Abacus

From the desk of the Abacus editor

As the school year winds down, let me take this opportunity to thank everyone who has contributed to the *Abacus* over the past eight months. Your activities and ideas have been greatly appreciated. I'm sure there are many other elementary teachers who might have wanted to submit some material, but just couldn't find the time during a busy school year to put pen to paper. Well, now's your chance. Perhaps you'll have some time as you relax at the cottage this summer, or while your kids are off at camp, or even in between conferences and those (expensive!) additional qualification courses.

This issue of the *Abacus* is one you'll want to keep in mind for the fall. The Early and Formative Years Committee of OAME has designed a wonderful unit on volume and capacity, most of which appears in this issue. (Due to space limitations, one activity will be deferred to September.) I hope you will be able to incorporate some or all of these activity ideas into your plans for '95– '96.

I wish all of you a restful, relaxing, and rejuvenating summer break. See you in September.

Jennifer

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Volume and Capacity Unit

Acknowledgement: Special thanks to the Early/Formative Years Committee of OAME for preparing and submitting this unit. (Committee members: Shirley Fairfield (Chair), Lynda Colgan, Ralph Connelly, Ron Sauer, Susan Stuart, Sandy Woodcock)

"Measurement experience is a powerful mathematical connection among topics in the mathematics curriculum."

"Measurement furnishes opportunities for students to engage in activity–oriented investigations of real–world problems that not only nurture reasoning and problem solving skills but also allows students to perceive first hand the power and practicality of mathematics."

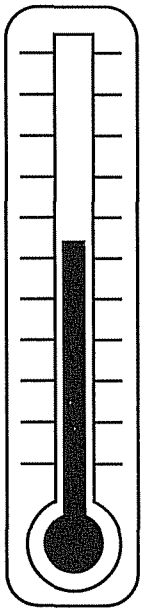
NCTM Addenda Series, *Measurement in the Middle Grades,* 1994.

Many teachers have commented that the topic Volume/Capacity seems to be a challenging one for students and one in which very few resources/ideas are available. This issue of the *Abacus,* prepared by the Early/Formative Years Committee of OAME, presents a collection of volume and capacity activities with related literature connections, home connections, strand integrations and assessment ideas. We hope teachers will find these activities helpful in teaching this very important measurement topic.

Outcomes From Policies and Outcomes, Grades 1-9

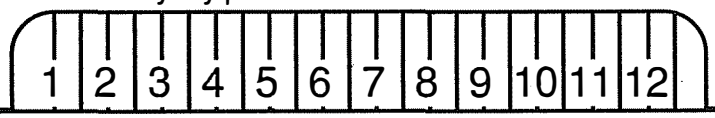
By the end of Grade 6, students will:

- estimate, measure and/or calculate, and record temperature, time, length, perimeter, area, capacity and volume, mass, amounts of money, distance, and speed, using appropriate units of measure.



More specifically, students will:

- use a variety of tools and standard units to estimate and measure length, perimeter, area, capacity, volume, mass, a period of time, and temperature in problem solving activities;
- use familiar objects to make comparisons in measurement activities;
- explain the differences between estimation and precise measurement;
- apply simple measurement formulas to solve problems;
- use an understanding of the relationship among various metric units to compare measurements of objects;
- use measurement skills in other areas of the curriculum and to solve everyday problems.

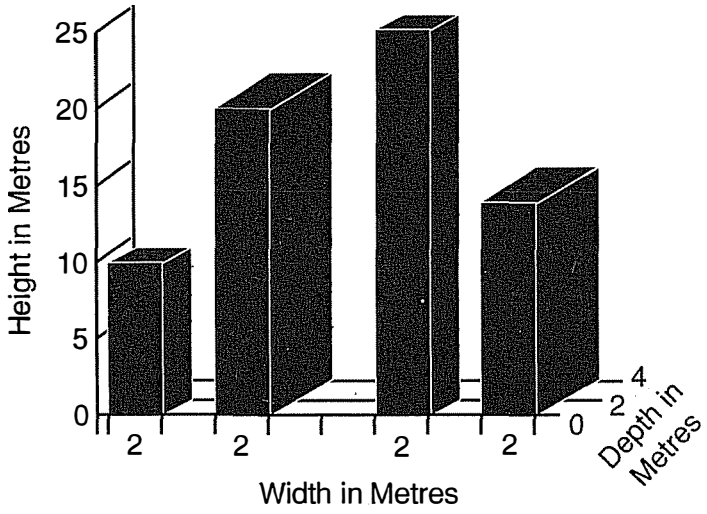


Definitions:

CAPACITY – Capacity is defined as the amount a container can hold. The term capacity is usually used in reference to liquid amounts. The standard units of capacity are the millilitre (mL) and the litre (L).

