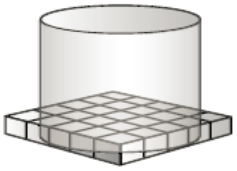
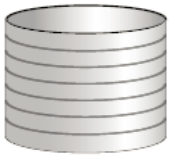
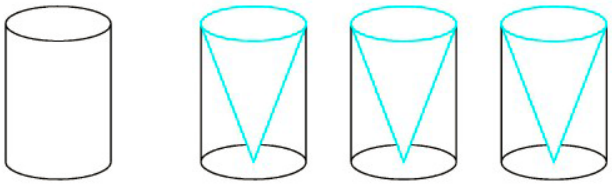
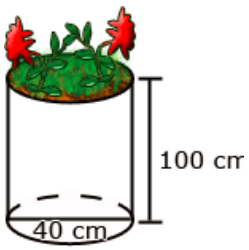
Unit 14: Volume

Cluster: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

Nevada Academic Content Standard	What does this standard mean that a student will know and be able to do? (adapted from North Carolina *8th Grade Standards, Unpacked 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.	***8.G.9*** Students build on understandings of circles and volume from 7th grade to find the volume of cylinders, finding the area of the base πr^2 and multiplying by the number of layers (the height).  Estimate the number of unit cubes in one layer.  And multiply by the number of layers. $V = \pi r^2 h$ *Students understand that the volume of a cylinder is 3 times the volume of a cone having the same base area and height or that the volume of a cone is $\frac{1}{3}$ the volume of a cylinder having the same base area and height.*  $V = \frac{1}{3}\pi r^2 h$ A sphere can be enclosed with a cylinder, which has the same radius and height of the sphere (Note: the height of the cylinder is twice the radius of the sphere). If the sphere is flattened, it will fill $\frac{2}{3}$ of the cylinder. Based on this model, students understand that the volume of a sphere is $\frac{2}{3}$ the volume of a cylinder with the same radius and height. The height of the cylinder is the same as the diameter of the sphere or 2r. Using this information, the formula for the volume of the sphere can be derived in the following way: $V = \pi r^2 h$ *cylinder volume formula* $V = \frac{2}{3}\pi r^2 h$ *multiply by $\frac{2}{3}$ since the volume of a sphere is $\frac{2}{3}$ the cylinder's volume* $V = \frac{2}{3}\pi r^2 2r$ *substitute 2r for height since 2r is the height of the sphere* $V = \frac{4}{3}\pi r^3$ *simplify* Students find the volume of cylinders, cones and spheres to solve real world and mathematical problems. Answers could also be given in terms of pi.

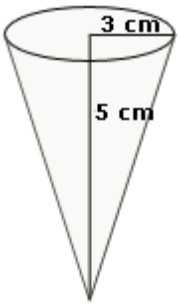
Example 1:
James wanted to plant pansies in his new planter. He wondered how much potting soil he should buy to fill it. Use the measurements in the diagram below to determine the planter's volume.



cylindrical planter

Solution:
$V = \pi r^2 h$
$V = 3.14\ (20)^2(100)$
$V = 125{,}600\ cm^3$
The answer could also be given in terms of π:
$V = 40{,}000\pi\ cm^3$

Example 2:
How much yogurt is needed to fill the cone to the right? Express your answers in terms of pi.



Solution:
$V = \frac{1}{3}\pi r^2 h$
$V = \frac{1}{3}\pi(3)^2(5)$
$V = \frac{1}{3}\pi(45)$
$V = 15\ \pi\ cm^3$

Example 3:
Approximately, how much air would be needed to fill a soccer ball with a radius of 15 cm?

Solution:
$V = \frac{4}{3}\pi r^3$
$V = \frac{4}{3}\pi(15)^3$
$V = 4500\pi\ cm^3$

"Know the formula" does not mean memorization of the formula. To "know" means to have an understanding of **why** the formula works and how the formula relates to the measure (volume) and the figure. This understanding should be for all students.

Note: At this level composite shapes will not be used and only volume will be calculated.

Approximate Time Frame: *1 week*

Terms:

- ✓ volume
- ✓ cylinder
- ✓ cone
- ✓ sphere
- ✓ radius
- ✓ diameter
- ✓ area
- ✓ base
- ✓ pi

Resources

MGH – McGraw Hill, Glencoe Math (2015)
ML – McDougal Littell, Pre-Algebra Book; Larson, 2005
EX – Explorations in Core Math (Holt McDougal)
NY – *Engage* New York
LZ – Learn Zillion Website
MAP – Math Assessment Project (MARS)

	Suggested Topics for Lessons	***Suggested Resources***
8.G.C.9	**Volume** SBAC Evidence: ➢ The student solves real-world problems by applying the formulas for the volumes of cylinders, cones, and spheres. ➢ The student solves mathematical problems by applying the formulas for the volumes of cylinders, cones, and spheres.	➢ MGH 8-1 Inquiry Lab*: Three-Dimensional Figures* (page 587) ➢ MGH 8-1 *Volumes of Cylinders* (page 589) ➢ MGH 8-2 *Volumes of Cones* (page 597) ➢ MGH 8-3 *Volumes of Spheres* (page 605) ➢ (Review/prep) EX 6-1 *Circles* (page 229) ➢ ML 10.7 *Volumes of Prisms and Cylinders* (page 552) ➢ ML 10.8 *Volumes of Pyramids and Cones* (page 558) ➢ EX 6-2 *Volumes if Prisms and Cylinders* (page 235) ➢ EX 6-3 *Volumes of Pyramids and Cones* (page 239) ➢ EX 6-4 *Spheres* (page 243) ➢ NY Module 5, Topic B, Lessons 10: Volumes of Familiar Solids ➢ NY Module 7, Topic D, Lessons 19: Cones and Spheres ➢ NY Module 5, Topic B, Lessons 11: Volume of a Sphere ➢ MathletePearce: *Visualizing the Volume of a Cylinder Formula* ➢ MathletePearce: *How Many Cones Does it Take to Fill a Cylinder?* ➢ MathletePearce: *Visualizing the Volume of a Sphere Formula* ➢ YouTube*: Common Core in the Classroom: Finding the Volume of Cylinders, Cones, and Spheres* ➢ PBS Learning Media: *School Yourself Geometry: Cone Volume* ➢ NC Dept of Instruction: *Gift Box Dilemma (page 55)* ➢ NC Dept of Instruction: *Meltdown (page 63)* ➢ Louisiana Dept of Ed Math Guide Book: *Tank Volume (page 196)* ➢ Yummy Math: *World Largest Cup of Coffee* ➢ MAP Assessment Lesson: *Making Matchsticks* ➢ MAP Assessment Lesson: *Estimating and Sampling: Jellybeans* ➢ Emergent Math: *Let them get it wrong: Caloric Quandary* ➢ LZ Lesson Set: *Know and use the formulas for volume of cones, cylinder, spheres* ➢ LZ Lesson Set: *Find volumes of cones, cylinders, and spheres* ➢ LZ Lesson Plan: *Model solns to real-world problems involving volume of a cone* ➢ LZ Lesson Plan: *Model solns to real-world prob involving the volume of a cylinder* ➢ LZ Lesson Plan: *Model solns to real-world prob involving the volume of a sphere*