**Could you build a skating rink?**

**Fun activities for measuring temperatures and organizing numerical data**

**A Grade 5 teaching resource prepared by** [**www.rinkwatch.org**](http://www.rinkwatch.org)

This resource contains suggested activities for use in Grade 5 mathematics classes to help students develop skills in:

- multiplication and division of multi-digit whole numbers

- collection and organization of discrete or continuous primary & secondary data

- displaying data using charts and graphs

This package includes:

- A teacher’s guide

- Reproducible student worksheets (black-line masters)

These activities are designed to correspond with specific objectives in the Ontario grade 5 math curriculum, but are suitable for general classroom use.

**Policy on use**: This resource may be reproduced freely by any teacher for use in her or his own classroom. We have deliberately left this master in MS Word format so that teachers may modify the contents to suit their own individual needs and teaching styles. Our sole request is that teachers provide feedback on the utility of this resource and suggestions for improvement via the [www.rinkwatch.org](http://www.rinkwatch.org) website. Teachers are also encouraged to share modified versions via the user forum on the RinkWatch website. School boards, textbook authors, and publishers who wish to reproduce this resource in whole or in part for commercial purposes or mass reproduction should contact [www.rinkwatch.org](http://www.rinkwatch.org) for written permission prior to doing so.

©2014, Robert McLeman on behalf of [www.rinkwatch.org](http://www.rinkwatch.org)

**Could you build a skating rink? Fun activities for measuring temperatures and organizing numerical data**

**Teacher’s guide**

Curriculum objectives

Ontario’s grade 5 mathematics curriculum[[1]](#footnote-1) expects students will be able to:

* measure temperatures
* solve problems involving multiplication and division of multi-digit whole numbers
* collect and organize discrete or continuous primary and secondary data, and display using charts and graphs

This module and the attached exercise sheets will help students practice the skills listed above, and to provide the teacher with evidence and marks for when it comes time to write report cards.

Context

Building and maintaining an outdoor skating rink is highly dependent on ambient air temperatures. The question, “Could you build a rink?” provides an excellent opportunity for teaching children how to measure and interpret temperatures, and provides a real-world context for the distinction between positive and negative numbers (i.e. freezing and thawing temperatures, above and below 0oC). For advanced students, the data used in these exercises can also be used to teach mean, median and mode averages. Finally, skating rink-based exercises in math can be linked to science lessons related to the freezing point of water, physical changes of state, and energy transfers.

Given the widespread interest among Canadian children in skating and ice hockey, these exercises may prove to be helpful in making basic math and science more interesting. Teachers are encouraged to show the class the map of skating rinks and rink photos on the [www.rinkwatch.org](http://www.rinkwatch.org) website before introducing the exercise, as a means of generating additional interest.

Key external resources for the instructor

Environment Canada posts the latest 7-day weather forecasts for most locations across Canada at <http://weather.gc.ca/mainmenu/weather_menu_e.html>

Historical weather data for many Canadian locations is available at <http://climate.weather.gc.ca> If you are teaching this module at a time of year when below-freezing temperatures are not expected, you may wish to download temperature data from the previous winter.

Essential background information about outdoor skating rinks

An outdoor skating rink can be successfully built once there has been at least five consecutive days where the average daily temperature is colder than minus five degrees Celsius (-5oC) with overnight air temperatures being consistently below zero degrees Celsius. After the rink has been built, so long as night-time temperatures remain below freezing, the rink will remain skateable even if daytime temperatures creep up near or above 0oC on occasion.

The exercises suggested below assume that skating rinks are being made simply by pouring water onto frozen ground with a plastic liner or onto a hard surface like an asphalt basketball court. They do not apply to natural water bodies like ponds or lakes where skating occurs; natural water bodies have their own physics. Remind students never to go onto frozen lakes or ponds without adult supervision. These exercises also obviously do not apply to rinks created with artificial refrigeration.

Possible exercises

On the following pages you will find teaching instructions and reproducible worksheets for activities that centre on the collection, organization, analysis, and displaying of temperature data. We provide 3 different options for teaching a related set of exercises:

Option 1: Measuring outdoor air temperature in the school yard over a 5-day period. (suitable for when schoolyard temperatures are at or below freezing. Requires students going outside each day with thermometers). Student worksheet = Appendix 1.

