

## **WAMC Lab Template**

Math Concept(s): Volume of Cones

Source / Text:

Developed by: Heather Brase E-Mail: [hbrase@northmasonschoools.org](mailto:hbrase@northmasonschoools.org) Date: June 22, 2022

### **Attach the following documents:**

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

### **Short Description (Be sure to include where in your instruction this lab takes place):**

Students will have designated flower and garden boxes around campus to measure. The goal is for students to calculate the amount and cost of the soil needed for the box.

### **Lab Plan**

Lab Title: Cost of Potting Soil

Prerequisite skills: Students need to know how to use measuring tools accurately and with precision. Students also need to know the difference between and how to calculator perimeter, area, and volume.

Lab objective: Use precision with measuring tools to accurately measure the dimensions of a planter box and determine the amount of soil needed to fill the planter.

### **Standards: (Note SPECIFIC relationship to Science, Technology, and/or Engineering)**

Mathematics K–12 Learning Standards:

- CCSS.MATH.CONTENT.HSG.GMD.A.3  
Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Standards for Mathematical Practice:

- MP1 Make sense of problems and persevere in solving them.
- MP2 Reason abstractly and quantitatively.
- MP4 Model with mathematics.
- MP5 Use appropriate tools strategically.
- MP6 Attend to precision.
- MP3 Construct viable arguments and critique the reasoning of others.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- CCSS.ELA-LITERACY.W.9-10.2.D  
Use precise language and domain-specific vocabulary to manage the complexity of the topic.
- CCSS.ELA-LITERACY.SL.9-10.1  
Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

- Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

K-12 Science Standards

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Technology

- 3.a. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- 3.b. Students evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
- 5.b. Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
- 5.c. Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Engineering

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Leadership/21st Century Skills:

<p><b>21st Century Interdisciplinary themes</b> (Check those that apply to the above activity.)</p> <input type="checkbox"/> Global Awareness <input checked="" type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy <input type="checkbox"/> Civic Literacy <input type="checkbox"/> Health/Safety Literacy <input type="checkbox"/> Environmental Literacy			
<p><b>21st Century Skills</b> (Check those that students will demonstrate in the above activity.)</p>			
<p><b>LEARNING AND INNOVATION</b></p> <p><u>Creativity and Innovation</u></p> <input checked="" type="checkbox"/> Think Creatively <input checked="" type="checkbox"/> Work Creatively with Others <input type="checkbox"/> Implement Innovations <p><u>Critical Thinking and Problem Solving</u></p> <input checked="" type="checkbox"/> Reason Effectively <input checked="" type="checkbox"/> Use Systems Thinking <input checked="" type="checkbox"/> Make Judgments and Decisions <input checked="" type="checkbox"/> Solve Problems <p><u>Communication and Collaboration</u></p> <input checked="" type="checkbox"/> Communicate Clearly <input checked="" type="checkbox"/> Collaborate with Others	<p><b>INFORMATION, MEDIA &amp; TECHNOLOGY SKILLS</b></p> <p><u>Information Literacy</u></p> <input checked="" type="checkbox"/> Access and Evaluate Information <input checked="" type="checkbox"/> Use and manage Information <p><u>Media Literacy</u></p> <input type="checkbox"/> Analyze Media <input type="checkbox"/> Create Media Products <p><u>Information, Communications and Technology (ICT Literacy)</u></p> <input checked="" type="checkbox"/> Apply Technology Effectively	<p><b>LIFE &amp; CAREER SKILLS</b></p> <p><u>Flexibility and Adaptability</u></p> <input type="checkbox"/> Adapt to Change <input type="checkbox"/> Be Flexible <p><u>Initiative and Self-Direction</u></p> <input checked="" type="checkbox"/> Manage Goals and Time <input type="checkbox"/> Work Independently <input type="checkbox"/> Be Self-Directed Learners <p><u>Social and Cross-Cultural</u></p> <input checked="" type="checkbox"/> Interact Effectively with Others <input checked="" type="checkbox"/> Work Effectively in Diverse Teams	<p><b>Productivity and Accountability</b></p> <input type="checkbox"/> Manage Projects <input checked="" type="checkbox"/> Produce Results <p><b>Leadership and Responsibility</b></p> <input checked="" type="checkbox"/> Guide and Lead Others <input checked="" type="checkbox"/> Be Responsible to Others

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## **Teacher Preparation: (What materials and set-up are required for this lab?)**

### Materials

- Measuring tapes
- Calculators
- Student worksheet
- Different planter boxes around campus (it is best to pick these in advance and maybe label them)

### Set-Up Required:

- Pick the planter boxes that are around campus that you want students to measure and have them labeled.

## **Lab Organization Strategies:**

### Cooperative Learning:

- Student will work in pairs: one taking measurements and one recording data.

### Expectations:

- Students will work in pairs collaborating to collect all needed data in a timely manner with precision. Students will then work on completing the rest of the lab together with each person having designated tasks. One lab will be turned in per partnership.

