Lesson Guide
In
Elementary Mathematics
Grade 6

Chapter IV
Measurement
Volume
The Mathematics Writing Committee

GRADE 6

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I N T R O D U C T I O N

The Lesson Guides in Elementary Mathematics were developed by the Department of Education through the Bureau of Elementary Education in coordination with the Ateneo de Manila University. These resource materials have been purposely prepared to help improve the mathematics instruction in the elementary grades. These provide integration of values and life skills using different teaching strategies for an interactive teaching/learning process. Multiple intelligences techniques like games, puzzles, songs, etc. are also integrated in each lesson; hence, learning Mathematics becomes fun and enjoyable. Furthermore, Higher Order Thinking Skills (HOTS) activities are incorporated in the lessons.

The skills are consistent with the Basic Education Curriculum (BEC)/Philippine Elementary Learning Competencies (PELC). These should be used by the teachers as a guide in their day-to-day teaching plans.
### IV. Measurement
#### A. Comprehension of Volume

1. Find the volume of a solid

   1.1 Tell the unit of measure used for measuring the volume of solids, rectangular prisms
   - Values Integrated: Being responsible
   - Strategies Used: Acting out
   - Techniques: Manipulative, Group work

   1.2 Convert one cubic unit of measure to a larger or smaller unit
   - Values Integrated: Humility
   - Strategies Used: Acting out
   - Techniques: Group work

   1.3 Derive a formula for finding the volume of solids like:
   - prism
   - cylinders
   - pyramid
   - cones
   - Values Integrated: Cooperation, Thrift, Perseverance, Kindness
   - Strategies Used: Derive a formula and equation
   - Techniques: Derive a formula and equation, Simplifying the problem, Derive a formula and write an equation, modeling

2. Application of measurement of volume

   2.1 Write an equation or formula to solve for the volume of solid
   - Values Integrated: Carefulness, sharing
   - Strategies Used: Simplifying the problem
   - Techniques: Reporting, Diagram

   2.2 Solve word problems involving measurement of volume

   2.1.1 Analyze a word problem

   2.1.1.1 Tell:
   - what is asked
   - what is/are given
   - the word clue/s
   - the operation to be used

   2.1.2 Transform word problems into number sentences
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</table>
Unit of Measure used for Volume of Solids

I. Learning Objectives

Cognitive: Tell the unit of measure used for measuring the volume of solids
Psychomotor: Write the correct unit of measure for volumes of solids
Affective: Learn the importance of being responsible in doing the assigned task

II. Learning Content

Skill: Naming the unit of measure used for volume of solids
Reference: BEC PELC IV.B.1.1
Materials: concrete objects and cutouts of solid figures, 5 see-through plastic containers, small cubes/dice, marbles, irregular shapes and sizes of pebbles, ballpens/pencils, illustrations, flash cards
Value: Being responsible

III. Learning Experiences

A. Preparatory Activities

1. Mental Computation Drill: Finding Areas of Plane Figures

   a) Teacher flashes pictures of plane figures with given dimensions.
   b) Two students at a time, solve mentally for the area. The first to give the correct answer is challenged by another student in class.
   c) Continue this until everyone in class has participated.

2. Review

   Match the drawing/cutout picture with the name of the space figure it represents:

   a) pyramid
   b) prism
   c) cone
   d) cylinder
   e) sphere
   f) cube

3. Motivation

   Present a story problem. Each group in the class is required to bring rectangular boxes for planting seedlings for their EPP class. However, only Group 3 brought their box. Their teacher showed it to the class. He asked, "If it is to be filled with soil, how much soil does it contain?"

B. Developmental Activities

1. Presentation

   a. Discuss the problem:
      1) What is the problem all about?
      2) What can you say about Group 3? Other groups?
      3) What are we asked to find?
4) Do you know the unit of measure used in finding the volume of a solid figure?

b. Activity 1
1) Divide the class into groups of 4.
2) Each group will be given a see-through plastic container and different small-sized objects. They will fill the container with objects or put the objects so that no gaps or spaces can be seen.
   Group 1 – marbles
   Group 2 – different shapes and sizes of pebbles
   Group 3 – small cubes/dice of the same sizes (Make sure that these cubes will fit the box)
   Group 4 – ballpens/pencils
3) Discussion
   Let each group show their box and give their observations. Let them compare the contents in each box.
   a) Which object is the best to put in the container so that there is no space or gap?
   b) How many cubes are there in the length, width, and height of the box?
   • We can say that the unit of measure for volume is cubic unit.

c. Activity 2 – Group Activity
   Let the pupils go back to the story problem. Let them discuss and answer the following questions:
   1) Is the length, width, and height of the rectangular box given?
   2) What metric unit of length should be used for its length, width, and height?
   3) For example the unit of length used is centimetre, what cubic unit of measure should be used to find its volume?
   4) Let each group share their answers to the class. Guide the class in writing cubic centimetre using the exponent 3. So cubic centimetre = cu. cm. = cm³.
   Example: notebook
   unit of length: cm
cubic unit: cu. cm. or cm³

2. Fixing Skills

1) Tell the cubic unit of measure to be used in the following illustrations:
   (in words and in exponential form)
   a) 
   b) 
   c) 
   d) 
   e) 

2) Give the appropriate unit of measure to be used in finding the volume of:
   a) room
   b) shoe box
   c) globe
   d) refrigerator
   e) ice cream cone
   f) baseball
3. Generalization

What is the unit of measure used for measuring the volume of solids? What are the cubic units used in the metric system? How do we write cubic units, say, cubic metres?

C. Application

Give the cubic unit of measure used in the following problems.
1) A piece of soap is 9 cm by 4 cm by 3 cm.
2) An aquarium is 0.8 m long, 0.4 m wide, and 0.45 dm deep.
3) An iron bar 2 m long and 0.05 m in diameter.
4) An ice cream cone 2 cm in radius and 6 cm in height.

