Measurement Learning Activities – Grade 5

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Weather or Not...

Strand: Measurement, Grade 5

Big Idea: Attributes, Units, and Measurement Sense

Overview
In this learning activity, students work through a series of “weather centres” to measure and record temperatures, research and record changes in the length of days, and measure and record precipitation. They will use this information to identify local climate patterns and to formulate their own weather predictions. Weather data are collected and recorded in an almanac format. Students make decisions about how to record their information in order to see patterns and draw conclusions from their data. During the final week of this study, students synthesize their data to generate a week of predictions that will allow them to determine whether outdoor electives should be scheduled or postponed for a given week. They will also make recommendations as to appropriate attire for the week. This measurement study has strong cross-curricular and multi-strand connections. The measurement tasks also support and align with the Earth and Space Systems science strand for Grade 5 related to weather and the Data Management strands of mathematics.

Students need to bring to this task an understanding of how to read a standard thermometer, how to determine whether temperature is rising or falling, and how to determine benchmarks for freezing, cold, cool, and warm temperatures.
Curriculum Expectations

Overall Expectation

• estimate, measure, and record perimeter, area, temperature change, and elapsed time, using a variety of strategies.

Specific Expectations

• measure and record temperatures to determine and represent temperature changes over time;
• estimate and determine elapsed time, with and without using a time line, given the durations of events expressed in minutes, hours, days, weeks, months, or years.

About the Learning Activity

Time: 6 hours over 4 weeks

Materials

• prepared “almanacs” – one exercise book or journal per student, divided into sections with the following subtitles:
  – Student Almanac: Final week (data synthesis and prediction section)
  – Temperature Measurements and Analysis (Centre 1 data and analysis)
  – Sunrise/Sunset Measurement and Analysis (Centre 2 data and analysis)
  – Precipitation Measurement and Analysis (Centre 3 data and analysis)

• M.BLM5a.1: Sunrise/Sunset Recording Sheet
• M.BLM5a.2: Sunrise/Sunset Data for August 3, 2006
• M.BLM5a.3: Student Instruction Sheet for Centre 1
• M.BLM5a.4: Student Instruction Sheet for Centre 2
• M.BLM5a.5: Student Instruction Sheet for Centre 3

Teacher Note: To facilitate the organization and presentation of the measurement data used in this study, you might provide students with notebooks containing grid paper.
thermometers, rain gauges (classes may choose to make their own)
newspapers/Internet access
plain and grid chart paper, grid paper, markers

Mathematics Language
Units of temperature and temperature tools (e.g., degrees Celsius, thermometer), mean, graphing terms (e.g., double bar graph, broken line graph, pictograph), metric units (e.g., millimetre, centimetre), units of time (e.g., minutes, hours, days, weeks, years), annual, probability

Instructional Grouping: Small groups working at three math centres. Students also work in expert groups:
Students in Expert Group 1 compare their primary data to data from a location in the Pacific Coast climatic region.
Students in Expert Group 2 compare their primary data to data from a location in the Arctic Tundra climatic region.
Students in Expert Group 3 compare their data to data from a location in the Atlantic Canada climatic region.

Teacher Note: You may choose to divide your class into 6 groups. If you do this, a second set of materials will be required for each centre.

About the Math
Temperature
While the use of negative integers is not introduced as a formal expectation until Grade 7, students have already encountered below-zero temperature readings in their everyday lives.

Elapsed Time
Working with authentic data for sunrise and sunset times, students calculate changes in elapsed “daylight” time. They identify patterns or trends in the measurement data and predict measures of daylight for an upcoming week or for specific dates in an upcoming month.
Precipitation
Students measure precipitation, analyse precipitation statistics, and explore the relationship between the specific attributes being measured and the measurement tools and units being used (e.g., the rain gauge is used as an indicator of the amount, in millimetres, of rain that has fallen in a given location).

Getting Started: Introducing the Weather Centres

Instructions to students
Describe the following scenario to the class:

“This study is organized as a series of weekly “weather centres” that groups of students will visit on a rotating basis. There will be an introductory lesson related to each of the centres. To begin each math session, work as a whole group to complete two tasks: add the daily forecast for your area to a class T-chart, then compare the forecast for the previous day with the actual weather measured by your class. To determine the accuracy of the forecasts, use information from each centre group: consider actual precipitation, temperature highs and lows, and other factors.”

Teacher Note: Some 24-hour weather data for Ontario locations can be found on the Environment Canada website:

http://www.weatheroffice.ec.gc.ca/forecast/canada/index_e.html?id=ON.

A Sunrise/Sunset Calculator can be found on the National Research Council of Canada website: http://www.hia-iha.nrc-cnrc.gc.ca/sunrise_e.html

During the final week of this measurement study, you will have students synthesize the data they have collected, and generate a 5-day prediction to be recorded in the first section of their almanacs.

Introduce centres through whole-class guided and shared lessons. In addition, involve students in collecting and recording primary data to be used at the centres.
Day One: Introducing Centre 1 – Measuring Temperature and Recording Temperature Change

In this mini-lesson, review how to read a standard thermometer and conduct a discussion on possible ways to record temperature data. Model the creation of a temperature graph using a 24-hour data sample. Have students work in groups to explore how weather data are presented on websites and/or in newspapers. Create a “Weather Data” chart, displaying the measurements taken, the units used, and the formats in which this information is displayed.