VOLUME – Volume refers to the amount of space occupied by a three dimensional object. The term volume is usually used when we are interested in determining the number of cubic units of which a solid shape consists. Volume is expressed in cubic units such as the cubic centimetre (cm^3) and the cubic metre (m^3).

Capacity and volume are related as follows: If a centimetre cube (i.e. a cube with a volume of 1 cm^3) was hollowed out to make a container, it would hold 1 mL of water. (1 mL = 1 cm^3)



ACTIVITIES:

ACTIVITY 1:

MARK THE SPOT
Measurement: *Capacity*

Grade Level: 3–6

Materials:

- cards
- a variety of different sized and shaped containers
- elastic bands
- graduated containers

100 mL	150 mL	250 mL
350 mL	500 mL	750 mL
1000 mL	1200 mL	1500 mL
1650 mL		

Make cards with each of the above measurements. Turn deck face down. Student picks up top card and estimates how much space that amount of water will occupy in a given container. Student marks the spot by wrapping an elastic around the container at the guessed level. Measured water is poured into the graduated container to test accuracy.

Repeat the above using containers of various sizes and shapes. Pour water from one container to another.

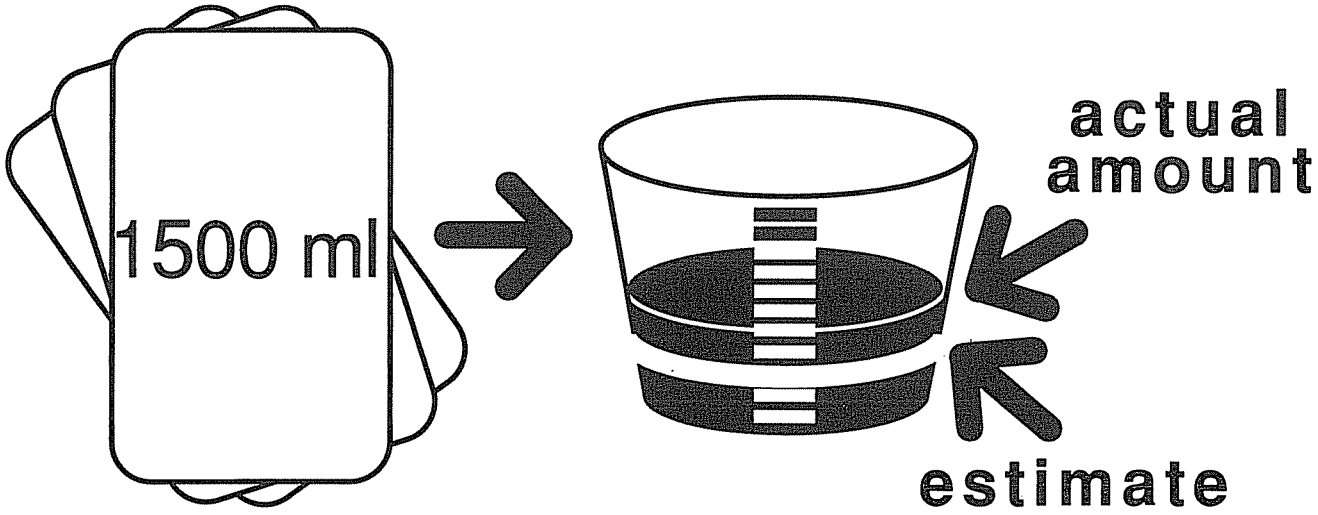
Extension: Students might estimate the level on a number of containers before checking for accuracy.

HOME CONNECTION

MARK THE SPOT



1. How many drops of water make 1 millilitre? Use an eyedropper to check.
2. A leaky faucet drips 1 drop every second. How many millilitres of water are wasted in a day? ___mL, or about ___L.
3. Mark a container with your estimate.



ACTIVITY 2:

THIRST QUENCHING
Measurement: *Capacity*
Data Management
& Probability: *Representation of data*

Grade Level: 4–6

Materials:

- graph paper
- markers

Keep a tally of different drink containers used during the lunch period at the school each day for a week. Graph the results. Which is the most appropriate graph to use: pictograph, bar graph, broken line graph, or other?