IV. Evaluation

A. Write the cubic unit of measure used.

1) 
2) 
3) 
4) 
5) 

B. Use cm$^3$, m$^3$, dm$^3$ to tell which cubic unit of measure is appropriate to be used.
   a) box of chocolate
   b) tent
   c) glass
   d) gymnasium
   e) math book

V. Assignment

Give the cubic unit of measure for finding the volume of the following:
   a) a box 44 cm by 9 cm by 6 cm
   b) a cone with height 9 dm and radius 4 dm
   c) a cabinet 1.2 m by 0.9 m by 0.5 m
   d) a ball with radius 10 cm
   e) a cylindrical tank 25 dm long and radius 8 dm
Conversion of Cubic Units of Measure

I. Learning Objectives

Cognitive: Convert one cubic unit of measure to a larger or smaller unit
Psychomotor: Write one cubic unit of measure to its larger or smaller equivalent
Affective: Admit mistakes with humility

II. Learning Content

Skill: Conversion of one cubic unit of measure to a larger or smaller unit
Reference: BEC PELC IV.B.1.2
Materials: chart, “Show-Me-Boards”, flash cards, water, plastic container, 1 L plastic bottle
Value: Humility

III. Learning Experiences

A. Preparatory Activities

1. Mental Computation/Drill
   I Am the Same As…
   Each group will be given 5 questions to answer. Only 5 members will be chosen to represent the group. First member answers one question and writes the answer on the “Show-Me-Board” then passes it on to the next player until all have answered. The group with the most number of correct answers wins.
   a. 3 m = ______ cm     d. 760 mm = ______ dm
   b. 40 cm = ______ dm   e. 312 dm = ______ cm
   c. 5 km = ______ m

2. Review
   a) Checking of assignment.
   b) I am a ______. The best cubic unit of measure to be used is ______.
      (One pupil will give a solid figure then he/she will call a classmate to provide the cubic unit of measure to be used.)
      Ex.
      Pupil 1 – I am a building. The best cubic unit of measure to be used is ______.
      Pupil 2 – The best cubic unit of measure to be used for a building is cubic metre.

3. Motivation
   Present a dialogue:
   Pupil 1: This box contains 6 cubic decimetres of space.
   Pupil 2: No, I think that box has a volume of 6 000 cubic centimetres.
   Pupil 3: I believe both of you are correct because 6 dm³ is the same as 6 000 cm³.
   Pupil 1: No, I am the right one.
   Pupil 2: No you’re not. My answer is correct.
   Teacher: Okay, let’s find out.

B. Developmental Activities

1. Presentation
1) What is the smallest cubic unit of measure? the next? etc.

2) Let each group list down the different cubic units of measure in the metric system.

\[
\begin{align*}
\text{mm}^3 & \quad \text{cm}^3 & \quad \text{dm}^3 & \quad \text{m}^3 & \quad \text{dam}^3 & \quad \text{hm}^3 & \quad \text{km}^3 \\
1 & \quad 1000 & \quad 10000 & \quad 100000 & \quad 1000000 & \quad 10000000 & \quad 100000000
\end{align*}
\]

3) Guide them in giving the equivalent of one cubic unit to the next cubic unit. In cubic measure, 1,000 of any metric unit is equivalent to 1 of the next higher unit. Let them make a table of equivalence.

Ex. How many cu. mm are there in 1 cu. cm?

Do this until they reach cu. km.

\[
\begin{align*}
1000 \text{ mm}^3 &= 1 \text{ cm}^3 \\
1000 \text{ cm}^3 &= 1 \text{ dm}^3 \\
1000 \text{ dm}^3 &= 1 \text{ m}^3 \\
1000 \text{ m}^3 &= 1 \text{ dam}^3 \\
1000 \text{ dam}^3 &= 1 \text{ hm}^3 \\
1000 \text{ hm}^3 &= 1 \text{ km}^3
\end{align*}
\]

4) Based on the equivalence table, let’s find out the cubic equivalence of each:
   a) 2000 mm\(^3\) is the same as _____ cm\(^3\)?

   Which is smaller mm\(^3\) or cm\(^3\)?

   b) 35 000 cm\(^3\) is equal to _____ dm\(^3\)?

   Which is smaller cm\(^3\) or dm\(^3\)?

   c) 4 000 000 cm\(^3\) is equivalent to _____ m\(^3\)?

   Which is smaller m\(^3\) or cm\(^3\)?

Questions:
   a) From the given examples, what did you do to change 2000 mm\(^3\) to 2 cm\(^3\)?

   35 000 cm\(^3\) to 35 dm\(^3\)?

   4 000 000 cm\(^3\) to 4 m\(^3\)?

   b) How do we change cubic measures from smaller units to larger units?

5) Now, let’s have these examples. Do this again by pairs or by groups. Use the table of equivalence for metric system of cubic measures:

   a) 3 cm\(^3\) = _____ mm\(^3\)?

   Which is larger, cm\(^3\) or mm\(^3\)?

   b) 41 m\(^3\) = _____ dm\(^3\)?

   Which is larger, m\(^3\) or dm\(^3\)?

   c) 5.6 m\(^3\) = _____ cm\(^3\)?

   Which is larger, m\(^3\) or cm\(^3\)?

   d) 3.4 km\(^3\) = _____ m\(^3\)?

   Which is larger, km\(^3\) or m\(^3\)?

Questions:
   1) How did we change 3 cm\(^3\) to 3 000 mm\(^3\)?

   (Discuss also the other examples.)

   2) How do we convert a larger unit of cubic measure to a smaller unit of cubic measure?

   • Let’s go back to the dialogue. Who do you think was correct? Why or why not?

   • What attitude should we exhibit if we make a mistake? Why?

6) Show that dm\(^3\), m\(^3\), cm\(^3\), mm\(^3\) can be expressed in litres (L), centilitres (cL), millilitres (mL), etc.

Materials: water, 1 litre plastic bottle

   1 plastic container 1 dm x 1 dm x 1 dm or 1 dm\(^3\) (for each group)

   a) Let each group measure the plastic container to make sure that they have a 1 dm x 1 dm x 1 dm container.

   b) Read the label of the bottle to make sure it contains 1 litre.

   c) Pour water to the bottle until you have 1 L.

   d) Pour the water from the bottle to the plastic container.

   e) Let them give their observations.

   f) They can reverse the activity, put water first to the plastic container up to its brim then pour it to the bottle without spilling.

   g) Record their observations.