### Timeline:

- This lab should take about 25 minutes for data collecting and 30 minutes to complete the student worksheet and computations.

## **Post Lab Follow-Up/Conclusions:**

### Discuss real world application of learning from lab

- What if you were building a raised garden bed and needed different layers of material?
- What is you needed to fill tank with liquid (ie. Pool, fish tank, vases, etc.)

### Career Applications

- Farming
- Gardening/landscaping
- Chefs/Bakers
- Machinists

### Optional or Extension Activities

- Students can design a garden bed with a maximum area or volume at the lowest cost possible.

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### Student work

**Directions:** You and a partner will go around campus and locate the 6 planter boxes that I have marked. You will need to measure all dimensions for each planter. You will then return to the classroom and calculate the volume of soil needed for each planter. Last, you will need to research how much soil costs and figure out how much you need and what the total cost will be.

1. Use the table below to record your own data. You might need all columns for every planter.

Planter Box	Length	Width	Diameter	Surface Area

2. Use this space to sketch a model of each planter with its dimensions.

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3. Calculate the Volume for each planter you measured. Show all work either below, or on a separate piece of paper.

Planter Box	Volume

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4. Do a little research online potting soil. How potting soil much would you need and what would it cost to fill all the planters?

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# WAMC Lesson Plan

Name(s): Heather Brase

Email Address: [hbrase@northmasonschoools.org](mailto:hbrase@northmasonschoools.org)

Lesson Title: Volume of Cylinders and Cones

Date: June 22, 2022

Text: CORD: A Contextual Approach to Geometry

STEM Correlation: Engineering

Lesson Length: 60 minutes

Big Idea (Cluster): Measuring in US Standard and Metric/Precision Measurement

Mathematics K–12 Learning Standards: CCSS.MATH.CONTENT.HSG.GMD.A.3

Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Mathematical Practice(s):

Content Objectives:

Students will be able to calculate the volume of cones and cylinders.

Language Objectives (ELL):

Students will be able to define the vocabulary words with 80% accuracy.

Vocabulary:

- Volume
- Cylinder
- Cone
- Height
- Diameter
- Radius
- Pi

Connections to Prior Learning

- Difference between area and volume
- Calculating the area of a circle
- The relationship between radius and diameter

Questions to Develop Mathematical Thinking:

- What formula do you need to use?
- What is the relationship between the diameter and radius?
- What is the relationship between a cone and a cylinder?
- How would you calculate the size of the circle part of a cylinder?

Common Misconceptions:

- Using length or width instead of radius and diameter
- Forgetting that a cone is  $\frac{1}{3}$  of a cylinder
- Forgetting to multiply by the height
- Forgetting Pi

Assessment (Formative and Summative):

- Formative: Student check in during independent practice and the wrap up activity
- Summative: End of Unit Test

Materials:

- Calculators
- Student worksheets (Rally Coach, Independent Practice)

Instruction Plan:

**Introduction:** Students will be presented with an entry task as they come into the classroom. The entry task will be a KWL chart with an introduction problem where students will need to write down what they know and then what they wonder. After 2-3 minutes of independent thinking time, students will turn to their partner and spend another 2-3 minutes share their knows and wonders. Review the KWL chart with the whole class and create a class chart to reference throughout the lesson.

## WAMC Lesson Plan

**Explore:** Go over the example problems. After the examples, students will work in their pairs to complete the Rally Coach activity. Once they are done with their Rally Coach activity students will start on their independent practice.

**When I observe students:** When working in pairs I expect to see and hear students collaborating, talking, and working together. When working independently, I expect to see students working, reviewing their notes from the examples, and asking questions when they are stuck. I will be watching for those students who are doing nothing, or I know struggle to seek help and sitting with them for one-on-one help and encouragement.

**Questions to Develop Mathematical Thinking as you observe:**

- What formula do you need to use?
- What is the relationship between the diameter and radius?
- What is the relationship between a cone and a cylinder?
- How would you calculate the size of the circle part of a cylinder?

**Answers:**

- Either Cylinder ( $V = \pi r^2 H$ ) or Cone ( $V = 1/3 \pi r^2 h$ )
- Diameter is twice the size of the radius ( $d = 2r$ )
- A cone is  $1/3$  the size of a cylinder or a cylinder is 3 times the size of a cone
- You would need to know the area of the circle to know the size of the top and bottom of a cylinder (Area of a circle =  $\pi r^2$ )

**Summarize:** When there is about 15 minutes of class time left, bring the class back together and have students independently complete the "What I Learned" column of the KWL chart. After about 2-3 minutes, have students turn to their partner and discuss their learnings for 2 more minutes. Bring the whole class together and collectively complete the "What I learned" column on the class chart. Lastly, give students two post it notes each and ask them to solve two problems that are on the board (one on each post it). Students are to leave each post it next to its corresponding problem on the board as they exit the classroom for the day.

