Unit 4 Title	**Estimated Time Frame**
Pythagorean Theorem, Surface Area, and **Volume**	**30 days** (includes a week of radical review and option to revisit Bivariate Data as review)

Big Idea (s)

Understand and apply the Pythagorean Theorem.
Solve real-world mathematical problems involving the volume of cylinders, cones, and spheres.

Essential Question(s)

How can you use the Pythagorean Theorem to solve problems?
How do models help solve math problems?
Why is the Pythagorean Theorem considered to be the most important mathematical equation?
How are the formulas for cylinder, cone, and sphere volume related?
How do models help calculate the volume of cylinders, cones, and spheres?

Standards for Mathematical Practice (MP.) - The practice standards in bold describe expertise to be intentionally developed in this unit.	**Kentucky Interdisciplinary Literacy Practices (KILP.) -** The practice standards in bold describe expertise to be intentionally developed in Mathematics.
MP.1. Make sense of problems and persevere in solving them. **MP.2. Reason abstractly and quantitatively.** **MP.3. Construct viable arguments and critique the reasoning of others.** **MP.4. Model with mathematics.** **MP.5. Use appropriate tools strategically.** MP.6. Attend to precision. **MP.7. Look for and make use of structure.** **MP.8. Look for and express regularity in repeated reasoning.**	KILP.1 Recognize that text is anything that communicates a message. KLIP.2 Employ, develop, and refine schema to understand and create text. KILP.3 View literacy experiences as transactional, interdisciplinary and transformational. KILP.4 Utilize receptive & expressive language arts to better understand self, others, and the world. KILP.5 Apply strategic practices, with scaffolding & then independently, to approach new literacy tasks. **KILP.6 Collaborate with others to create new meaning.** **KILP.7 Utilize digital resources to learn and share with others.** **KILP.8 Engage in specialized, discipline specific literacy practices.** **KILP.9 Apply high level cognitive processes to think deeply and critically about text.** 10.Develop a literacy identity that promotes lifelong learning.

Common Preconceptions/Misconceptions

Make sure students understand the Pythagorean Theorem can be used to find missing sides for triangles that are right triangles ONLY.

Students may confuse the formulas for the volumes of cones, cylinders, and spheres if they are asked to memorize them without any understanding of

why they make sense. Time should be spent on the derivations and have students physically take part in making *self-discoveries.*

KAS Standards	Prerequisite Skill, Considerations, and Coherence	Samples of Learning Intentions and Success Criteria
KY.8.G.6 Explain a proof of the Pythagorean Theorem and its converse. **MP.3, MP.7, KILP.1, KILP.2, KILP.8**	**Considerations:** Students verify, using a model, that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Students understand if the sum of the squares of the two smaller legs is equal to the square of the third leg, then the triangle is a right triangle. Coherence KY.7.G.6→ KY.8.G.6→KY.HS.G.11	We are learning to understand the Pythagorean Theorem **(Lessons 7-1, 7-2)** ● I can use the Pythagorean Theorem to find an unknown side length (leg or hypotenuse) of a right triangle. We are learning about the converse of the Pythagorean Theorem. **(Lessons 7-1, 7-2)** ● I can use the converse of the Pythagorean Theorem to identify right triangles.
KY.8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **MP.1, MP.2, MP.4**, **KILP.3, KILP.9**	**Considerations:** Students apply the Pythagorean Theorem to real-world mathematical problems. Coherence KY.8.G.7→KY.HS.G.12	We are learning to apply my knowledge of the Pythagorean Theorem to solve real-world problems. **(Lesson 7-3)** ● I can use the Pythagorean Theorem to verify right triangles and solve real-world problems.
KY.8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **MP.5, MP.6, KILP.2, KILP.8**	**Considerations:** Students calculate distances on the coordinate plane between two non-vertical or non-horizontal points by applying the Pythagorean Theorem. Students calculate distances between two non-vertical or non-horizontal points not given on a coordinate plane by applying the Pythagorean Theorem to absolute horizontal and vertical distances the student calculates. Coherence KY.8.G.8→ KY.HS.G.21	We are learning to apply the Pythagorean Theorem to find distances on a coordinate plane. **(Lesson 7-4)** ● I can plot points on a coordinate plane to form a right triangle. ● I can determine the lengths of the legs of the triangle. ● I can use the Pythagorean Theorem to determine the triangle's hypotenuse, which is the distance between the two original points.