Ask:

- What information was available from your source?
- Was it available in a variety of formats? What formats were presented?
- Why is it important to present weather information in a variety of formats?

Select samples that will be used to add visuals to the “Weather Data” anchor chart. Using a shared lesson format, explore particular data representations in greater depth. For example, a line graph outlining weather trends may be displayed on the overhead projector. Using the think-aloud strategy, model how the data are read and used to make informed decisions.

Explicitly communicate expectations for recording data during the introductory input lesson so as to ensure consistency. Students will then be able to focus on patterns in their data and to use information effectively to make predictions.

Teacher Note: Students working at independent centres will be responsible for measuring hourly outdoor temperatures. You may wish to establish classroom routines for taking these measurements.

Teacher Note: Radio and television reports, websites, and newspapers provide a variety of formats for the presentation of weather data. Ensure that students have access to multiple representations of data as they make their own choices for data recording throughout this unit. A rich “Weather Data” anchor chart will include pictographs, tables, graphs, charts, and a variety of weather maps.
For the first three days of introductory lessons, have students collect hourly temperature data during the school day. To enrich the data set, you might also ask students to collect daily measurements for late afternoon and early evening (see Home Connection). The data will be used in the “Working on It” section to identify high and low temperatures, variations in temperature throughout the day, and weekly temperature trends.

**Day Two: Introducing Centre 2 – Hours of Daylight**
Model how to access the present day’s sunrise and sunset data and challenge students to determine from these data the elapsed time between sunrise and sunset.

Ask students to work in pairs and use their own strategies to calculate the elapsed time between sunrise and sunset. Next, ask them to share their solutions, strategies, and thinking with the rest of the class. Identify efficient strategies for determining elapsed time and prepare a class anchor chart to be used as a reference for Centre 2.

Teacher Note: An anchor chart highlighting various approaches enables students to reference personally meaningful strategies in their independent work.

Invite students to use what they know about the amount of elapsed time between sunrise and sunset to determine the hours of darkness in one day from midnight to midnight. Ask:

- What strategy did you use to calculate the hours of darkness between midnight and sunrise, and between sunset and midnight the following night?
- How could you incorporate into your calculations information about the length of a day?
- How are the two lengths of elapsed time (daylight/darkness) related?
- Are there times in the year when the days seem longer or shorter? Explain.
- What evidence could you use to support your theory?

Refer students to the prepared classroom graph and model how to plot the sunrise and sunset times. Add daily information throughout the week.
Teacher Note: The length of a day changes by about 2.4 minutes each day, getting longer or shorter depending on the season. Therefore, both the sunrise and sunset times change by about 1.2 minutes daily. The dimensions of the grid needed for a 30-day period would be 30 days across and 40 minutes vertically.

Day Three: Introducing Centre 3 – Measuring Precipitation and Analysing Precipitation Statistics
This centre involves accessing measurement information and using it in a variety of contexts. To prepare students, model the skills and strategies they will use in their independent work. Because students will be responsible for daily precipitation measurements, model the measurement of precipitation using a gauge, and record the measurements on a graph. This centre requires students to access and use a variety of data. Decisions need to be made as to how information will be accessed by students. You might consider providing statistics in a variety of print formats or identifying websites for student use. Regardless of the format chosen, there is a need to model how to access, read, and use the information to create graphs and tables.

Working on It
Centre 1: Measuring Temperature and Recording Temperature Change
Provide the centre with the following instructions:
“Each day, measure and record temperatures every hour on the hour throughout the school day and at home. When you are unable to personally measure the temperature, use secondary data. Use data from the previous day for your area, as well as the climatic region assigned to your group, in order to graph hourly temperatures and identify:

- daily high and low temperatures from sample data
- the range of temperatures on a given day
- the mean daily high and low temperatures for the week
- the weekly temperature trends
Note to Teacher: Data will need to be gathered over the weekend for use on Monday. Because students will be plotting 24-hour data, they will need to measure and record each hourly temperature and gather information from a secondary source for the hours during which they were asleep.

Compare the daily high and low of your area to the climatic region of Canada designated to your group. You may also choose to compare your area to another world location (near the equator, near one of the poles, in another hemisphere). Once you have determined the weekly temperature trends, display your information in a format that can be posted. Include explanatory notes that interpret the information. You may also wish to include information detailing what you learned about daily high and low temperatures, ranges of temperatures and mean.”

Centre 2: Graphing Sunrise and Sunset
Provide the centre with the following instructions:

“There are two components to this centre. Each day, you must check the sunrise and sunset times and plot this information on a class graph. Calculate the elapsed time for daylight as well as darkness, record your calculation in the Measurement and Analysis section of your almanacs. In addition to this assignment, you must complete a related daily task.

Day One: Check the sunrise and sunset times for your area and the climatic region assigned to your expert group. Calculate the elapsed daylight hours and hours of darkness, and record these measurements in your almanac.

Day Two: Check the sunrise and sunset times for your area and the climatic region assigned to your expert group. Calculate the elapsed daylight hours and hours of darkness, and record these measurements in your almanac. Using the sunrise and sunset information for both regions, write a prediction for the sunrise and sunset times for your fifth day at this centre. Justify your prediction using specific measurement vocabulary and visual supports, and explain your calculations.
Day Three: Check the sunrise and sunset times for your area and the climatic region assigned to your expert group. Calculate the elapsed daylight hours and hours of darkness, and record these measurements in your almanac.