**Career Application(s):**

- Farming
- Gardening/landscaping
- Chefs/Bakers
- Machinists

**Leadership/21<sup>st</sup> Century Skills:**

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> Global Awareness       | <input type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy | <input type="checkbox"/> Civic Literacy |
| <input type="checkbox"/> Health/Safety Literacy | <input type="checkbox"/> Environmental Literacy                               |   |

21st Century Skills (Check those that students will demonstrate in the above activity.)

**LEARNING AND INNOVATION**

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

**INFORMATION, MEDIA & TECHNOLOGY SKILLS**

Information Literacy

- Access and Evaluate Information

Media Literacy

- Use and manage Information
- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

**LIFE & CAREER SKILLS**

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

- Manage Goals and Time
- Work Independently
- Be Self-Directed Learners

Social and Cross-Cultural

- Interact Effectively with Others
- Work Effectively in Diverse Teams

**Productivity and Accountability**

- Manage Projects
- Produce Results

Leadership and Responsibility

- Guide and Lead Others
- Be Responsible to Others

# WAMC Lesson Plan

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

## Entry Task

Problem: I want to make a candle out of a pretty container that was gifted to me. How much wax do I need to fill the container?



What I <b>K</b> now	What I <b>W</b> onder	What I <b>L</b> earned

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## WAMC Lesson Plan

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### Examples

1. I want to make a candle out of a pretty container that was gifted to me. How much wax do I need to fill the container?



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2. The height and diameter of a cone-shaped storage tank are 9 feet and 14 feet respectively. Find the volume of liquid the tank can hold.

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# WAMC Lesson Plan

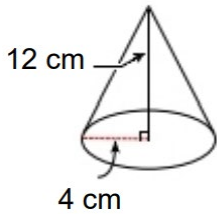
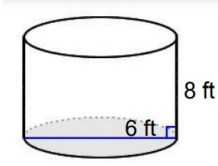
Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

## Rally Coach

Choose who will be Partner A and Partner B. Partner A will solve the problems marked A, with Partner B coaching them through if they get stuck. Partner B is NOT allowed a pencil during this time. Then, switch for the problems marked B. When all sections are done, please raise your hand for a check in with the teacher.

A. Calculate the Volume. Be sure to show all work.

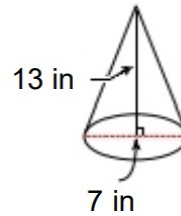
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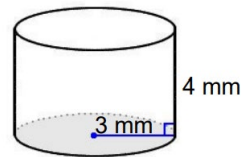
ii.

B. Calculate the Volume. Be sure to show all work.

i.



ii.



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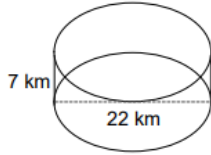
# WAMC Lesson Plan

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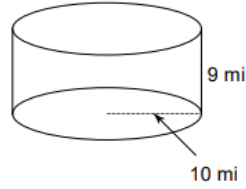
## Independent Practice

Find the volume of each figure. Round your answers to the nearest tenth, if necessary.

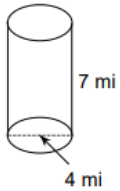
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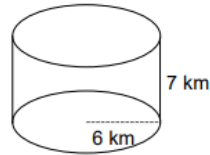
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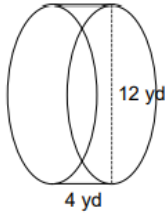


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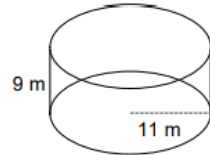


Find the volume of each figure. Leave your answers in terms of  $\pi$ .

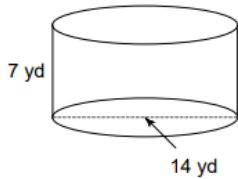
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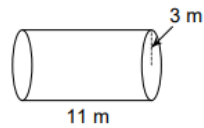
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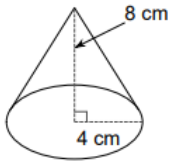
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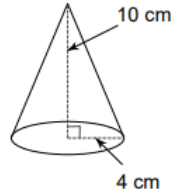
# WAMC Lesson Plan

Find the volume of each figure. Round your answers to the nearest tenth, if necessary.

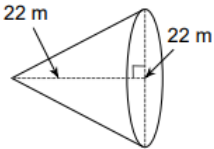
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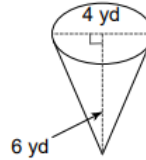
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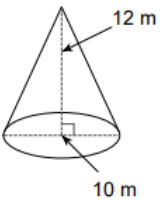


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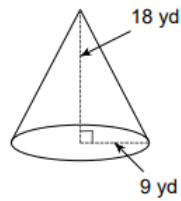


Find the volume of each figure. Leave your answers in terms of  $\pi$ . Use fractions instead of decimals, when necessary.

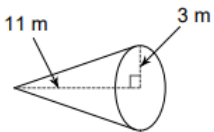
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14)



15)



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