<u>**WAMC Lab Template**</u>
Math Concept(s): Volume of Cylinders and Cones
Source / Text:
Developed by: Kendra Pullin   E-Mail: kpullin@cloverpark.k12.wa.us   Date: 06/25/24

<u>**Attach the following documents:**</u>
- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

<u>**Short Description (Be sure to include where in your instruction this lab takes place):**</u>
- This lab is a comparison of the volume of cylinders and cones to help students derive the formula of the volume of a cone. This would take place after students have learned about the volume of cylinders and before the volume of cylinders.

<u>**Lab Plan**</u>
Lab Title: Volume of Cones

Prerequisite skills: The student should have an understanding of how to find the volume of cylinders.

Lab objective: In this lab the student will construct cylinders and cones with the same radius and height. They will then use beans to compare the volume of cones to the volume of cylinders.

<u>**Standards:**</u> *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*
Mathematics K–12 Learning Standards:
- 8.G.C.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems

Standards for Mathematical Practice:
- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Model with Mathematics
- Use appropriate tools strategically
- Attend to precision

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):
- CCSS.ELA-LITERACY.RST.6-8.3
  Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Engineering

- MS-ETS1-4
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)
☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

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

LEARNING AND INNOVATION	**INFORMATION, MEDIA & TECHNOLOGY SKILLS**	**LIFE & CAREER SKILLS**	**Productivity and Accountability**
Creativity and Innovation	Information Literacy	Flexibility and Adaptability	☐ Manage Projects
☒ Think Creatively	☐ Access and Evaluate Information	☐ Adapt to Change	☐ Produce Results
☐ Work Creatively with Others	☐ Use and manage Information	☐ Be Flexible	Leadership and Responsibility
☐ Implement Innovations	Media Literacy	Initiative and Self-Direction	☐ Guide and Lead Others
Critical Thinking and Problem Solving	☐ Analyze Media	☐ Manage Goals and Time	☐ Be Responsible to Others
☐ Reason Effectively	☐ Create Media Products	☐ Work Independently	
☐ Use Systems Thinking	Information, Communications and Technology (ICT Literacy)	☐ Be Self-Directed Learners	
☐ Make Judgments and Decisions	☐ Apply Technology Effectively	Social and Cross-Cultural	
☐ Solve Problems		☐ Interact Effectively with Others	
Communication and Collaboration		☐ Work Effectively in Diverse Teams	
☐ Communicate Clearly			
☐ Collaborate with Others			

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

Materials

- Card stock or construction paper – 2 pieces of $9" \, x \, 12"$ for each student
- Scissors – 1 pair for each pair of students
- Rulers and/or measuring tape
- compass
- Tape or glue sticks
- Beans

Set-Up Required:

- To do this lab effectively you will need flat worksurfaces (desks) for construction and using the models. The classroom is an appropriate venue for this.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- For this lab the students will be working together creatively to create the cylinder and the cone.

Cooperative Learning:

- For this lab the students will be placed in pairs to construct the cylinder and cone.

Expectations:
- My expectation for this lab are for students to derive the formula for volume of cones.
- **Formative Assessment**: While students are doing this lab, I will be walking around monitoring to check their progress. There will also be follow-up questions after the lab to check for understanding.

Timeline:
- Construction of the cylinder and cone should take about 20 minutes and about 15 minutes for the comparison of the volumes.

<u>Post Lab Follow-Up/Conclusions:</u>

Discuss real world application of learning from lab
- Real world applications would be any field that requires employees to be able to follow directions working with peers to construct a product.

Career Applications
- Any which require people to solve problems and build a product