Use the graph to predict weekly consumption of different drinks. Continue to collect and display data to test predictions.

How many litres of milk or juice or soft drinks are consumed in a day? a week?

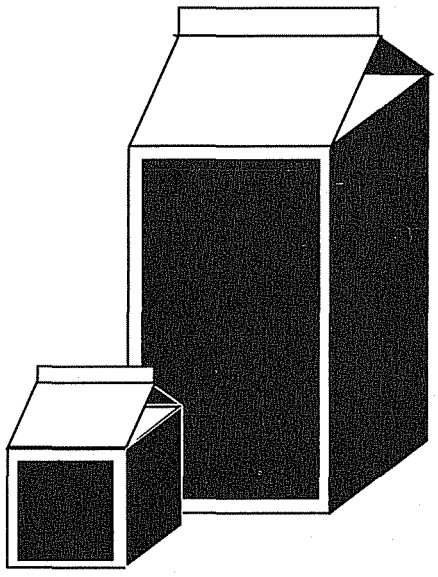
How many litres of liquid are consumed in a day? a week?

Is that enough to fill a bath tub? a swimming pool?

Small groups of students may be given different tasks within this activity and the results compared.

This activity can be done as a small group experiment or as part of a learning centre.

Extension: Describe and explain patterns over two or three weeks.



HOME CONNECTION

THIRST QUENCHING

1. Measure how many millilitres a paper cup holds. ___mL
2. About how many of these cups of liquids do you drink in a day? (For example, milk – 3 cups; water – 2 cups; ...)
3. How many mL do you drink in a day? ___mL, or about ___L
4. Work with family members to estimate how much liquid each of them drinks in a day. Ask each member to measure and tally. Graph the results.

ACTIVITY 3:

"DUALLING" CYLINDERS
Measurement: *Capacity*

Grade Level: 3–6

Materials:

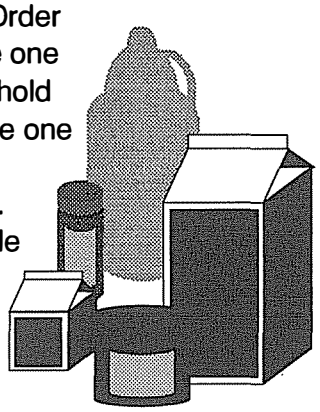
- pourable materials i.e. vermiculite chips, aquarium gravel, rice cereal
- graduated container
- paper
- tape
- bristol board square

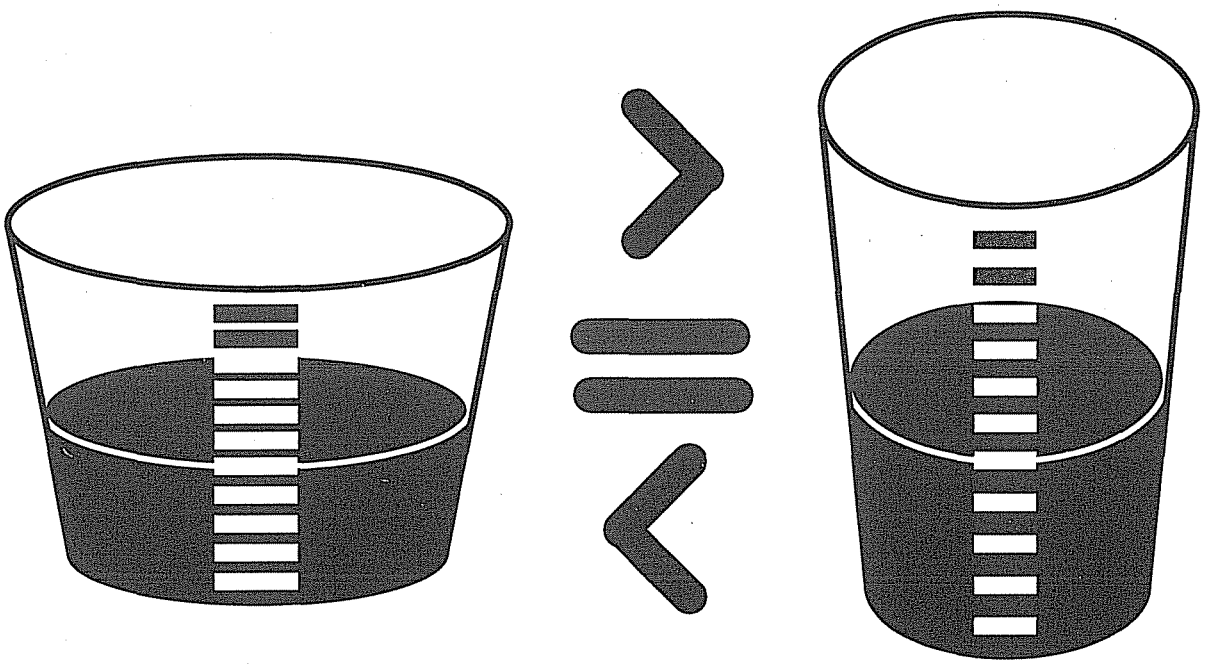
Using tape and a sheet of paper for each, create two cylinders, one whose height is the width of the paper and the other whose height is the length of the paper. Fill the two cylinders with a pourable material. Compare the capacities.