The sunrise and sunset times, as recorded by Environment Canada on August 3, 2006, for Iqaluit, Nunavut, and for Toronto, Ontario, are shown in the table below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Sunrise</th>
<th>Sunset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto, Ontario</td>
<td>06:08</td>
<td>20:39</td>
</tr>
<tr>
<td>Iqaluit, Nunavut</td>
<td>03:50</td>
<td>21:30</td>
</tr>
</tbody>
</table>

Source: Environment Canada

Using the sunrise and sunset data, discuss the information contained in the table.”

Teacher Note: The following key questions and prompts might be helpful to guide discussion:
1. Determine the elapsed time between sunrise and sunset in Toronto on August 3, 2006.
2. Determine the elapsed time between sunrise and sunset in Iqaluit on August 3, 2006.
3. How many more hours of daylight are there in one location than the other?
4. How might the difference in daylight hours affect day-to-day living in these locations?

Teacher Note: This activity may be extended by having students track sunrise and sunset times for these locations over a number of days.

Day Four: Check the sunrise and sunset times for your area and the climatic region assigned to your expert group. Calculate the elapsed daylight hours and hours of darkness, and record these measurements in your almanac.

For today’s date, locate the sunrise and sunset times from the following Canadian weather stations: Gjoa Haven, NU; Iqaluit, NU; Arviat, NU; Sanikiluaq, NU; Moosonee, ON; Thunder Bay, ON; and Toronto, ON. Record your data on M.BLM5a.1.

Consider:
- How does latitude affect the amount of elapsed time between sunrise and sunset?

Record your work in your almanac.

Note to Teacher: Where access to the current daily information is limited, teachers may wish to use M.BLM5a.2, which contains data for August 3, 2006, for these locations.
Day Five: Check the sunrise and sunset times for your area and the climatic region assigned to your expert group. Calculate the elapsed daylight and hours of darkness, and record these measurements in your almanac. Using your graphed data, look for trends and patterns, and record your findings in your almanac.

You may also choose to compare your area with another world location (near the equator, near one of the poles, in another hemisphere).

Gather information on Daylight Savings Time, identify important ideas in the information, and discuss your new learning. Create a mind map to record this information in your almanac.”

Centre 3: Precipitation Statistics
Provide the centre with the following instructions:

“There are two components to this centre. You will use your personally created rain gauges to collect and record daily precipitation statistics, and you will also complete a specific daily assignment.

Note to Teacher: Because students will be measuring and recording precipitation for the previous 24-hour period, they will need to take their measurement tools home with them the Friday before their week at this centre.

Day One: Observe your rain gauge. Measure and record the precipitation that has accumulated over the past 24 hours. Record your measurement on the class graph. Empty your rain gauge to ensure that tomorrow’s reading will be accurate. Check annual precipitation statistics for your area and use this information to create a double bar graph detailing the average amount of rain and snow that falls in your area each month.

- What trends do you see?
- Why do you think that two units of measure are used for recording precipitation instead of one standard unit?

Record your findings in the Precipitation Measurement and Analysis section of your almanac.
Note to Teacher: Rainfall is normally recorded in millimetres and snowfall is generally recorded in centimetres. It will be important for students to know this as they transfer statistical data into a double bar graph format. As they work with statistics in millimetres and centimetres they will need to make decisions about the most appropriate units and scale to use when creating their graph.

Day Two: Observe your rain gauge. Measure and record the precipitation that has accumulated over the past 24 hours. Record your measurement on the class graph. Empty your rain gauge to ensure that tomorrow’s reading will be accurate. Check annual precipitation statistics for the climatic region assigned to your expert group and use this information to create a double line graph detailing the average amount of rain and snow that falls in that region each month. What trends do you see? Use the graphs of average precipitation for your area and for your designated climatic region to compare and contrast the two regions. Summarize your findings, identifying mathematical relationships you observe in the data. Record your findings in the Precipitation Measurement and Analysis section of your almanac. You may also choose to compare your area with another world location (near the equator, near one of the poles, in another hemisphere).

Day Three: Observe your rain gauge. Measure and record the precipitation that has accumulated over the past 24 hours. Record your measurement on the class graph. Empty your rain gauge to ensure that tomorrow’s reading will be accurate. In the past, people developed and relied on weather sayings, such as “April showers bring May flowers”, to help them predict the weather. Many of these sayings exist but how valid are they? Using a variety of sources, identify three weather sayings. Use statistical data to comment on the reliability of the sayings. Do the measurements related to weather support these folkloric sayings? Choose one saying for which you have strong supporting or contradictory data. Choose a visual format for presenting the saying and comment on its reliability.
Day Four: Observe your rain gauge. Measure and record the precipitation that has accumulated over the past 24 hours. Record your measurement on the class graph. Empty your rain gauge to ensure that tomorrow’s reading will be accurate. Check the weather reports for the last 6 days. Focus on the “probability of precipitation” section. Create a T-chart with the headers Probability of Precipitation (POP) and Actual Precipitation. Compare the forecasted probability of precipitation data with the precipitation that actually occurred in your area. Use this information to make judgements about the accuracy of precipitation forecasting for your six-day sample. Record your ideas in the Precipitation Measurement and Analysis section of your almanac. Use a variety of sources to answer the following key questions as a group:

- What does the term “probability of precipitation” mean?
- How is the probability of precipitation determined?
- How do people use probability of precipitation measures in their daily lives?