Optional or Extension Activities
- This activity can be modified to include cylinders and cones of different size radii and heights. You could ask students to create a cylinder and cone with the same volume but different radii and heights. You could also use different materials and use water (or colored water so it shows up better) to find the volume of the cylinder and cone to compare them.
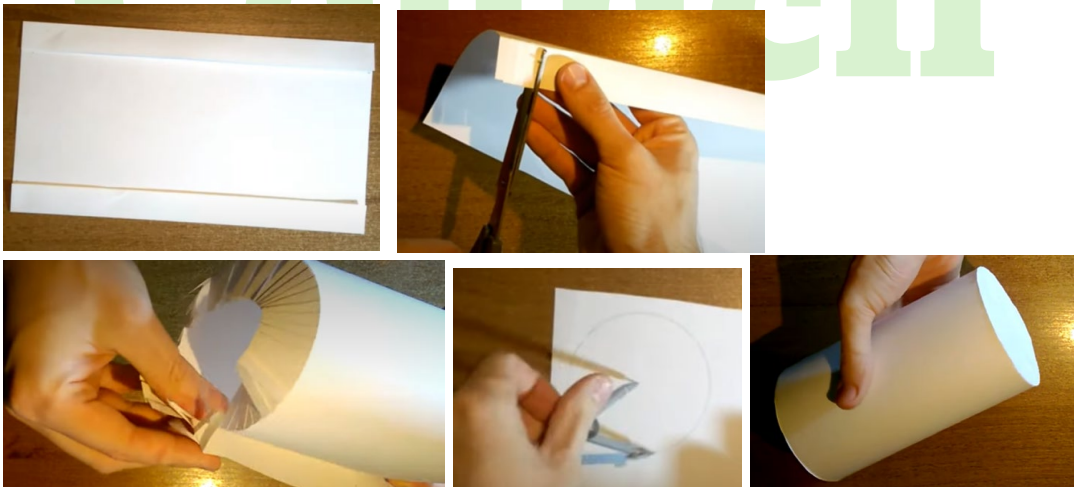
Name: _____ **Date:** _____ **Period:** _____

Volume of Cylinders & Cones Lab Instructions

Materials:

- Card stock or construction paper – 2 pieces of $9" \, x \, 12"$ for each student
- Scissors – 1 pair for each pair of students
- Rulers and/or measuring tape
- compass
- Tape or glue sticks
- Beans

1. Gather all materials from the materials list above.

2. Create a cylinder by using the paper, scissors, ruler, compass, and tape or glue. The cylinder should have a circular base with the radius of 3 cm. and a height of 6 cm. Using the compass with the paper, create a circle for the base of the cylinder with a radius of 3 cm. Then, create the lateral surface of the cylinder by cutting out a rectangle with a width of 9 cm and a length of 18 cm. Use scissors to cut 1.5 cm strips along each edge of the 18 cm width of the paper. (see picture below). Fold the paper around until you have created a cylinder with a diameter of 6 cm. Tape or glue the circular base to the lateral surface to form the cylinder by glueing or taping the strips to the base (see picture below).

3. Create a cone using the paper, scissors and tape or glue. The cone should have a radius of 3 cm and height of 6 cm. (see pictures below). When drawing your circle, it should have 6.5 cm radius (13 cm diameter) to account for the design and how it's folded.

4. Take the cone and fill it with beans. Then pour the beans into the cylinder.

5. Continue to fill the cone with beans and pour it into the cylinder until the cylinder is full.

6. Repeat step #4 at least 2 more times.

7. Answer the follow-up lab questions on the next page.

https://wa-appliedmath.org/

Volume of Cylinders & Cones Lab Questions

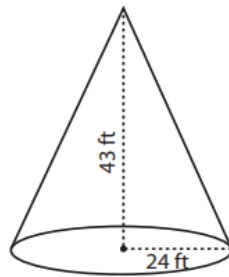1) Based on your experiment, how many cones will fill a cylinder with the same radius and height?

2) If the formula for the volume of a cylinder is $V = \pi r^2 h,$ what is the formula for the volume of a cone (hint: use your answer from #1 and think inverse)?

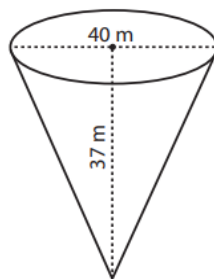3) Use the formula to find the volume of the cone in the picture:

43 ft
24 ft

Volume = _____

4) Use the formula to find the volume of the cone in the picture:

40 m
37 m

Volume = _____

Volume of Cones Assessment

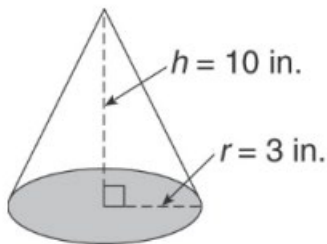1) Based on your experiment, how many cones will fill a cylinder with the same radius and height?

2) If the formula for the volume of a cylinder is $V = \pi r^2 h,$ what is the formula for the volume of a cone (hint: use your answer from #1 and think inverse)?

3) Use the formula to find the volume of the cone in the picture:

$h = 10$ in.

$r = 3$ in.

4) Darius and Annabelle decided to go get ice cream. Darius ordered a cone with a radius of 2 cm and a height of 8 cm. Annabelle ordered a cylindrical bowl with a radius of 4 cm and height of 5 cm. If both the cone and the bowl were filled to the top, who got more ice cream?