7) Discussion
   a) What can you say about 1 cubic decimetre and 1 litre?

   So 1 dm\(^3\) = 1 L

   b) How about 1 L, is it equal to how many m\(^3\)? Ans. 1 000 L = 1 m\(^3\)

   c) Another conversion is 1 cm\(^3\) = 1 mL

8) Give other examples.

   8 L = _____ dm\(^3\)

   2.6 L = _____ m\(^3\)

   12.5 = _____ dm\(^3\)

   _____ L = 8 500 m\(^3\)
2. **Practice Exercises/Fixing Skills**

   a) Change each of the following to cu mm:
      a. 8 cm$^3$  
      b. 15 m$^3$  
      c. 6.1 dm$^3$
   b) Change each of the following to cu cm:
      a. 27 m$^3$  
      b. 4.95 dm$^3$  
      c. 6.226 mm$^3$
   c) Change each of the following to cu dm:
      a. 63 m$^3$  
      b. 2.930 cm$^3$  
      c. 86.4 cm$^3$
   d) Change each of the following to cu m:
      a. 1 700 dm$^3$  
      b. 36 800 cm$^3$  
      c. 9 400 000 mm$^3$

Write the missing numbers to make the statements true.

   a) 48 dm$^3$ = _______L  
   b) 72 L = _______m$^3$  
   c) 61.28 mL = _______ cm$^3$

   b) 8 ml = _______ dm$^3$
   c) 240 000 m$^3$ = _______ L

3. **Generalization**

   How do we convert one cubic unit of measure to its larger or smaller equivalent?

   How do we change the unit of measure of capacity (L) to the cubic unit of metric measure?

C. **Application**

   Solve the problem.
   1) Sam bought a 500 mL of water. How much is that in cubic centimetres?
   2) A room can contain 336 cu m of air. Convert the volume of the room to cu dm.
   3) Mother prepared a 2 500 cu cm of juice. Change it to cubic decimetres then to litres.

IV. **Evaluation**

   Fill in the blanks:
   1) 5 cm$^3$ = _______ m$^3$  
   2) 60 000 m$^3$ = _______ km$^3$  
   3) 7.2 m$^3$ = _______ mm$^3$  
   4) 450 000 cm$^3$ = _______ m$^3$  
   5) 630 dm$^3$ = _______ m$^3$
   6) 45 L = _______ m$^3$
   7) 4.65 dm$^3$ = _______ L
   8) 3 430 mL = _______ mm$^3$
   9) 345 L = _______ dm$^3$
   10) 200 000 dm$^3$ = _______ mL

V. **Assignment**

   A. Convert to its higher or smaller cubic unit of equivalence.
      1) 4 cm$^3$ = _______ mm$^3$  
      2) 35 cm$^3$ = _______ mm$^3$  
      3) 2 000 000 mm$^3$ = _______ cm$^3$  
      4) 3.6 m$^3$ = _______ mm$^3$  
      5) 5 dm$^3$ = _______ cm$^3$
      6) 700 m$^3$ = _______ dm$^3$
      7) 4 000 dm$^3$ = _______ m$^3$
      8) 84 m$^3$ = _______ cm$^3$
      9) 23 000 cm$^3$ = _______ dm$^3$
      10) 837 dm$^3$ = _______ m$^3$

   B. Fill in the blanks.
      1) 8.6 L = _______ cm$^3$
      2) 1 248 dm$^3$ = _______ L
      3) 8 m$^3$ = _______ L
      4) 3.28 cm$^3$ = _______ mL
      5) 248 000 m$^3$ = _______ dm$^3$
Volume of Rectangular Prisms

I. Learning Objectives

Cognitive: 1. Derive a formula for finding the volume of rectangular prisms
           2. Find a volume of rectangular prism

Psychomotor: Writes solution in finding volumes of rectangular prisms correctly

Affective: Work cooperatively to achieve best results

II. Learning Content

Skill: Finding volume of rectangular prisms

Reference: PELC IV.B.1.3

Materials: transparent rectangular containers, small cubes, Rubik’s cube, worksheets,
pictures of plane figures, paper, ballpen

Value: Cooperation

III. Learning Experiences

A. Preparatory Activities

1. Mental Computation Drill: Solving for Areas of Plane Figures
   Play “Pass-It-On”
   a) Teacher divides the class into 6 groups (per column).
   b) Teacher instructs the pupils in front to prepare a piece of paper (1/4 sheet), which will be
      the group’s answer sheet.
   c) Teacher shows a picture of a plane figure with given dimensions. For example:

   \[
   \begin{align*}
   \text{10 cm} & \quad \text{8 m} \\
   \text{20 m} & \quad \text{6 dm} \\
   \text{6 m} & \quad \text{5 m} \\
   \text{10 m} & \quad \text{6 m}
   \end{align*}
   \]

   d) Students in front solve mentally for the area and write their answer on the piece of paper,
      with the proper label.
   e) Teacher shows another picture of a plane figure with given dimensions.
   f) The pupils in front pass the paper to the one behind them who, in turn, solve mentally for
      the area.
   g) Continue this until everyone in the group or column has participated.
   h) Teacher gives the correct answers.
   i) The group with the correct answer and label gets 2 pts.
   j) The group with the most number of points wins.

2. Review: Formulas in Solving for the Areas of the Following: Square, Rectangle, Parallelogram, Trapezoid, Triangle

   Give one example each for the above shapes. These may be in the form of a word problem
   or a picture with given dimensions. Let the class solve for the area of each.

3. Motivation

   Show a Rubik’s cube.

   Questions:

   A Rubik’s cube is a 3 x 3 x 3 cube that can be manipulated so that each face of the cube will
   have the same design.
1) What do you call this object?
2) Do you know how to play it? How?
3) How many small cubes does this Rubik’s cube have?
   (Pupils may give an estimate or give the exact answer.)

B. Developmental Activities

1. Presentation
   a. Tell the class that the number of small cubes that make up the Rubik’s cube is its volume.
   b. Activity – Group Work
      Materials: worksheet, 1 transparent rectangular container, small cubes
      Procedure: Fill the container with small cubes until its upper portion.

Ex.

