Co-Teaching Planning Guide

Date: 4/19/2016 **Co-Teachers:** Jenna Convalle and Kirsti Jenkins

Grade Level / Content: 8th Grade Geometry

Lesson Objectives:

Students will…

- Explore cylinders in depth to find the formula for the volume.
- Compare the volumes of cones and spheres to the volume of cylinders.
- Use these comparisons to find the formulas for the volume of cones and spheres.

Content Standards Addressed:

CCSS.Math.Content.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.

Co-Teaching Model(s) used: (check all that apply)

☐ Parallel
☐ Station
☐ Alternative
☐ Team

Materials needed for the lesson:

- Play-dough
- Hard, bendable plastic
- Scissors
- Tape
- Rulers
- Rice

Scaffolds needed for the lesson:

Students need to know:

- General formulas for the volume of prisms (surface area X height).
- Formula for the area of a circle.

UDL Principles used for the lesson:

- Engagement:
  - Vary demands and resources to optimize challenge.
    - The students will be interested in the unit since they get to use manipulatives.
- Representation:
  - Highlight patterns, critical features, big ideas, and relationships.
    - The students will draw connections between the volumes of different shapes.
  - Guide information processing, visualization, and manipulation.
    - The students will be able to show the volume of these shapes in multiple different representations:
      - Physical shapes
      - Equations
      - Real-life situations
- Action and Expression
  - Enhance capacity for monitoring progress.
    - Since the students are split into smaller groups, as teachers, we will be more able to monitor their progress in discovery learning.

How is the student learning assessed?

With 5 minutes left of class, we will post a real-life scenario about the volume of these shapes for the students to answer individually. When they have finished, they will turn it in to one of us and be allowed to leave.

Guide for expectations for each teacher during the lesson

	Teacher:_____Jenna Convalle_____	**Teacher:____Kirsti Jenkins_____**
What are the specific tasks that I do **BEFORE** the lesson?	• Before the lesson, we will perform the following activity while thinking of what common misconceptions may arise, as well as how to address them.	• Before the lesson, we will perform the following activity while thinking of what common misconceptions may arise, as well as how to address them.

	• Before the students get there, we will make sure to have all of the necessary materials prepared for the day.	• Before the students get there, we will make sure to have all of the necessary materials prepared for the day.
What are the specific tasks that I do **DURING** the lesson?	**CUE:** • While Kirsti passes out the frame, I will begin to explain it: • "Ms. Jenkins is passing out the Volume Frame to each of you. Since this is not our first frame, you should be used to this format. During today's lesson, we will begin, as a class, with an exploration of cylinders to fill out the first section together. Once we all feel confident, half of you will stay with me and the other half will go with Ms. Jenkins. My group will explore the volume of cones and Ms. Jenkins' group will explore the volume of spheres. After 15 minutes in these groups, you will switch to the other teacher in order to complete the entire frame." **DO:**	**CUE:** • Pass out a "blank" frame to each of the students. **DO:** • We will begin filling out the frame with the use of the ELMO. • "As you can see from the top of my frame and from what Ms. Convalle said, we will be discussing the volume of cylinders, cones, and spheres today." • "Based on your prior knowledge of volume, what do you think this lesson will be about?"

		• *Natural commentary from students.* • Once the class has discussed, we will fill out the "is about" section. • At this point, the "key topic", "is about", and "main idea" sections should be filled out.
	• "By looking at our "is about" statement, how do you think 2-dimensional shapes will be used to find the volume of a cylinder?" • *Natural commentary* • During this discussion, we expect to focus on the concept of *Volume = Surface Area x Height* • "Looking at the cylinder I have put on the board, what is the base shape?"	• At this point, we expect it to be necessary to go into a small recap of the area of a circle that I will lead. • "Now that we all remember how to find the area of a circle, how can we use that to find the volume of a cylinder?" • *Natural commentary* • We expect to arrive at the final equation: $V = \pi r^2 h$ • We will now split the class randomly in half.
	• Pass out all materials needed to construct their 3-dimensional shapes. • Instruct students to first construct a cylinder from the hard, bendable	• Pass out all materials needed to construct their 3-dimensional shapes. • Instruct students to first construct a cylinder from the hard, bendable

