Practice basic mathematical concepts by making mini-ice rinks

A Grade 3 teaching resource prepared by [www.rinkwatch.org](http://www.rinkwatch.org)

This resource contains suggested activities for use in Grade 3 math classes to help students develop skills in:

* Measuring positive temperatures and identifying benchmarks for boiling and freezing of water
* Measuring perimeter using a ruler
* Estimating and measuring the capacity of containers
* Identifying right angles
* Collecting simple data
* Collecting and organizing categorical data

This package includes:

- Materials list

- Teacher’s guide

- Reproducible student worksheets

These activities are designed to correspond with specific objectives in the Ontario grade 3 math curriculum, but are suitable for general classroom use.

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Material List

* Small containers of various shapes/sizes for student’s to use to make their mini ice rinks
* A thin-tipped permanent black marker
* A benchmark tool to measure right angles
* Thermometers
* Measuring cups
* A scale suitable for measuring weight of relatively light objects
* Access to a freezer
* Some old towels or a mop to clean up spilled water

Before class, have students bring in unbreakable small containers from home that are capable of holding water. Note that the students will measure the volume of water their container holds by filling it using a measuring cup. They will also measure the dimensions of their container, which can then be compared with the amount of water added to the container. Advanced learners may be taught to calculate the volume of a container without the use of a measuring cup.

Teacher’s guide

Curriculum objectives:

Ontario’s grade 3 mathematics curriculum expects students to be able to:

* Measure positive temperatures and identifying benchmarks for boiling and freezing water
* Measure perimeter using a ruler
* Estimate and measuring the capacity of containers
* Identify right angles
* Collect simple data
* Collect and organizing categorical data

Context

Building a backyard skating rink is more complicated than it sounds. By giving students a hands-on opportunity to build a miniature rink of their own, they will begin to think about the different elements that go into this process. Building a rink provides an opportunity to have students apply basic mathematical principles in a fun and engaging activity, and begin to think about the relationship between perimeter, area, volume, and capacity. This activity also provides an entry lesson into understanding the different states of matter, an important component of primary science curriculum. For example, students in this activity can assess whether the weight of water changes when it goes from a liquid to a solid and vice versa. 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.

Lesson Plan

This activity should be initiated in the morning, if possible.

The teacher should begin with a discussion of skating rinks before running the activity, asking students if they have skated on an outdoor rink before, if anyone in the class has one at home, etc. The most common method of building a backyard rink is to build a rectangular frame of wood and install a plastic liner, into which water is poured from a garden hose. The plastic liner ensure that the water does not escape should there be a warm period during the skating season. In other words, the rink is like a large, shallow cake pan that contains water. Teachers may wish to demonstrate by filling a shallow cake pan with water and freezing it the night before and bring it out at the start of the lesson.

For the following activities students should be split into groups of no more than five. They will work together to create and measure one rink. In each of their groups, students will pick one of the containers they brought in to create a rink.

Step 1: The students measure their containers for perimeter, depth, and weight of the container BEFORE adding water. These measurements should be recorded by each group.

Step 2: Using the black permanent marker, the group should make a mark on the inside of the container, one centimeter from the bottom.

Step 3: Students should carefully fill their containers with water using the measuring cup until the black line is just barely visible above the surface of the water. They should calculate the total amount of water used to fill the container to this level, based on how many whole and partial measuring cups of water were added. They should then take a temperature reading of the water, and record it. They should also carefully weigh the filled container, and subtract from it the weight of the empty container to calculate the weight of the water. The containers of water should then be transferred carefully to the freezer, to avoid spilling any water. Please try to lay the containers flat/level in the freezer. Students should make an estimate of how many hours they think it will take for the water to freeze.

Step 4: After several hours have passed, carefully remove the containers from the freezer and have the students record written descriptions of what they see. They should try to imagine the containers are miniature skating rinks, and decide whether they would be safe enough to skate on, or if more freezing is needed.

Depending on how much time has elapsed (and on the temperature of the freezer and the starting temperature of the water), the water in the containers may be fully frozen, partially frozen, or still mostly unfrozen. If not fully frozen, have students carefully make a small hole in the frozen top layer and measure the temperature of the water below (or simply insert the thermometer into the water if there is not yet a frozen top layer). Students should record the temperature and compare it with the initial starting temperature. If classroom conditions allow, the teacher may wish to repeat this process several times during the day, having students record the time and temperature measurements in a table, and using the data to create a line chart.

Step 5: (the next morning) The water in the containers should now be fully frozen. Students should weigh their containers. Unless there has been a spill, the weight should remain unchanged. Students should then look for the black line on the inside wall of the container. Water expands in volume when frozen, so unless there has been spillage (or the container was not level in the freezer), the ice should cover the black line. The students can use the marker to mark the surface level of the ice. Students should also hold the base of the thermometer against the ice surface and record their findings. They can also record observations of the colour of the ice (e.g. is it clear and colourless as it was when it was unfrozen?). Do they see anything trapped inside the ice (i.e. air bubbles?)

Step 6: The frozen blocks should now be dumped into an empty sink. The students can then assess the frozen blocks to identify and measure right angles, and count the total number of right angles on the block. Then, ask the children what would happen if you were to fill the sink with water. Would the blocks float or sink? After they answer, then fill the sink with water and watch what happens. When the ice floats, ask them why they think it floats. After this, the students can measure the distance between the two black lines on the inside of the container, to see by how much the water expanded when frozen.

The activity should be concluded by reviewing with the class the basic principles being explored in the lesson, namely (how to measure perimeter, how to measure volume, how to identify a right angle, how to record different types of measurements, and differences in the state of water).

Appendix A: Student worksheets

1. What is the shape of your mini-rink? Draw a small, simple sketch diagram of it.

2. Measure the perimeter of the opening of your container and the depth of the container, and add these to your sketch.

3. How many right angles does your rink have?

4. Using a scale, measure the weight of the container. The weight of my container is \_\_\_\_.

5. Make a black mark on the inside of the container 1 centimeter from the bottom. Now use the measuring cup to fill the container until the black mark is just covered by the surface of the water. How much water did it take to fill up your rink? Write you answer in liters, centiliters, or milliliters, whichever is the best unit of measure.

6. Now carefully weigh your container with the water in it. How much does it weigh? Then, subtract the weight of the empty container to calculate the weight of the water.

 Weight of the full container =

Weight of the empty container =

 Weight of the water =

7. Your mini-rink is much smaller than the rinks in people’s backyard. How much water would you need to fill a rink that is 10 times the size of yours?

How much water would you need to fill a rink that is 100 times the size of yours?

How many containers of water do you think it would take to make a rink your whole class could skate on at the same time?

8. What is the starting temperature of the water in your rink? And what time is it when you make that measurement?

9. What temperature will it need to be for the water to freeze? Calculate how many degrees colder your water will need to be to freeze?

10. When you take your rink out of the freezer later today, record the time and the temperature. How much time has passed? And how many degrees colder did the water get during that time period?

11. The next day, when your rink is frozen, weigh your rink. Has it changed overnight or stayed the same?

12. Now look for the black mark on the inside of the container. Is it still visible? What has happened to the volume of the water after it froze?

13. What does the water look like now that it is frozen? Does it look the same as liquid water, or is it different? Do you see anything in the ice?

14. Feel the surface of your mini-rink. If you were as tiny as an insect, could you skate on it? Is the surface smooth or rough? Can you think of how you might make it smoother?

15. Now dump your frozen block of ice into a sink. How many right angles are there on your block? What is the measurement of a right angle, in degrees?

16. Do you think your block of ice would float or not if the sink is filled with water? Why?