Guide Questions:
1) What kind of solid figure is the container?
2) How many cubes did you put inside the rectangular container?
3) How can you find the number of cubes in the container without counting them all?
   a) Count the cubes in one layer.
      Ex. 4 x 2 = 8 cubes
   b) Count the layers. Ex.: 3 layers
   c) How many cubes in all? 8 x 3 = 24 cubes
4) When we get the total number of cubes that the container has, what have we looked for? (Answer: Volume)
5) What kind of polygon is the base of the container? What are its dimensions?
6) How many cubes fit the length? the width?
7) What other dimension does the rectangular container have? How many cubes fit the height?
8) Can you give the volume of the rectangular prism by just using the dimensions (length, width, height)? How?
9) What is the formula in finding the volume of a rectangular prism?
   Volume = length x width x height
   \( V = lwh \)
10) What unit of measurement will you use?
11) When you multiply the length and the width, what does it represent? length x width = area of the base
12) So if the area of the base and the height are given, how will you write the formula for the volume of a rectangular prism?
   \( V = \text{area of the base} \times \text{height} \)
   (Note: The teacher must tell the pupils that the area of the base can be written as B in symbols if they could not give the formula in symbols.)
   \( V = Bh \)
13) What are the 2 formulas in finding the volume of rectangular prisms?
* 14) Did your group perform the activity properly? Why? How did cooperation help in the attainment of good results?
2. Fixing Skills

Let the pupils work by pairs.

1) Count the cubic units to find the volume of each.
   a) 
   b) 
   c) 
   
   \[ V = \quad \quad \quad \quad \] 
   \[ V = \quad \quad \quad \quad \] 
   \[ V = \quad \quad \quad \quad \] 

2) Write the formula then solve for the volume.
   d) 
   e) 
   f) \[
   \begin{align*}
   l &= 2.5 \text{ m} \\
   w &= 3.3 \text{ m} \\
   h &= 1.8 \text{ m}
   \end{align*}
   \]
   g) \[
   \begin{align*}
   B &= 29.4 \text{ sq dm} \\
   h &= 5 \text{ dm}
   \end{align*}
   \]
   h) \[
   \begin{align*}
   B &= 10 \frac{1}{2} \text{ sq cm} \\
   h &= 3 \frac{1}{2} \text{ cm}
   \end{align*}
   \]

3) Find each missing number.
   i) \[
   \begin{align*}
   V &= 372 \text{ cu m} \\
   l &= 31 \text{ m} \\
   w &= \_\_\_ \\
   h &= 3 \text{ m}
   \end{align*}
   \]
   j) \[
   \begin{align*}
   V &= 1232 \text{ cm}^3 \\
   l &= 11 \text{ cm} \\
   w &= 8 \text{ cm} \\
   h &= \_\_\_\_
   \end{align*}
   \]

3. Generalization

How do you solve for the volume of rectangular prisms? What is the formula used?

C. Application

Draw the indicated figure and solve the problem.

1) A sewing box is 12 cm by 9 cm by 6 cm. What is its volume?
2) How many cubic metres of soil has to be removed for the foundations of a building 52 m long and 35 m wide if the hole is to be 1.5 m deep?
3) A wooden block below has a volume of 600 \( \text{cm}^3 \). Bert sawed 2 pieces of wood (as shown in shaded parts) out of the block. Find the volume of the block that was left.

IV. Evaluation

A. Complete the table. Find the volume of the following.

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>9 dm</td>
<td>8.6 dm</td>
<td>5 dm</td>
</tr>
<tr>
<td>2)</td>
<td>1.4 m</td>
<td>1.5 m</td>
<td>1.8 m</td>
</tr>
<tr>
<td>3)</td>
<td>40 cm</td>
<td>15 cm</td>
<td>24 cm</td>
</tr>
<tr>
<td>4)</td>
<td>18.5 cm</td>
<td>9.4 cm</td>
<td>15 cm</td>
</tr>
</tbody>
</table>
5) | 5 3/4 m | 4 1/2 m | 7 2/3 m | ________ |

B. Find each missing dimension:

6) \( V = 945 \text{ cu m} \)
   \( w = 9 \text{ m} \)
   \( l = 7 \text{ m} \)
   \( h = _____ \)

7) \( V = 213.12 \text{ cm}^3 \)
   \( l = _____ \)
   \( w = 7.4 \text{ cm} \)
   \( h = 3.6 \text{ cm} \)

8) \( V = 366 \text{ cu cm} \)
   \( h = _____ \)
   \( B = 30.5 \text{ sq. m.} \)

C. Read, analyze and solve.

1. How many jewelry boxes 10 cm by 6 cm by 4 cm can be packed into a box 50 dm long, 4 dm wide and 3 dm high.

2. The volume of a cube is 343 cm\(^3\). What is the length of the edge?

V. Assignment

Complete the table.

<table>
<thead>
<tr>
<th>Length</th>
<th>15 cm</th>
<th>8.2 dm</th>
<th>5 1/2 m</th>
<th>_____</th>
<th>2.3 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>9 cm</td>
<td>4.7 dm</td>
<td>2 1/4 m</td>
<td>6 m</td>
<td>_____</td>
</tr>
<tr>
<td>Height</td>
<td>7 cm</td>
<td>2.6 dm</td>
<td>4 3/8 m</td>
<td>9 m</td>
<td>2.6 m</td>
</tr>
<tr>
<td>Volume</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
<td>756 m(^3)</td>
<td>17.94 m(^3)</td>
</tr>
</tbody>
</table>

Volume of Cylinders

I. Learning Objectives

Cognitive: 1. Derive a formula for finding the volume of cylinders
             2. Solve for volume of cylinders correctly

Psychomotor: Construct different cylinders and measure the volume of each

Affective: Show awareness of the importance of conserving water

II. Learning Content

Skill: Finding the volume of cylinders

Reference: BEC PELC III.B.1.3

Materials: cardboards, paste/tape, illustrations, chalk, eraser, illustration board, ruler

Value: Importance of conserving water/thrift

III. Learning Experiences

A. Preparatory Activities

1. Mental Computation Drill: Solving for Volumes of Prisms
   a) Teacher divides the class into 6 groups (per column). Each group is provided with an illustration board (\(\frac{1}{4}\)), chalk, and eraser.
   b) Teacher flashes a card with the dimensions of a prism.
      For ex.: \( l = 8 \text{ cm} \)
                \( w = 5 \text{ cm} \)
                \( h = 10 \text{ cm} \)
                \( B = 18 \text{ m}^2 \)
                \( h = 3 \text{ m} \)
                \( l = \frac{1}{2} \text{ m} \)
                \( w = \frac{1}{5} \text{ m} \)
                \( h = \frac{1}{4} \text{ m} \)
   c) The first student from each group solves mentally for the volume of the prism and writes the answer on the illustration board provided.
d) When teacher say “boards up,” they raise their boards up.
e) Whoever gives the correct answer, with the proper label, gets 2 points for his/her group.
f) Teacher flashes another card and the next student in each group solves mentally for the volume and so on.
g) The group with the highest number of points wins.