	plastic. • Make sure students know to keep a good record of the dimensions of *each* shape (i.e. height, radius, etc.). • **My group is cylinders and cones.** • Instruct students to construct a cone with the same height and radius as the cylinder from the hard, bendable plastic. • "From here, we will fill your cone with rice." • "Before doing anything, how many cones of rice do you think it will take to fill 1 cylinder with rice?" • *Natural commentary* • "Let's try!" • Students will come to the conclusion that it takes three cones to fill a cylinder with the same height and radius. • "Based off of this discovery, what do you think the formula for the volume of a cone is?" • Students should decide on the formula: $V = \pi r^2 \frac{h}{3}$ • "Take a moment to fill out the "Cones" section of your frame." • As a group, before they leave, we will make sure everyone has the right information. • At the end of this 15 minute section, we will switch groups and perform the same steps with the other half of the class.	plastic. • Make sure students know to keep a good record of the dimensions of *each* shape (i.e. height, radius, etc.). • **My group is cylinders and spheres.** • Instruct students to construct a sphere from the play-dough with the same radius (and height) as the cylinder. This sphere should fit perfectly inside the cylinder. • "Squish your sphere so that it fills the bottom of the cylinder like so (do example)." • "Use your ruler to measure the height of the play-dough." • "How does that relate to the height of your cylinder?" • Students should decide this is 2/3 the height of the cylinder. • "For us to see this a little easier, we will rewrite the formula for the volume of a cylinder in terms of the diameter instead of the radius. What would we get?" • *Students should get the equation:* $V_{cylinder} = \pi r^2 2r$ or $V_{cylinder} = 2\pi r^3$ • "Since we see that the "sphere" takes up 2/3 of the cylinder, how can we write the formula for the sphere based on the cylinder?" • *Students should arrive at:* $V_{sphere} = \frac{2}{3}(2\pi r^3)$ or

		$V_{sphere} = \frac{4}{3}\pi r^3$ • "Take a moment to fill out the "Spheres" section of your frame." • As a group, before they leave, we will make sure everyone has the right information. • At the end of this 15 minute section, we will switch groups and perform the same steps with the other half of the class.
	REVIEW: • When both groups are done, we will bring the class back together for a large group discussion. • I will have the fully completed Volume Frame displayed on the ELMO, including the "So What?" section. • "Take a second to check your answers and fill out the "So What?" section of your Frame." • "With a partner, give at least one example each of how you saw the "So What?" section in today's activity." • Write real-life scenario on the board.	**REVIEW:** • When both groups are done, we will bring the class back together for a large group discussion. • At this time, we will take questions from students and make sure that everyone fully understands how to develop the formulas for the volume of cylinders, cones, and spheres. • "For your exit slip for the day, answer the question that Ms. Convalle has

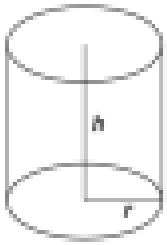
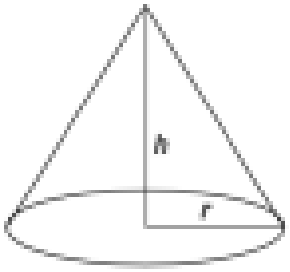
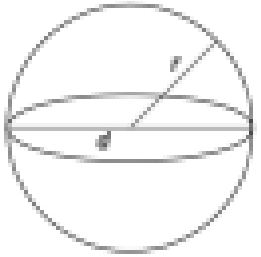
		written on the board individually. You may use only your frame and a calculator (if necessary) as an aid. Before leaving class, make sure you turn it in."
What are the specific tasks that I do **AFTER** the lesson?	• We will reflect on the lesson and use their exit slips to determine where the students are in terms of the lesson. • If necessary, we will provide more information on this concept the following class.	• We will reflect on the lesson and use their exit slips to determine where the students are in terms of the lesson. • If necessary, we will provide more information on this concept the following class.

The FRAME Routine

Key Topic
Volume

is about...

Developing 3-dimensional reasoning based on their prior knowledge of 2-dimensional shapes

	Main idea: Cylinders	Main idea: Cones	Main idea: Spheres
	Essential details	**Essential details**	**Essential details**
Picture			
What is needed	Radius and height	Radius and height	Radius
Formula	$V = \pi r^2 h$	$V = \pi r^2 \frac{h}{3}$	$V = 4\pi \frac{r^3}{3}$

So What? (What's important to understand about this?)

The most important aspect of this lesson is for students to explore cylinders, cones, and spheres to discover the formulas for the volume and why they make sense in relation to the physical object.