Identify three new learnings or key mathematical ideas to record and explain in the Precipitation Measurement and Analysis section of your almanac.

Day Five: Observe your rain gauge. Measure and record the precipitation that has accumulated over the past 24 hours. Record your measurement on the class graph. Access a meteorological website to check the precipitation statistics for these dates.

- How do your measurements compare?
- If there are differences in the data, what factors might account for them?

Note to Teacher: Precipitation measurements taken by students reflect precipitation at the school location. Where the location of students’ gauges is geographically distant from the locations used for published reports, there may be significant variation between the two sets of data. Such a situation provides students with an opportunity to see an authentic application of data sets, where a set of data is a sample of a larger population or, in this case, of a larger geographic area. In addition, student measurement instruments may not afford the same level of precision as the instruments used in published reports.
Create a table comparing the published daily precipitation measurements for the past five days with your daily measurements for the same dates. What trends do you see? Use the Precipitation Measurement and Analysis section of your almanac to record your work."

**Reflecting and Connecting**
Ongoing reflection has been embedded in each centre of this measurement study. Divide your class into three groups to participate in a “Gallery Walk”. Have students visit each set of posted data to look for trends and patterns. Ask them to discuss and analyse the measurement information presented at each data centre and make jot notes in the appropriate section of their almanac.
Reconvene the class to discuss findings. Advise students that they may add to their jot notes during the discussion. As a conclusion for each section of their almanac, have students write a brief summary of key learnings related to the measurement of temperature, daylight hours, and precipitation.
Make sure that the expert groups have opportunities to share their comparative data and analysis related to climatic regions. Rich discussions may be facilitated by having expert groups detail the trends they notice in each region and apply the language of measurement when comparing regions.
To connect learning to a context that is relevant in the world beyond the classroom, introduce students to the *Farmer's Almanac*.
Challenge students to predict the weather for the coming week, using the measurement information they have gathered. Have them use their predictions to decide whether outdoor electives should be scheduled or postponed for the next week. Ask them to use their almanacs to make recommendations for suitable attire for participants of these electives.

**Tiered Instruction**
Supports and extensions can be beneficial for all students. For any given activity, there will always be some students who require more or less support, or for whom extensions will increase interest and deepen understanding.
Supports for student learning
This measurement study provides many opportunities for differentiated instruction; it requires students to make choices and it promotes cooperative learning. Model measurement procedures, data recording, and analysis, using think alouds. As students progress through centre-based learning tasks, you will have the opportunity to circulate and assess student needs, provide feedback, and scaffold instruction. Encourage journalling by providing sentence starters, checklists, and prompts or picture cues. Simplify the investigations by selecting key activities at each centre and allowing additional time for their completion.

Extensions
Daylight Saving Time. Have students complete a research project on Daylight Saving Time. They may choose any format for a presentation focusing on how people have used mathematics to make informed decisions regarding the adoption of Daylight Saving Time.
A Meteorological Measurement Guide. Have students choose from the following topics to write procedural texts:

- how to calculate the number of daylight hours that will elapse in a day
- how to build and use a rain gauge to measure precipitation
- how to determine the daily high and low temperatures

Students are more likely to engage in this writing task if an authentic purpose and audience are provided. For instance, they could share their texts with meteorologists at a local weather station or news affiliate.

Meteorological Newsletter. Engage students in writing articles for a meteorological newsletter. Topics could be linked to the measurements students have collected.
Home Connection

Measuring Temperature At Home
Dear Parent/Guardian,
At school we are investigating temperature measurement and temperature change. We are measuring temperatures in Celsius at one-hour intervals on the hour. In order to expand our data set, students are encouraged to measure and record outdoor temperatures at home as their schedules permit.
Ask your child to tell you about our study and to describe and explain patterns that we are noticing in temperature, rainfall, and daylight hours.

Assessment
Ongoing assessment opportunities are embedded throughout this measurement study.

Rubric

<table>
<thead>
<tr>
<th>Assessment category</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and understanding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• estimates, collects, measures, and records weather data</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>thorough</td>
</tr>
<tr>
<td>• estimates and determines elapsed time</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>thorough</td>
</tr>
<tr>
<td>• determines weather data change over time</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>thorough</td>
</tr>
<tr>
<td>• organizes and displays measurement data</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>thorough</td>
</tr>
<tr>
<td>• reads, interprets, and draws conclusions from data</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>thorough</td>
</tr>
<tr>
<td>Thinking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• creates plan of action for exploring weather over time</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• identifies and uses patterns in measurement data</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• makes predictions for weather patterns over time</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• explores alternative solutions</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• explains mathematical thinking</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• communicates using a variety of modes (short answers, lengthy explanations, verbal and written reports)</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• uses appropriate vocabulary and terminology</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• applies measurement skills in familiar contexts</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• transfers knowledge and skills to new contexts</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
<tr>
<td>• makes connections among concepts</td>
<td>limited</td>
<td>some</td>
<td>considerable</td>
<td>high degree</td>
</tr>
</tbody>
</table>
## M.BLM5a.1: Sunrise/Sunset Recording Sheet

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Sunrise</th>
<th>Sunset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gjoa Haven, Nunavut</td>
<td>68 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iqaluit, Nunavut</td>
<td>63 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arviat, Nunavut</td>
<td>61 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanikiluaq, Nunavut</td>
<td>56 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moosonee, Ontario</td>
<td>51 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thunder Bay, Ontario</td>
<td>48 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toronto, Ontario</td>
<td>43 N</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
M.BLM5a.2: Sunrise/Sunset Data for August 3, 2006

The following table details the sunrise and sunset times for August 3, 2006, in a number of Canadian locations, as reported by Environment Canada.