2. **Review: Finding the Volume of Prisms**

Formula: \( V = Bh \) where \( B = \text{area of the base} \)
\[ h = \text{height of the prism} \]

Ex.
a) An aquarium is 60 cm long, 20 cm wide, and 30 cm high. How much water can it hold?
\[ V = Bh \]
\[ = (l \times w) \times h \]
\[ = 60 \times 20 \times 30 \]
\[ = 36,000 \text{ cm}^3 \]
The aquarium can hold 36,000 cm\(^3\) of water.

b) \[
\text{Volume of the prism} = \left( \frac{bh}{2} \right) \times h \\
= \left( \frac{4 \times 6}{2} \right) \times 12 \\
= 144 \text{ m}^3
\]

3. **Motivation**

Present a story problem:
Water is indispensable because of its many uses. However, some places do not have enough supply of water. People need to store water using jars, plastic containers, drums, and water tanks.

Carlo lives in a barangay with a low supply of water. They need to store water to ensure that they have enough water to use for their daily needs. To make sure that they have a good supply of water, his father installed a new cylindrical water tank behind their house.

The water tank, which is 18 dm high with radius of 6 dm, assures Carlo’s family that they have enough water for their daily consumption. How much water can the cylindrical tank hold?

**B. Developmental Activities**

1. **Presentation**

a. Let each group/pair discuss the following questions and record their answers or ideas. Afterwards, they can share them to the class.

1) Why is water important? What are its uses?
2) Do you only need to conserve if your place do not have enough supply of water? Why or why not?
3) How can we conserve water?
4) What did Carlo’s father install in their house? What is its shape?
5) What are the dimensions of the tank?
6) What are we asked to find?
7) Do you know how to find its volume?
Discussion:

1) Let the pupils illustrate the tank. Let them write/put the given data correctly.
   \[ \text{radius} = 6 \text{ dm} \]

2) Review then write the formula for finding the volume of rectangular prisms:
   \[ V = B \times h \]
   \[ V = l \times w \times h \]
   where
   \[ B = \text{area of base} \]
   \[ h = \text{height of prism} \]

3) Do you think that solving for the volume of a cylinder is somewhat similar to that of a prism? Do we use the same formula \( V = Bh \)?

4) What specific formula do we use in finding volumes of cylinders? Elicit formula: \( V = \pi r^2 \times h \)

5) What is the base area of the cylinder? How can we find the area of the base or the circle? (Let them write the formula.) \( \text{area of circle} = \pi r^2 \).

6) Let the pupils solve for the area of the circle in the given cylinder. Let them understand that the area of the circle represents the base of the cylinder.

7) Afterwards, let the pupils solve for the volume of the given cylinder.

b. Activity – Groups/Pairs

1) Let each group construct cylinders of various sizes using cardboard and glue.
2) Let them measure the height and the radius of each cylinder in cm.
3) Let them solve for the volume of their cylinders using the formula.
4) Group sharing follows afterwards.

2. Practice Exercises

a. Find the volume of each of the following cylinders. Use \( \pi = 3.14 \).

1.

   \begin{align*}
   &3 \text{ cm} \\
   &10 \text{ cm}
   \end{align*}

2.

   \begin{align*}
   &8 \text{ dm} \\
   &15 \text{ dm}
   \end{align*}

3.

   \begin{align*}
   &1 \frac{1}{6} \text{ m} \\
   &5 \frac{1}{3} \text{ m}
   \end{align*}

4.

   \begin{align*}
   &14.6 \text{ m} \\
   &2.2 \text{ m}
   \end{align*}

b. Find the volume of the cylinder. Use \( \pi = 3.14 \).

1. \( r = 2 \text{ cm} \) \( \hspace{1cm} \) \( h = 9 \text{ cm} \) \( \hspace{1cm} \) \( V = \)

2. \( d = 10 \text{ mm} \) \( \hspace{1cm} \) \( h = 16 \text{ mm} \) \( \hspace{1cm} \) \( V = \)

3. \( d = 20 \text{ dm} \) \( \hspace{1cm} \) \( h = \) \( \hspace{1cm} \) \( V = 4710 \text{ dm}^3 \)
4. \( r = \)
   \( h = 1.6 \text{ m} \)
   \( V = 1.256 \text{ m}^3 \)

5. \( B = \)
   \( h = 24 \text{ cm} \)
   \( V = 10,851.84 \text{ cm}^3 \)

3. **Generalization**
   How can you find the volume of a cylinder?

C. **Application**

Read, analyze and solve
1. A milk can has a height of 12 cm and a radius of 3.5 cm. What is its volume? Find the volume of a pipe with a height of 1.5 m and a diameter of 0.18 m.
2. A water tank has an interior height of 10 metres and a diameter of 6 m. What is the volume in cubic metres? How many litres of water can it hold half-full?

