cultural sensitivity on the collection of data.

SP2 Select and defend the choice of using either a population or a sample of a population to answer a question.

SP3 Develop and implement a project plan for the collection, display and analysis of data by:
- formulating a question for investigation
- choosing a data collection method that includes social considerations
- selecting a population or a sample
- collecting the data
- displaying the collected data in an appropriate manner
- drawing conclusions to answer the question.

PR2 Graph linear relations, analyze the graph and interpolate or extrapolate to solve problems.

Planning Notes: Global Warming

You may wish to use the following steps to introduce and complete this Challenge:

1. As a class, read and discuss the introduction to the Challenge. Discuss extreme weather events that are familiar to students, such as recent tornadoes, floods, droughts, tsunami, and killer heat waves. Ask questions such as the following:
   - What are the effects of extreme weather events? (Effects include loss of human and animal lives, displacement of people and animals, disease, economic difficulty.)
   - According to reports in the media, how common are extreme weather events?
   - Are extreme weather events increasing? Explain your reasoning.

   Ask students to explain global warming. Global warming (or climate change as some scientists prefer) refers to the increase in the average measured temperature of the Earth's surface air and oceans. You might explain that scientists have done studies showing that global warming would increase the frequency or intensity of many kinds of extreme weather. For instance, warmer water temperatures in oceans result in more severe hurricanes, since hurricanes get their power from warm waters, and warmer air temperatures result in heavier rainfalls and more flooding.

Ask students how they could find out if global warming is actually occurring.

2. Provide students with Internet access to research climate data. Students who choose an area in Canada may find the Web Link in the student resource useful. As they work on analysing their data, circulate and coach students using the following questions:
   - What do the statistics suggest about a warming trend for your area?
   - What do the statistics suggest about global warming?
   - What concerns do you have about your data as you analyse it?
   - How accurate and reliable are your data sources?

   For #3, you might provide students with **BLM 11–16 Global Mean Temperature** to help them assess what the temperature trends are globally.
3. Clarify that the task is to
   - collect climate data for a local or global area
   - critique the quality of the data
   - graph the data
   - analyse the data
   - critique the data and graph(s) of a classmate
4. Review the **Master 1 Project Rubric** with students so that they will know what is expected.

Meeting Student Needs

- Some students may need assistance with finding and/or using appropriate data. You may wish to adapt the Challenge and provide them with **BLM 11–16 Global Mean Temperature**, which provides data for global mean temperatures. For more information about the source of this data (Intergovernmental Panel on Climate Change), see the related Web Link on this TR page. Explain that the left hand axis shows anomalies relative to the 1961 to 1990 average. The right hand axis shows the estimated actual temperature in °C. Point out that the trend lines are steeper for shorter periods of time and indicate accelerated warming. Prompt students to observe that prior to 1910, there was little change. From about the 1910s to the 1940s and more strongly from the 1970s to the present, there has been a warming trend. Have students provide responses to the following questions:
  – What does the graph suggest about global warming? (The global mean temperature is increasing.)
  – What period of time does this graph cover? (1860 to 2000)
  – What trends do you observe? Explain. (The global mean temperature has risen by 0.74 °C $\pm$ 0.18 °C over the past 100 years. The rate of warming over the last 50 years is almost twice as much as over the last 100 years.)
  – How could you check that the temperature where you live follows the global trend?
- Provide coaching to students who need assistance in organizing and displaying their data.

Gifted and Enrichment

- Challenge students to answer the following questions before starting their research.
  – How many cities would make a reasonable sample for a weather data study?
  – If you plan to include more than one city, how will you select cities? (For instance, select cities located in countries on different continents and at different degrees of longitude and latitude.)
  – What time frame should you research? (It is important to consider as long a time frame as possible. There have been warming trends in the past. Students need to be able to identify warming that is not part of a long-term pattern.)
  – What temperatures will you search for? Why?
  – What factors might affect a change in temperature? (Factors include rising demand for natural resources, economic growth of China and India in recent years, industrial pollution, moisture, precipitation.)