HOME CONNECTION

"DUALLING" CYLINDERS

1. Pick a container. Compare it to a litre box. Guess how many millilitres it holds. ___mL
2. Now measure how much it holds. ___mL
3. Collect some containers from the recycle box. Order them from the one you think will hold the most to the one you think will hold the least. Use a pourable material to check your estimate.





ACTIVITY 4:

OVERFLOW
Measurement: *Volume*

Grade Level: 4–6

Materials:

- modelling material
- displacement can or a pail sitting in a plastic basin
- rock
- softball
- grapefruit
- graduated container
- balance (to compare masses)

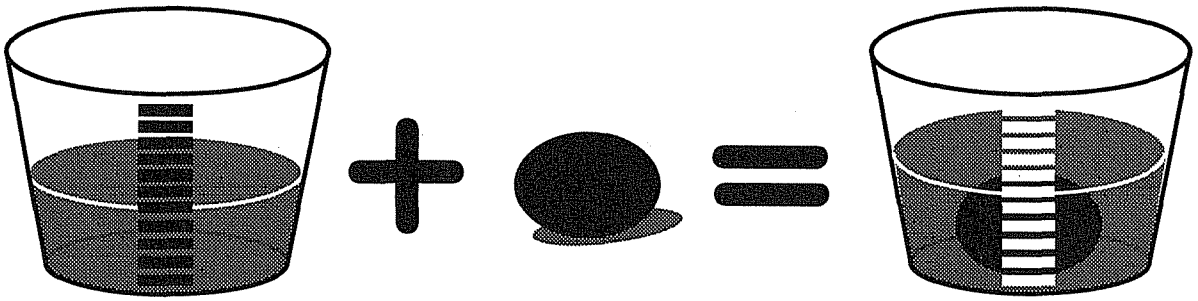
Use a rock and a piece of modelling material (clay, plasticine, Play Doh) of approximately the same size, and estimate how much water each will displace. Does the mass of the object affect the results?

Repeat using a grapefruit and a softball. Does the mass of the objects affect the results?

HOME CONNECTION

OVERFLOW

Environmentalists often suggest placing a brick in the tank of your toilet to conserve water. How much water could your family save in one week using this method? How did you find out?



MILLION DOLLAR WORD

In response to the editor's challenge in the April Abacus, I received the following letter:

Dear ABACUS Editor

With respect to Activity 4 on page 3 of Vol. 33 #3, I think I have a "word" equal to 1 000 000. Well, I know the value is 1 000 000, but I'm challenged (so far) to find a dictionary that contains the "word":

My submission is BEDDY–BYE!
(2x5x4x4x25x2x25x5 = 1 000 000)

I'll leave the judging to you and your team. Thanks for the fun.

Yours sincerely,
Bob McRoberts

Well Bob, it sounds good to me. Thanks for your letter.

By the way, the challenge still stands. Any other million dollar words out there?

Editor's note: Look for Bob's name amoung the 1994/95 Prime Minister's Awards, elsewhere in this issue.

ACTIVITY 5:

SURPRISE PACKAGE
Measurement: *Volume*
Patterning and Algebra
Data Management and Probability

Grade Level: 4–6

Materials:

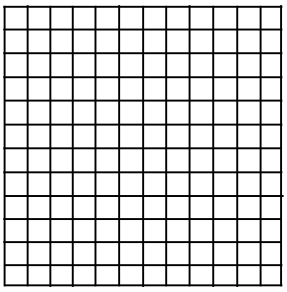
- graph paper
- scissors
- centicubes (optional)
- tape

Use 12 cm x 12 cm graph paper. Cut out 1 square from each corner, fold to form a topless box. Then cut out 2 x 2 squares from each corner, then 3 x 3, then 4 x 4, then 5 x 5 squares. Predict which of these boxes will hold the most cubes. How many cubes does each box hold? Students can use centicubes or count the number of squares on the graph paper to find the answer. Do you see a pattern? Which size box has the greatest volume?