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Sunrise</th>
<th>Sunset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gjoa Haven, Nunavut</td>
<td>68 N</td>
<td>02:37</td>
<td>22:22</td>
</tr>
<tr>
<td>Iqaluit, Nunavut</td>
<td>63 N</td>
<td>03:50</td>
<td>21:30</td>
</tr>
<tr>
<td>Arviat, Nunavut</td>
<td>61 N</td>
<td>04:54</td>
<td>21:51</td>
</tr>
<tr>
<td>Sanikiluaq, Nunavut</td>
<td>56 N</td>
<td>05:21</td>
<td>21:25</td>
</tr>
<tr>
<td>Moosonee, Ontario</td>
<td>51 N</td>
<td>05:50</td>
<td>21:08</td>
</tr>
<tr>
<td>Thunder Bay, Ontario</td>
<td>48 N</td>
<td>06:34</td>
<td>21:32</td>
</tr>
<tr>
<td>Toronto, Ontario</td>
<td>43 N</td>
<td>6:08</td>
<td>20:39</td>
</tr>
</tbody>
</table>
M.BLM5a.3: Student Instruction Sheet for Centre 1

Centre 1 – Measuring Temperature and Recording Temperature Change

Days One to Four
1. Measure and record temperatures every hour on the hour throughout the school day (and at home, when possible).
2. Graph the temperatures from the previous day using a line graph. (The first day you complete this activity you will need to use a secondary source, such as the Internet, to collect your data.)
3. Record the range of temperatures, noting the times of both the high and the low.

Repeat steps 2 and 3 for the climatic region assigned to your group.

Day Five
Complete steps 1-3, and then proceed to the following tasks:
1. Calculate the mean daily high and low temperatures for the week.
2. Using a double line graph, record your findings in a format that can be posted.
   Include explanatory notes that interpret your information. You may wish to include information detailing what you learned about daily high and low temperatures, ranges of temperatures, and mean.

Repeat steps 1 and 2 for the climatic region assigned to your group.
M.BLM5a.4 Student Instruction Sheet for Centre 2

Centre 2 – Hours of Daylight

Every Day
1. Check today’s sunrise and sunset times for your area and for the climatic region assigned to your group.
2. Plot this information on the class graph.
3. Calculate the number of elapsed daylight hours and hours of darkness, and record this information in the Measurement and Analysis section of your almanac.

Day One
Complete the daily activity.

Day Two
1. Write a prediction of the sunrise and sunset times for your area and climatic region for your fifth day at this centre.
2. Justify your prediction using specific measurement vocabulary and visual supports, and explain any calculations you may have used.

Day Three
The sunrise and sunset times on August 3, 2006, for Iqaluit, Nunavut, and Toronto, Ontario, are shown in the table below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Sunrise</th>
<th>Sunset</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 3, 2006</td>
<td>Toronto, Ontario</td>
<td>06:08</td>
<td>20:39</td>
</tr>
<tr>
<td></td>
<td>Iqaluit, Nunavut</td>
<td>03:50</td>
<td>21:30</td>
</tr>
</tbody>
</table>

Source: Environment Canada

Using the sunrise and sunset data in the table:
- determine the elapsed time between sunrise and sunset in Toronto on August 3, 2006.
- determine the elapsed time between sunrise and sunset in Iqaluit on August 3, 2006.
- determine how many more hours of daylight there are in one location than in the other.
• determine how the difference in daylight hours might affect day-to-day living in these locations

Day Four
Locate today's sunrise and sunset times for the following Canadian weather stations:

<table>
<thead>
<tr>
<th>1. Gjoa Haven, NU</th>
<th>2. Iqaluit, NU</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Arviat, NU</td>
<td>4. Sanikiluaq, NU</td>
</tr>
<tr>
<td>5. Moosonee, ON</td>
<td>6. Thunder Bay, ON</td>
</tr>
<tr>
<td>7. Toronto, ON</td>
<td>8. Your area weather station</td>
</tr>
</tbody>
</table>

Record your data on M.BLM5a.1.

Consider:
• How does moving farther north affect the amount of elapsed time between sunrise and sunset?

Record your work in your almanac.

Day Five
1. Using your graphed data, look for patterns and trends and record these findings in your almanac.
2. Investigate Daylight Saving Time using print sources and web-based resources such as Google.ca and Wikipedia.org.
3. Identify important ideas and new learning through discussion.
4. Create a mind map to record this information in your almanac.
M.BLM5a.5: Student Instruction Sheet for Centre 3

Centre 3 – Measuring Precipitation and Analysing Precipitation Statistics

Every Day
1. Observe your rain gauge.
2. Measure and record the precipitation that has accumulated over the past 24 hours.
3. Empty your rain gauge to ensure that tomorrow’s reading will be accurate.
4. Add your measurement to the class chart.