Option 2: Using current 5-day forecasts or historical weather data obtained from the Environment Canada website. (Does not require students to go outside. Does require students to have access to an internet-connected computer). Student worksheet = Appendix 1.

Option 3: Using a temperature data set that is already provided. (Simplest option). Student worksheet = Appendix 2.

**Instructions for teaching the activities described in student worksheets**

Proper method for measuring temperatures out of doors

1. Organize the students into groups of 5 or less and provide each with a thermometer suitable for measuring outdoor air temperatures.
2. Select a location in the school yard that meets the following criteria, if possible:

* is in the shade at the time when measurements are to be taken
* is sheltered from the wind
* is not near any source of artificial heat (e.g. an air vent) and is at least 3 meters away from the nearest building wall

1. Students should aim to observe the air temperature at the same time each day for 5 consecutive school days (it is preferable if these are not interrupted by a weekend or school holiday, but not essential). Students should take turns within the group making the observation.
2. When making the observation, the glass part of the thermometer should not be in contact with the student’s hand or other body parts, and students should not breathe on the thermometer. The thermometer should not be set on the ground; the observation should be taken at eye level. The thermometer should not go directly from the classroom to the observation site, but should be outside for 2-3 minutes in order for the mercury to stabilize.

Tabulating data

(A pre-printed data table is found on the worksheets; students could also be asked to create one manually or using spreadsheet software)

1. Students enter each day’s temperature in the appropriate cell. On the same row, students should enter in the Notes cell any important observations, such as whether it was raining, snowing, cloudy, sunny, windy, etc.
2. After 5 days of observations, students calculate the average temperature for that week as follows:
3. In the cell labelled SUM in the Temperature column, students enter the sum of the numbers in the five cells above (note that students may be summing positive and negative numbers here and may need some guidance).
4. The next cell below prompts students to divide the SUM by the number of days (5) and calculate the answer.
5. The answer is entered in the cell below. This is the mean average of the temperature readings they have recorded that week.

Discussion questions

Immediately following the table are suggested questions that may be answered individually or in groups, in writing or verbally. The questions ask that students use the data table to support their answers. Students are also given the option of creating a line chart of the data.

Steps in creating a line chart using the pre-printed X- and Y-axis lines on the worksheet

1. Write a numerical scale on the vertical axis. The top number should be slightly higher than the warmest temperature the students recorded (e.g. if the warmest day was 4.5oC, write 5o next to the top-most hash mark on the vertical axis). The lowest hash mark should be slightly lower than the coldest temperature recorded (e.g. if coldest day was -4.5oC, write -5o next to the bottom line).
2. The hash marks between the top and bottom should be labeled, at even intervals. To calculate the correct interval, find the difference between the warmest temperature and the coldest temperature, and divide by ten. For example, if the lowest hash mark is labeled -6o and the topmost one is labeled -1o, the interval is -5o and the hash marks from bottom to top should read -6o, -5.5o, -5o, -4.5o and so on.
3. Place an x in the space immediately above each day to mark where the temperature would fall on the vertical scale.
4. Draw a line to join each x. The student has now successfully created a line graph.

Using Environment Canada data instead of outdoor measurements

Option 1: Best used in winter. Environment Canada posts 7-day weather forecasts for most locations across Canada at <http://weather.gc.ca/mainmenu/weather_menu_e.html>. Select the weather station nearest your school and use the current forecast of daytime high temperatures for the next 5 days to create a data table in the worksheets. Students enter this data into the table as per instructions above, using the Worksheet Appendix 1.

Option 2: Best used at other times of year. Access historical winter weather data from <http://climate.weather.gc.ca> Select the weather station nearest your school, and find the average daily temperatures for a 5-day period from the preceding winter (we suggest using the dates December 25-29). Students enter this data into the table as per instructions above, using the Worksheet Appendix 1.

Option 3: Use this prepared temperature data set recorded at the weather station at Toronto’s Pearson International Airport. A separate worksheet that contains this pre-printed data table is available in Appendix 2 for teachers using this option.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Toronto International Airport, average daily temperatures, December 2013 | | | | | | | | | | | | | | |
| Date | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| Temperature | -0.4 | -4.7 | -4.9 | -1.6 | -7.0 | -7.7 | -9.6 | -8.9 | -12.9 | -9.2 | -9.8 | -3.3 | -0.4 | 0.1 |

Students are asked to identify the coldest 5-day period within the above data, and use the table to calculate the mean average to determine if they have selected correctly. A number of discussion questions and instructions for creating a line chart are also given on the worksheet. The correct answer is that December 12-16 represents the coldest 5 day period. The average daily temperature for that period is -10.08oC.