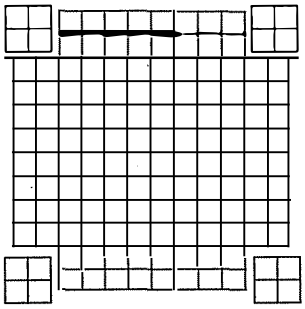
Students can make a table, make a list, make a graph, or show a pattern, as an entry in their Math journal.

The class can brainstorm items that could be stored in each container.

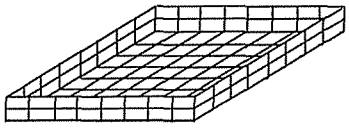
You need to cut a 12 x 12 cm square.



If you cut a square out of each corner,



you can fold up the rest to make a box.



What size square do you need to cut out of the corners to make the box that holds the most?

HOME CONNECTION

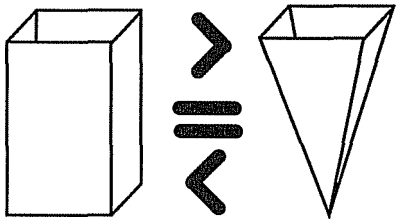
SURPRISE PACKAGE

Can you explain how what you've learned in these capacity and volume activities applies to the ways in which companies package and market their products? Give an example from your local grocery store or your own kitchen cupboard.

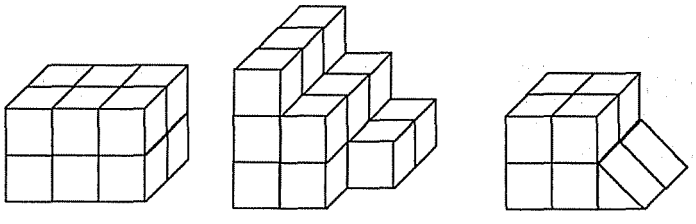
Some Sample Assessment Techniques

CONFERENCE: Show the students a glass that is partially filled with water. Ask them to describe what will happen if a ball is dropped into the glass and sinks to the bottom. Ask, "If the ball floats instead of sinks, will the water overflow? Explain."

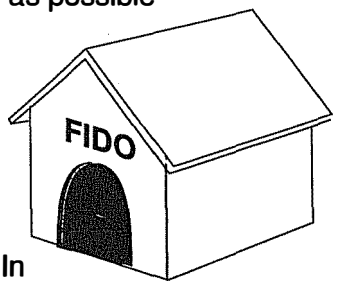
INVESTIGATION: A theatre decides to change the shape of its popcorn container from a rectangular box to a pyramidal box (the tops of both boxes are the same size and both containers are the same height) and charge only half as much. Is this a bargain? Why or why not?



PERFORMANCE ASSESSMENT: Ask students to estimate the number of cubes needed to build each of the structures shown in the pictures. Then have them build each structure, using the pictures to guide their construction. When they have finished, they can compare their estimates with the number of cubes actually used.



OPEN–ENDED QUESTION: Design a doghouse that can be made from a single 1 m x 2 m sheet of plywood. Make the doghouse as large as possible and show how the pieces can be laid out on the plywood before cutting.



JOURNAL WRITING: In your journal write a short essay or poem on "All I Know About Volume or Capacity".

REFERENCES

NCTM Addenda Series, *Measurement in the Middle Grades,* 1994.

NCTM, *How to Teach Perimeter, Area, and Volume, 1986.*

LITERATURE CONNECTIONS

1. Mark the Spot: *Counting on Frank*, Frank Clement
   Anno's Math Games II, Anno Mitsumasa
2. Thirst Quenching: *Lemonade Parade*, Ben Brooks
3. "Dualling" Cylinders: *The Rajah's Rice*, David Barry
   The King's Chessboard, David Birch
4. Overflow: *Mr. Archimedes' Bath*, Pamela Allen
   Stone Soup, Marsha Brown
5. Surprise Package: *Make It With Boxes*, Joan Irvine
   The Mitten, Jan Brett

COMPUTER RESOURCES

Sunburst (800) 321–7511

1. *Puzzle Tanks*
2. *Building Perspective*

Both of these programs are available for Apple II, Macintosh and Windows.