Day One
1. Check annual precipitation statistics for your area.
2. Create a double bar graph detailing the mean amount of rain and snow that falls in your area each month.
3. In the Precipitation Measurement and Analysis section of your almanac, record any trends you see.
   - Why do you think snow accumulation is measured in centimetres and rainfall accumulation is measured in millimetres? Record your thoughts.

Day Two
1. Check annual precipitation statistics for the climatic region assigned to your group.
2. Create a double bar graph detailing the mean amount of rain and snow that falls in that region each month.
3. In the Precipitation Measurement and Analysis section of your almanac, record any trends you see.
4. Compare and contrast precipitation in your local area with precipitation in this climatic region.
Day Three
In the past, people developed and relied on weather sayings to help them predict the weather. Many such sayings exist, but are they valid?

1. Using a variety of sources, identify three weather sayings.
2. Use statistical data to comment on the reliability of the sayings.
3. Choose one saying for which you have strong supporting or contradictory data.
4. Create a poster to illustrate the saying, and comment on its reliability.

Day Four
1. Check the weather reports for the last 6 days, focusing on the “probability of precipitation” section.
2. Create a T-chart with the headers: Probability of Precipitation (POP) and Actual Precipitation.
3. Compare the forecasted data on the probability of precipitation with the precipitation that actually occurred in your area.
4. Use this information to make judgements about the accuracy of precipitation forecasting in weather reports for your six-day sample.
5. Answer the following questions:
   - What does the term “probability of precipitation” mean?
   - How is the probability of precipitation determined?
   - How do people use probability of precipitation measures in their daily lives?
6. Identify three new learnings or key mathematical ideas based on your findings and discussion.

Day Five
1. Check your area’s precipitation statistics for the past week
2. Create a T-chart to compare your findings with the secondary precipitation statistics.
3. How do your findings compare with the findings from the secondary source?
4. Record in the Precipitation Measurement and Analysis section of your almanac any trends you see.
Hiking the Bruce Trail

**Strand:** Measurement, Grade 5  
**Big Idea:** Measurement Relationships

**Overview**  
Canada is world-renowned for its natural beauty and vast expanses of wilderness. These areas afford Canadians opportunities to enjoy a wide variety of outdoor activities. In Ontario, the Bruce Trail, extending from Niagara to Tobermory, provides an ideal setting for hiking adventures. In this learning activity, students explore measurement problems and relationships in the context of a Bruce Trail hike. Working with conversions, students will be required to recognize and apply the relationship between kilometres and metres. They will use their understanding of elapsed time in dynamic ways to determine distances covered over time.

Students should bring to this task an understanding of the relationship between varying units of length. They should be familiar with selecting the most appropriate standard units in problem solving contexts, and with justifying their choices. Students also need previous experience in displaying information on graphs. In particular, familiarity using broken-line graphs will allow students to focus on interpreting, drawing conclusions, and comparing their data to related sets.
Curriculum Expectations
Measurement Relationships

Overall expectation
• determine the relationships among units and measurable attributes, including the area of a rectangle and the volume of a rectangular prism

Specific Expectation
• solve problems requiring conversion from metres to centimetres and from kilometres to metres

Attributes, Units and Measurement Sense

Overall expectation
• estimate, measure, and record perimeter, area, temperature change, and elapsed time, using a variety of strategies

Specific Expectation
• estimate and determine elapsed time, with and without using a time line, given the durations of events expressed in minutes, hours, days, weeks, months, or years

About the Learning Activity
Time: 3 hours

Materials
• M.BLM5b.1: Home Connection
• chart paper, grid paper, markers
• overhead projector, overhead transparency (math problem), highlighter, rulers

Mathematics Language
Broken-line graph, conversion, data, distance, elapsed time, rate, units of distance (kilometre, metre), time intervals (minutes, hours)

Instructional Grouping: whole group and triads
About the Math

Rates of travel
If a hiker travels 9 km in 3 hours, the rate of travel is 3 km/hr. This is equivalent to 3000 m in 1 hour, or 750 m every 15 minutes, or 500 m every 10 minutes, or 50 m every minute.

Getting Started – Problem 1

The Bruce Trail
The Bruce Trail, extending from Niagara to Tobermory, provides an ideal setting for hiking adventures. At nearly 800 km, it is Ontario’s longest trail.

Introducing the problem
Describe the following scenario to the class.

“An Ontario hiker has just completed a three-hour hike along this trail. At a number of picturesque locations, the hiker stopped to take photographs. The digital camera recorded the time each photograph was taken. The hiker wants to use these recorded times to pinpoint the locations on a map for a hiking club’s website. Over the three-hour period the hiker travelled nine kilometres and took 5 photographs. The hiker left the trailhead at 9:00 a.m. and took photographs at the following times:

- Photograph 1 9:15 a.m.
- Photograph 2 9:20 a.m.
- Photograph 3 10:25 a.m.
- Photograph 4 11:20 a.m.
- Photograph 5 11:56 a.m.