Black line masters of student worksheets begin on the next page.

Appendix 1: Using data students measure with thermometers or obtain from Environment Canada website

Student worksheet

**Is it cold enough to build a skating rink? Let’s use math and science to find out!**

Table of recorded temperatures

|  |  |  |  |
| --- | --- | --- | --- |
| *Date* | *Time* | *Temperature* | *Notes (Is it sunny? Raining? Snowing?)* |
| Day 1 |  |  |  |
| Day 2 |  |  |  |
| Day 3 |  |  |  |
| Day 4 |  |  |  |
| Day 5 |  |  |  |
| SUM of Days 1-5 | |  | *If you have positive and negative temperature values and are not sure how to add them, ask the teacher* |
| Divide SUM by 5 | | =SUM /5 | *Make your calculation to one decimal place* |
| RESULT | |  | RESULT= the mean average temperature for Days 1-5 |

**Questions**

To build an outdoor rink you need to have at least five consecutive days where the average daily temperature is colder than minus five degrees Celsius (-5oC).

Would you have been able to successfully build a rink during this 5-day period? Why or why not?

Were there other weather conditions besides temperature that might have affected your ability to build a rink? Please explain.

What will be the weather trend in days 6-10? Why do you think so? How would this trend affect your ability to build a rink?

What was the warmest day you recorded? What was the coldest? Can you rank the days in order from warmest to coldest?

Can you draw a line chart to illustrate the data in your table?

Take a look at this chart:

Would you have been able to successfully make a rink during that 5-day period? Why or why not?

Appendix 2: Using pre-printed temperature data

Student worksheet

**Is it cold enough to build a skating rink? Let’s use math and science to find out!**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Toronto International Airport, average daily temperatures, December 2013 | | | | | | | | | | | | | | |
| *Date* | *6* | *7* | *8* | *9* | *10* | *11* | *12* | *13* | *14* | *15* | *16* | *17* | *18* | *19* |
| Temperature (oC) | -0.4 | -4.7 | -4.9 | -1.6 | -7.0 | -7.7 | -9.6 | -8.9 | -12.9 | -9.2 | -9.8 | -3.3 | -0.4 | 0.1 |

Circle the coldest 5-day period in the table above (they must be consecutive days). Enter the temperatures into the table below and calculate the average temperature for the complete 5-day period:

**Table of recorded temperatures**

|  |  |  |  |
| --- | --- | --- | --- |
| Day | Date | Temperature |  |
| Day 1 |  |  |
| Day 2 |  |  |
| Day 3 |  |  |
| Day 4 |  |  |
| Day 5 |  |  |
| SUM of Days 1-5 | |  | *If you have positive and negative temperature values and are not sure how to add them, ask the teacher* |
| Divide the sum by 5 | | SUM/5 | *Make your calculation to one decimal place* |
| RESULT | |  | The RESULT is the mean average daily temperature for the five day period |

The coldest 5-day period has an average daily temperature of -10.08 oC. If the dates you selected have a different average, select again, and keep trying until you get it right.

**Questions**

To build an outdoor rink you need to have at least five consecutive days where the average daily temperature is colder than minus five degrees Celsius (-5oC).

Would you have be able to successfully build a rink during this 5-day period? If so, why? If not, why not?

What would have been the best date to start building a rink? Why?

What do you expect the weather would have been like from December 20th to 25th? Why do you think so? If you had already built a rink, would you still be able to skate?

What was the warmest date listed in the table above? What was the coldest? Can you rank the dates in order from warmest to coldest?

Can you draw a line chart to illustrate the data in your table?

Take a look at this line chart:

Would you have been able to successfully make a rink during that 5-day period? Why or why not?

1. Note that this is not a complete list of math curriculum expectations; for a full list, see <http://www.edu.gov.on.ca/eng/curriculum/elementary/math18curr.pdf> [↑](#footnote-ref-1)