IV. **Evaluation**

**A.** Give the volume of the given cylinder.

1) \( r = 9 \text{ cm} \)
   \( h = 3 \text{ cm} \)
   \( V = \) 

2) \( r = 10 \text{ dm} \)
   \( h = 14 \text{ dm} \)
   \( V = \) 

3) \( d = 200 \text{ mm} \)
   \( r = \)
   \( h = 115 \text{ mm} \)
   \( V = \) 

4) \( B = 530.66 \text{ sq. m.} \)
   \( h = 18 \text{ cm} \)
   \( V = \) 

5) \( r = 1.5 \text{ dm} \)
   \( h = 3.7 \text{ dm} \)
   \( V = \) 

**B.** Find the radius or height of the base of the cylinder.

6) \( r = 7 \text{ m} \)
   \( h = \) 
   \( V = 1384.74 \text{ m}^3 \) 

7) \( r = \) 
   \( h = 6 \text{ m} \)
   \( V = 169.56 \text{ m}^3 \) 

8) \( B = 63.585 \text{ sq. m.} \)
   \( h = \) 
   \( V = 394.227 \text{ cm}^3 \) 

V. **Assignment**

**A.** Complete the table. Use the formula \( V = \pi r^2 h \), where \( \pi = 3.14 \).

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Radius (r)</th>
<th>Diameter (d)</th>
<th>Height (h)</th>
<th>Volume (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6 cm</td>
<td></td>
<td>14 cm</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>110 mm</td>
<td></td>
<td>250 mm</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>40 cm</td>
<td></td>
<td>75 cm</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1.75 dm</td>
<td></td>
<td>3.9 dm</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>9 m</td>
<td></td>
<td>7.1 m</td>
<td></td>
</tr>
</tbody>
</table>

**B.** Solve for what is being asked. Use the formula \( V = Bh \).

1) \( B = 153.86 \text{ dm}^2 \)
   \( h = 13 \text{ dm} \)
   \( V = \) 

2) \( B = 2826 \text{ m}^2 \)
   \( h = 45 \text{ m} \)
   \( V = \) 

3) \( B = 7.065 \text{ cu. m.} \)
   \( h = 4.7 \text{ m} \)
   \( V = \) 

4) \( B = 254.34 \text{ cm}^2 \)
   \( h = \) 
   \( V = 3306.42 \text{ cm}^3 \) 

5) \( B = \)
   \( h = 18 \text{ cm} \)
   \( V = 6838.92 \text{ cm}^3 \)
Volume of Cones

I. Learning Objectives

Cognitive: 1. Derive a formula for finding the volume of cones
2. Solve for volumes of cones

Psychomotor: Write the formula or equation in solving for volumes of cones correctly

Affective: Show kindness to everyone

II. Learning Content

Skill: Deriving the formula and solving for the volume of cones

Reference: BEC PELC IV.B.1.3

Materials: flash cards, different sizes of cans, sand, mongo beans, ruler, worksheets, \( \frac{1}{4} \) cartolina, pair of scissors, tape, cylindrical containers, conical containers, 10 oz. cans

Values: Kindness

III. Learning Experiences

A. Preparatory Activities

1. Mental Computation Drill: Multiplying Whole Numbers

Multiply the following mentally: (use flash cards)

<table>
<thead>
<tr>
<th>a. 15 \times 4</th>
<th>b. 6 \times 2 \times 5</th>
<th>c. 8 \times 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. 3 \times 4 \times 4</td>
<td>e. 16 \times 6</td>
<td></td>
</tr>
</tbody>
</table>

2. Review: Finding the Volumes of Cylinders

Prepare different sizes of cans (as many as the number of groups).
Each group will get one can and do the following:
- measure its height and its radius in cm
- find its volume
- share the solution and answer to the class

3. Motivation

Let pupils give examples of objects that are conical in shape. Have them define or describe a cone.

B. Developmental Activities

1. Presentation

a. Activity 1

Present a Story Problem:

Marie attended a birthday party where all children were given party hats and ice cream in cones. One little girl accidentally dropped her ice cream, so she started crying. Marie saw the incident. She went over to the girl and gave her ice cream. The little girl gave her a big smile and said “thank you.” Marie was very happy.

Discussion:

a) What was the story all about?

b) Why was the little girl crying?
c) What did Marie do?
d) Why was Marie very happy?
e) If you were Marie, would you have done the same thing? Why or why not?
f) What kind of solid figure was the container of the ice cream?
g) If the cone has a height of 10 cm and a diameter of 5 cm, what is its volume?
   Do you know how to solve the problem? How?

b. Activity 2 – Group Activity (by pairs)

Materials: a cylinder which is open at one end and a cone that is open at the base (note: the cylinder and the cone must have congruent bases and altitude), sand, worksheet

Procedure: Let the children fill the cone with sand then ask them to guess how many “conefuls” of sand it would take to completely fill the cylinder. Let them check their guesses by filling the cylinder with sand from the cone.

Questions:
1) How many “conefuls” of sand did you put to fill up the cylinder?
2) Was your guess correct? Why?
3) What mathematical formula can you derive for the volume of a cone?
   Note: Volume of the cylinder is three times the volume of the cone or the volume of the cone is \( \frac{1}{3} \) that of the cylinder.
4) What is the formula used to find the volume of a cylinder?
   \( V = B \times h \)
   where \( B = \text{area of the base} \)
   \( B = \pi r^2, \pi = 3.14 \) or \( \frac{22}{7} \)
5) How do we write the formula for the volume of a cone?
   \( V_{\text{cone}} = \frac{1}{3} Bh \)
   where \( B = \text{area of the base} \)
   \( B = \pi r^2, \pi = 3.14 \) or \( \frac{22}{7} \)
   \( h = \text{height of cone} \)
   \( V_{\text{cone}} = \frac{Bh}{3} \text{ or } \frac{\pi r^2 h}{3} \text{ or } \frac{1}{3} \pi r^2 h \)
6) From the given word problem, can you now find the volume of the ice cream cone?
   a) Let them draw the cone with its dimensions.
   b) Find the radius of the cone.
   c) Write the formula for volume.
   d) Solve for the answer.
   e) Label the answer correctly.

\[ r = 2.5 \text{ cm} \]
\[ V = \frac{1}{3} Bh \text{ or } \frac{1}{3} \pi r^2 h \]
\[ V = \frac{1}{3} (3.14 \times 2.5 \text{ cm} \times 2.5 \text{ cm} \times 10 \text{ cm}) \]
\[ V = \frac{1}{3} (3.14 \times 6.25 \text{ cm}^2 \times 10 \text{ cm}) \]
\[ V = \frac{1}{3} (3.14 \times 62.5 \text{ cm}^3) \]
\[ V = \frac{1}{3} (196.25 \text{ cm}^3) \]
\[ V = 65.42 \text{ cm}^3 \text{ (the answer is rounded off to the nearest hundredths)} \]

c. Activity 3 – Group Activity (Alternative Activity)
Comparing the Volume of a Cone and Volume of a Cylinder