How far is each photograph location from the trailhead, assuming the hiker walked at a steady pace?”

Teacher Note: Students may seek clarification regarding the amount of time that elapsed as the photographer paused to take each photograph. For the purposes of this task, assume that the photographer took each picture quickly and then resumed the hike.
Shared reading of the problem
Shared reading is an effective instructional approach that can be applied in this context as the students read and interpret the problem together as a class. They will benefit from explicit reading instruction regarding the format and features of mathematics text. A shared reading approach will support students as they learn to isolate the key pieces of information they need to solve this problem. Through a skilfully led discussion, you can prompt students to justify the reasoning behind their choices.

Teacher Note: Showing text on an overhead transparency or using an LCD projector is an effective shared-reading approach. The format of a math problem frequently presents the key question at or near the end of the text. Modelling the “skimming and scanning” strategy during the initial read will help students to recognize an effective reading approach for such math problem formats. On subsequent readings, shift the focus to locating pertinent facts. You may wish to use a highlighter to facilitate this process. The shared reading format also provides opportunities for students to engage in mathematical talk and to clarify their understanding of the task.

Student Thinking: Because I know that the key question is often presented near the end of a math problem, scanning the text will allow me to become familiar with the context and to identify the key question. Identifying the key question will help me to read for the specific information I need to solve this problem.

Working on It – Problem 1
Creating a visual representation
At this point in the learning task, it may be helpful for each triad of students to create a visual representation (such as a time line or a hiking route) of the key information identified during the shared reading of the math problem. The reading comprehension strategy of visualization encourages students to represent key information to synthesize what they know. This visual representation also provides a personally relevant referent from which each student can work.
Calculating the distance for each photograph
Have the triads determine the distance from the trailhead of each photograph location. While students are engaged in this task, circulate and encourage mathematical talk. Ask:

- How are you using the information in the problem to determine the hiker’s rate of travel?
- How could the information on the time each photograph was taken help you to determine the distance from the trailhead of each photograph location?
- How will you decide which units of measure to use in your calculations?

Note to Teacher: This task provides a rich opportunity for students to reason mathematically as they determine relationships. If the rate of travel is 3 km/hour, students may use this information to determine distances travelled over time. For example, the knowledge that a hiker travels 3 km/hour allows students to determine that the hiker will travel 1.5 km per half hour and 0.75 km or 750 metres in 15 minutes. This line of reasoning will help them identify distances travelled over smaller increments of time. If 750 metres can be travelled in 15 minutes, then 250 metres can be travelled in 5 minutes, and 50 metres can be travelled in one minute.

Teacher Note: Ensure that students are able to recognize the relationships between rate, time, and distance. An integral part of these calculations will involve working flexibly with conversions from kilometres to metres. It may be necessary to engage in small- or whole-group mathematics instruction. Alternatively, you may invite students to share and discuss their strategies for determining rate and distance.

Sharing ideas
Once triads have determined the distance from the trailhead of each photograph location, reconvene the class and have students communicate their findings. As they share their work, record (or have a student record) accurate distances related to time on a class T-chart.

Ask students to summarize the information on the T-chart, using a broken-line graph that displays time on one axis and distance on the other. The graph will be a straight line, since the distance/time rate is constant (3 km/h).
While students are engaged in the reading, interpretation, and analysis of their data, ask them:
What conclusions can you draw about the relationship between time and distance by examining your graph?

**Getting Started – Problem 2**
Another hiker travels the 9 kilometre trail at the rate of 2.4 km per hour. This hiker leaves at 9:00 a.m. and stops at all the same locations to take photographs. Determine the time each photograph will be taken.

- What impact will this different rate of travel have on the time at which each photograph will be taken?

**Working on It – Problem 2**

**Teacher Note:** In the previous problem, students developed and shared efficient strategies to identify and apply the relationship between time and distance. Problem 2 will allow students to work from what they already know to be true, rethink the problem within a new context, and search for related information that may be helpful.

Have students work in triads to determine the time each photograph was taken. While they are engaged in this task, circulate and encourage them to reflect on strategies shared in stage one of the task. Ask:
- Which strategies do you think will be most useful in approaching this new challenge? Explain your thinking.

**Sharing ideas**
There are many formats for communicating observations on the comparison of the two sets of data. You may wish to:
- have a class discussion
- have each triad share graphs and observations
- have students reflect individually in a math journal

Once triads have determined the time each photograph was taken by the second hiker, reconvene the class and have students communicate their findings. During sharing,
record (or have a student record) calculations related to this problem on a second class T-chart.

After students have completed this stage of the task, ask them to summarize the information on the same graph used in stage one (that is, two broken-line graphs will be drawn on the same grid or set of axes). Before they plot the new values, have students anticipate how this data set will compare with the representation of values from stage one. The graphs will be straight lines, since the distance/time rates are constant (3 km/h and 2.4 km/h). However, the steepness (or slope) of the graph lines will differ: The faster the rate, the steeper the graph line. Ask:

- How do you think the graphed data for the second hiker will compare with the plotted values for the first hiker?

Completed graphs provide a rich opportunity for comparing two related sets of data. Ask:

- What can be determined by comparing the two related sets of data?