  After students have completed the Challenge, have them assess how well they met the guidelines they set.
- Have students research methods that climatologists use to measure climate. They may find the related Web Link that follows helpful.

WWW Web Link

The Intergovernmental Panel on Climate Change (IPCC) has finalized its Fourth Assessment Report (AR4) titled Climate Change 2007. For the reports by the three Working Groups, which assess the current state of knowledge about climate change, go to www.mathlinks9.ca and follow the links.

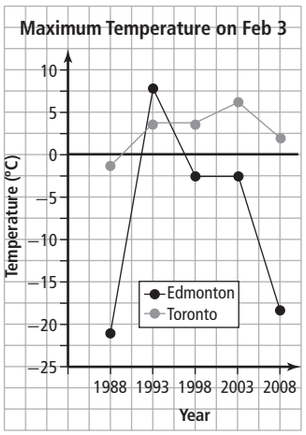
For more information about what climate scientists do, go to www.mathlinks9.ca and follow the links.

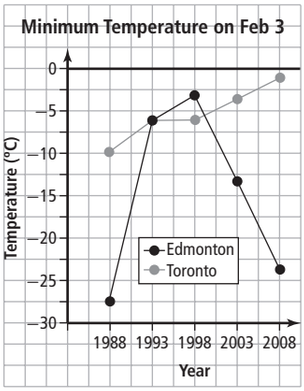
Answers

Global Warming

1. Example: Environment Canada has records of climate data back to 1840. The data is collected from Canadian climate stations and updated at the end of each decade. The data should be reliable and accurate.

2. Example: The graphs show maximum and minimum temperature for two Canadian cities over a 20-year period.





3. Examples are related to the graphs in #2.

a) Example:
- Toronto's high and low temperatures appear to be on the rise over the 20-year period.
- Edmonton's high and low temperatures appear to be decreasing over a 20-year period.

b) Example: The time period for the data collection is too short. It may require hundreds of years for a clear warming or cooling trend to occur. Many say that this warming trend is a natural phenomenon and is not a result of human intervention.

c) Example:
- The data for Toronto appear to support global warming.
- The data for Edmonton do not appear to support global warming.

4. Students should be able to assess the limitations of the data and identify any trend in their partner's work.

This Challenge can be used for either Assessment *for* Learning or Assessment *of* Learning.

Assessment	Supporting Learning
Assessment *for* Learning	
Global Warming Discuss the Challenge as a class. Have students provide individual responses.	• Consider allowing students to work with a partner and then write individual responses.
Assessment *of* Learning	
Global Warming Introduce the Challenge to the class. Have students provide individual responses.	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this Challenge. Page 603 provides notes on how to use this rubric for the Challenge. • To view student exemplars, go to www.mathlinks9.ca, access the Teacher Centre on the Online Learning Centre, go to Assessment, and then follow the links.

The chart below shows the **Master 1 Project Rubric** for tasks such as this Challenge, Global Warming, and provides notes that specify how to identify the level of specific answers for this project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 (Standard of Excellence)	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides a complete and correct solution
4 (Above Acceptable)	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	• provides a complete response with weak justification or communication
3 (Meets Acceptable)	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	Demonstrates one of the following: • provides a correct and complete response to #1 to 3 but may have weak justification or communication • provides a correct and complete response to #1, 2, and 4 based on an incorrect #3 • provides partially correct solutions to all parts of the question that demonstrate a basic understanding of the problem but the solution may have weak justification and weak communication
2 (Below Acceptable)	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	Demonstrates one of the following: • provides a correct and complete response to #1 and a start to #2; data may be incorrectly displayed but shows an initial understanding of the appropriate data display • provides a correct and complete #1 and displays some data correctly but the display does not allow for a comparison or conclusion to be made
1 (Beginning)	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	Demonstrates one of the following: • provides a correct and complete #1 • provides a correct initial start to any part of the question

For student exemplars, go to www.mathlinks9.ca and follow the links.