Materials: worksheet, 10 oz can, \( \frac{1}{4} \) cartolina, pair of scissors, mongo beans, tape

Procedure:
a) Give each group a 10 oz (milk) can and \( \frac{1}{4} \) cartolina. (Or pupils can bring out the materials if these are pre-assigned.)

b) Have the pupils construct a cone from the cartolina by cutting out a semicircle, and taping the sides.
   Have the pupils form a cone whose base has the same circumference as that of the base of the can.

c) Have the pupils completely fill the cone with beans and pour them into the can.
   Repeat until the can is full.

d) Have the pupils describe the volume of the can in relation to that of the cone.

e) Questions:
   1) How many "conefuls" of beans did you pour in the can?
   2) What can you say about the volume of the can compared to the volume of the cone?
      Volume of the can = 3 times the volume of the cone
      Volume of the cone = \( \frac{1}{3} \) volume of the can
   3) What solid figure is represented by the can?
      Therefore, we can say, that,
      Volume of the cone = \( \frac{1}{3} \) volume of the cylinder
   4) What mathematical formula can you derive for the volume of a cone?
      \[ V_{cone} = \frac{1}{3} Bh \]
      where \( B \) = area of the base = \( \pi r^2 \);
      \[ \pi = 3.14 \text{ or } \frac{22}{7} \]
      \( h \) = height of the cone

5) Going back to our word problem, can you now solve for the volume of the ice cream cone?

   a) Draw/illustrate the cone. Write the dimensions.
   b) Find the radius of the cone.
   c) Write the formula for the volume.
   d) Solve for the volume. Label the answer correctly.

   \[ r = 2.5 \text{ cm} \]
   \[ V = \frac{1}{3} Bh \text{ or } \frac{1}{3} \pi r^2 h \]
   \[ V = \frac{1}{3} (3.14 \times 2.5 \text{ cm} \times 2.5 \text{ cm} \times 10 \text{ cm}) \]
   \[ V = \frac{1}{3} (3.14 \times 6.25 \text{ cm}^2 \times 10 \text{ cm}) \]
   \[ V = \frac{1}{3} (3.14 \times 62.5 \text{ cm}^3) \]
   \[ V = \frac{1}{3} (196.25 \text{ cm}^3) \]
   \[ V = 65.42 \text{ cm}^3 \text{ (Answer was rounded off to the nearest hundredth)} \]

2. Practice Exercises

Let the pupils work by pairs, and answer the following:
Find the volume of each cone, use \( \pi = 3.14 \):
Find the missing dimension. Fill in the blanks:

d) radius = 8 m, height = _____; Volume = 602.88 m³

e) diameter = 14 cm, radius = _____, height = 5.1 cm, Volume = _____

f) r = _____, h = 2.1 m, V = 19.782 m³

Solve for the missing value to complete the table. Use \( \pi = 3.14 \).

<table>
<thead>
<tr>
<th>Cone</th>
<th>Radius</th>
<th>Diameter</th>
<th>Height</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>_____</td>
<td>20 dm</td>
<td>15 dm</td>
<td>_____</td>
</tr>
<tr>
<td>2</td>
<td>1.5 m</td>
<td>_____</td>
<td>2.7 m</td>
<td>_____</td>
</tr>
<tr>
<td>3</td>
<td>40 cm</td>
<td>_____</td>
<td>72 cm</td>
<td>_____</td>
</tr>
<tr>
<td>4</td>
<td>48 cm</td>
<td>_____</td>
<td>_____</td>
<td>72 345.6 cm³</td>
</tr>
<tr>
<td>5</td>
<td>_____</td>
<td>_____</td>
<td>9 dm</td>
<td>150.72 dm³</td>
</tr>
</tbody>
</table>

3. Generalization

How do you find the volume of a cone? What is the formula used?

C. Application

Read, analyze and solve. Illustrate/draw the figure.

1) A conical tent of radius, 3 m and height, 4.2 m was assembled by the boy scouts. How much air does it enclose?

2) In Elen’s Geometric Park, different solid figures can be found. Ruby went to the conical building. It has a height of 67 dm and radius of 45 dm. What is its volume?

IV. Evaluation

A. Solve for the volume of each cone:

1) \( V = _____ \)

2) \( V = _____ \)

3) \( V = _____ \)
A conical tent has a base of 426.7cm in diameter and a height of 243.8cm. What is the volume of the air that it holds in metres?

V. Assignment

A. Find the missing dimension. Use π = 3.14.

1) r = _____
   h = 8 m
   V = 301.44 cu. m.

2) r = 5 cm
   h = _____
   V = 235.5 m$^3$

3) B = 5.3066 m$^2$
   h = _____
   V = 2.6533 m$^3$

B. Pupils make different cones or they may use cones that are already made. Pupils measure each cone to get the height and the radius then let them practice finding its volume. Ask them to record their observations in their math journals.

Word Problems on Volume

I. Learning Objectives

**Cognitive:** Solve word problems involving volume

**Psychomotor:** Writes the solution in solving for the volume of solids

**Affective:**
1. Share things with others
2. Practice carefulness in order to avoid accidents

II. Learning Content

**Skill:** Solving word problems on volume

**Reference:** PELC IV.B.2.1

**Materials:** a drawing of a big basket, cutouts of flowers, illustration/diagram, manila paper

**Value:** Carefulness, sharing

III. Learning Experiences

A. Preparatory Activities

1. **Mental Computation Drill: Multiplying Fractions and Whole Numbers**
   A Basket of Flower Facts
   
   **Materials:** a drawing of a big basket, cut outs of flowers with number facts
   
   **Procedure:** One pupil will pick a flower, read the number fact written at the back then he/she and the class will solve it mentally.
2. **Review**

Match the formula to the name and picture of the solid figure.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Name</th>
<th>Volume Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>a. Cylinder</td>
<td>$V = \frac{1}{3}(\pi r^2h)$</td>
</tr>
<tr>
<td>II.</td>
<td>b. Rectangular Prism</td>
<td>$V = \pi r^2h$</td>
</tr>
<tr>
<td>III.</td>
<td>c. Cone</td>
<td>$V = lwh$</td>
</tr>
<tr>
<td>IV.</td>
<td>d. Square Pyramid</td>
<td>$V = \frac{s^2h}{3}$</td>
</tr>
</tbody>
</table>

3. **Motivation**

Give each group a set of steps in solving problems. Let them arrange the steps in correct order.
(This can be done in the form of a game.)