**Reflecting and Connecting**

At key points in the process of solving the problem, there may be a need for shared discussion or guided math instruction. Questions and prompts that encourage student reflection have been embedded in each stage of this learning task. Draw students’ attention to different visual formats that could be used to represent and solve the problem. Sharing opportunities that demonstrate and model a wide range of efficiency in strategy use allow students to focus on process. Students benefit from comparing approaches. Such comparisons help them to self-assess and to set goals as they continue to work on the problem. Provide opportunities for students to ask questions of one another, share ideas, and justify their reasoning.
Tiered Instruction
Supports and extensions can be beneficial for all students. For any given activity, there will always be some students who require more or less support, or for whom extensions will increase interest and deepen understanding.

Supports for student learning
- This measurement task provides many opportunities for differentiated instruction; it requires students to make choices and it promotes cooperative learning.
- As students progress through this task, you have the opportunity to circulate and assess student needs, provide feedback, and scaffold instruction.
- The task allows for multiple entry points. You have the opportunity to control the number of variables students are using, and can thus make the calculations more manageable. For example, you might decide to provide the rate of travel for stage one of the problem, enabling students to focus solely on the relationship between time and distance.
- Some students may require help to organize their data and calculations. Differentiate instruction for these students by assisting them in the creation of a table or graphic organizer.

Extensions
Staggered starting times. Create a scenario in which the hikers’ starting times are staggered and students are challenged to predict outcomes. For example, if one hiker leaves the trailhead at 9:00 a.m., travelling at a rate of 2.4 km per hour, and another hiker leaves the trailhead at 9:30 a.m., travelling at a rate of 3 km per hour: Will the hikers meet on the trail? Who will be the first to take photograph number 4? Who will be first to complete the hike?
Graphical stories. Provide small groups of students with a variety of broken-line graphs (like the one shown on the right) representing distance and time. Ask the groups to select a particular graph and create a related math story.

Hiking story. Ask students to create a story involving distance travelled over time. For example, the following story could match the graph shown above: “I started at 8 am. I walked at a rate of 4 km/h for 15 minutes. I stopped for 10 minutes to talk to a friend. We walked together for 5 minutes, covering a distance of 400 m. We stopped for a break. Then I walked home at a rate of 5 km/h. The whole trip took 60 minutes.” Notice that a steeper slope indicates a faster rate. Advise them that they may choose to write math stories with realistic contexts related to their own experiences or they may create and use imaginative fictional scenarios.
Home Connection
See M.BLM5b.1.

Assessment
Ongoing assessment opportunities are embedded throughout this learning task.

Suggested prompts and questions have been provided in the Getting Started and Working on It sections. Focus your observations in order to assess how well students:

- express their understanding of measurement relationships (time, distance, rate);
- work flexibly with conversions (kilometres to metres);
- select and compare units of measure and justify their reasoning;
- draw upon their understanding of quantity and fractional relationships with respect to time;
- apply reasoning and logical thinking;
- communicate and justify their solutions.

Rubric

<table>
<thead>
<tr>
<th>Assessment category</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and understanding</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ thorough</td>
</tr>
<tr>
<td>• estimates and determines elapsed time</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ thorough</td>
</tr>
<tr>
<td>• works flexibly with measurement unit conversions</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ thorough</td>
</tr>
<tr>
<td>• identifies relationships among units and measurable attributes</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ thorough</td>
</tr>
<tr>
<td>• construct tables, graphs, and diagrams to represent data</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ thorough</td>
</tr>
<tr>
<td>Thinking</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>• creates plan of action for analysing measurement data</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>• identifies and uses patterns in problem solving</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>• explores alternative solutions</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>Communication</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>• explains mathematical thinking</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>• communicates using a variety of modes (short answers, lengthy explanations, verbal and written reports)</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>• uses appropriate vocabulary and terminology</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>Application</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>– applies measurement skills in familiar contexts</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>– transfers knowledge and skills to new contexts</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
<tr>
<td>– makes connections among concepts</td>
<td>☐ limited</td>
<td>☐ some</td>
<td>☐ considerable</td>
<td>☐ high degree</td>
</tr>
</tbody>
</table>
Dear Parent/Guardian,

Your child has been asked to select and complete one of the tasks below and to share with you his or her work and thought process. Please take a few minutes to discuss this activity with your child.

- **Task 1.** Travelling to school each day, we generally follow a consistent route. Determine the distance from your front door to the entrance of the school. One way to obtain this information is to use a scale map of your neighbourhood. Alternatively, a web-based tool such as Mapquest.com or Google Maps will provide an exact distance between two addresses, as would the odometer of a car. Determine the time it takes you to travel to school, noting your time of departure and time of arrival. Use this information to determine your average hourly rate of travel. Depending upon the measured values with which you are working, it may be necessary to use a calculator as a computational tool.

- **Task 2.** Travelling to school each day, we generally follow a consistent route. Determine the distance from your front door to the entrance of the school. One way to obtain this information is to use a scale map of your neighbourhood. Alternatively, a web-based tool such as Mapquest.com or Google Maps will provide an exact distance between two addresses, as would the odometer of a car. Determine the time it takes you to travel to school, noting your time of departure and time of arrival. In addition, note the time and duration of any stops along your route. Create a graph to represent your data (time on the horizontal axis, and distance on the vertical axis). How does your graph tell the math story of your trip to school?

Sincerely,