Ex.: What operation is needed to solve the problem?
- What are the given facts?
- What is the correct number sentence?
- Write the solution with correct label.
- What is being asked?

**B. Developmental Activities**

1. **Presentation**
a. Activity 1 – News Report (Class → Group Activity)

1) Let one pupil read the news report. (This can be written on manila paper.)

Quezon City – an electric post, 150 cm long with radius 15 cm, was hit by a truck yesterday at 4:30 a.m. This caused a two-hour brownout in the area. The driver, Mr. Luis Mercado, and his friend, Mr. Mark Fernando, were rushed to the nearby hospital. Luckily, they just had mild contusions and minor bruises. The two were being questioned as to the cause of the accident – Ruby Hilario.

2) Discussion:
   a) What was the news all about?
   b) Why do you think the truck hit the post?
   c) How can you avoid accidents (of any form)?
   d) What kind of solid figure is given in the news?
      Can you read that part.
      • I am going to use the electric post to solve a problem. Let’s see if you can find the answer.

   Find the volume of the electric post, 150 cm long with radius 15 cm, that was hit by a truck.

3) Analysis of the problem:
   • What are the given facts?
     Let them draw or illustrate the electric post using the given facts.
   • What are we looking for in the problem?
     Identify the figure.
   • What is the operation to be used?
     Write the formula to find the volume of the given solid figure.
   • What is the number sentence?
   • Write the solution with correct label.
     Ex.: Volume of Cylinder

\[
V = \pi r^2 h \\
V = 3.14 \times 15 \text{ cm} \times 15 \text{ cm} \times 150 \text{ cm} \\
V = 3.14 \times 225 \text{ cm}^2 \times 150 \text{ cm} \\
V = 3.14 \times 33,750 \text{ cm}^3 \\
V = 105,975 \text{ cm}^3
\]

b. Activity 2 – Using a Diagram

1) Present a story problem:
   Victor and Carlos are brothers. They share their toys with each other. One day, they were playing with dominoes. They were making different shapes and figures out of these dominoes. Victor made a rectangular solid using 7 dominoes. If each domino has a length of 3.5 cm, width of 2 cm, and a height of 1 cm, find the volume of the rectangular figure that Victor made.
   Analysis and solution of the problem through a table:
a) What is being asked?  
   - Identify the solid figure
b) What are the given facts?  
   - 1 domino has l = 3.5 cm, w = 2 cm and height = 1 cm
   - Victor used 7 dominoes
c) What is the hidden fact?  
   - The height of the 7 dominoes
d) What operation should be used to find the hidden fact?  
   - Multiplication
e) What formula is needed to find the volume of a rectangular prism?  
   - V = l x w x h
f) What is the mathematical sentence?  
   - V = 7 x (3.5 cm x 2 cm x 1 cm)
g) Solve the equation.  
   - Label the answer correctly.
   
   \[ V = 7 \times (3.5 \text{ cm} \times 2 \text{ cm} \times 1 \text{ cm}) \]
   
   \[ = 7 \times (7 \text{ cm}^3) \]
   
   \[ = 49 \text{ cm}^3 \]

Let the pupils go back to the story.
What can you say about the two brothers? What good character traits do they possess?

2. **Fixing Skills**

Solve the following problems. (The pupils may follow the analysis format as given or they can make their own as long as they can explain their answers.)

1) Alice has a paperweight in the shape of a pyramid. Its height is 6 cm, length is 5.2 cm and width is 4.9 cm. What is its volume?
2) A juice can has a base area of 34 cm\(^2\) and a height of 12.2 cm. What is its volume?
3) Each book of a set of encyclopedia measures 2.85 dm by 2.15 dm by 0.4 dm. The encyclopedia has 19 books. What is the total volume of all 19 books?

3. **Generalization**

How do you solve word problems involving measurement of volume?

C. **Application**

1) The toy hat of Alex is in the shape of a cone. Its base area is 72 cm\(^2\) and its height is 21 cm. What is its volume?
2) A can of sardines is shaped like a cylinder. It has a radius of 2.9 cm and a height of 7.1 cm. Find \(r^2\) and the volume of the can.
3) The length of a box is twice its height. The width of the box is 12 cm and the height is 8.5 cm. What is the volume of the box?
4) Look at the illustrations below. Which cylindrical will hold more water? Show your solutions.

![Illustration of cylinders A and B with dimensions]

IV. **Evaluation**

Analyze then solve the problems.

1) A box of milk is 9 cm long, 8 cm wide, and 18 cm high. Find its volume.
2) A cone hat has a radius of 1.2 dm and a height of 3.4 dm. What is its volume?
3) Harold is molding a cylindrical candle with a diameter of 12 cm and a height of 18 cm. About how much wax does Harold need to mold the candle?
V. Assignment

Solve each of the following problems.

1) The base of a pyramidal tent is a square. If the tent is 2 metres long and $1\frac{1}{2}$ metres high, how many cubic metres of space can it hold inside?

2) The volume of a cylindrical tin can placed on top of a table is 282.6 cm$^3$. If it is 10 cm high, how much space does it occupy on the table?

3) A bookcase is 3.1 m long, 0.42 m wide, and 1.9 m high. What is its volume?

4) A cone-shaped paper cup has a radius of 4.2 cm and a height of 9 cm. How many cm$^3$ of water can it contain?

5) The ratio of the diameter of a cone to its height is 2 to 3. If the diameter is 10 cm, what is the volume of the cone?

6) A rectangular water tank is $\frac{1}{2}$ metre wide, 1 metre long and $1\frac{1}{2}$ metres high. If it is half-filled, how much water does it contain?