KY.8.G.9 Apply the formulas for the volumes and surface areas of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. **MP.1, MP.7, MP.8, KILP.3, KILP.5, KILP.9** **Cones:** *V ISA* **Cylinders:** *V ISA* **Spheres:** *V ISA*	Cones: $V = \frac{1}{3}\pi r^2 h \quad SA = \pi r\,(r + \sqrt{(r^2 + h^2)})$ Cylinders: $V = \pi r^2 h \quad SA = 2\pi rh + 2\pi r^2$ Spheres: $V = \frac{4}{3}\pi r^3 \quad SA = 4\pi r^2$ Coherence KY.7.G.4→ KY.8.G.9→ KY.HS.G.25	We are learning how to find the surface area of three-dimensional figures. **(Lesson 8-1)** ● I can use the net and formulas for the two-dimensional parts of a cylinder, or the formula SA= 2πr²+(2πr)h, to find the surface area. ● I can use the formula SA= πr² + πrℓ (where ℓ is the slant height) to find the surface area of a cone. ● I can use the formula SA= 4πr² to find the surface area of a sphere. We are learning how to find the volume of three-dimensional figures. **(Lesson 8-2, 8-3, 8-4)** ● I can relate the volume of a rectangular prism, V= area of base x height, to the volume of a cylinder. ● I can use the formula V= πr²h to find the volume of a cylinder. ● I can relate the volume of a cone to the volume of a cylinder, ● I can use the formula V= ⅓ πr²h to find the volume of a cone. ● I can use the formula V = 4/3πr²h to find the volume of a sphere.
8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association **MP.2, MP.7, KILP.2, KILP.3, KILP.10**	**Considerations:** For example, given the data and scatter plot to the left, students explain the relationship between students' absences and math scores shows a negative, linear association and has no obvious outliers Coherence KY.8.SP.1→ KY.HS.SP.8	We are learning to construct and interpret scatterplots. (**Lesson 4-1**) **(option to revisit)** ● I can determine ordered pairs for a set of data. ● I can plot ordered pairs on a coordinate grid ● I can describe the association of a scatter plot as positive, negative, or no association.
8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and	**Considerations:** Students are informally fitting a line to data; they judge whether or not a given line is a good fit for the data and describe	We are learning to analyze linear associations. (**Lesson 4-2**) **(option to revisit)** ● I can determine whether the paired data has a linear association, nonlinear association, or no association.

informally assess the model fit by judging the closeness of the data points to the line. **MP.2, KILP.7, KILP.8**	needed adjustments. Recognize some scatter plots cannot be described by a line. Coherence KY.8.SP.2→ KY.HS.SP.8	• I can draw a trend line to determine if the linear association is positive or negative. • I can determine if the data has a strong or weak association by judging the closeness of the data points on the scatter plot to the line of “Best Fit” (trend line).
8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. **MP.2, MP.4, KILP.5, KILP.8**	**Considerations:** For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height and an initial value of 4 cm means the plant was 4 cm tall when measuring began. Coherence KY.8.SP.3→ KY.HS.SP.7	We are learning to use the equation of a linear model to make predictions and solve problems. (**Lesson 4-3**) **(option to revisit)** • I can write an equation for the trend line of a scatter plot. • I can use the trend line of a scatter plot to make predictions. • I can interpret the slope (rate of change) and the y-intercept of the trend line on the scatter plot.

Essential Vocabulary

converse - The interchanging of the "if" and "then" parts of a conditional statement.
Pythagorean Theorem - "The theorem that relates the three sides of a right triangle: a^2 + b^2 = c^2".
right triangle - A triangle in which one angle is a right angle. The relation between the sides and angles of a right triangle is the basis for Trigonometry.
area
volume
base
center
cone
cylinder
sphere
diameter
radius
height
pi

Common Assessment
Common Assessment Unit 4 Grade 8 Math

Anchor Resources

enVision Topic 7 – Understand and Apply Pythagorean Theorem	**enVision Topic 8 – Solve Problems Involving Surface Area & Volume**	**enVision Topic 4 - Investigate Bivariate Data (option to revisit)**
MILC - MILC Topic 7 resources - **MILC Pythagorean Theorem Resources** **FAL** (one per semester): Discovering the Pythagorean Theorem - Finding the Shortest Route: A Schoolyard Problem **3 Act Math Task: Go with the Flow** NOTE - (One additional week review of radicals included) **Lesson 7-1: (3) days** ● Day 1 solve for a leg ● Day 2 solve for the hypotenuse ● Day 3 real-world	**MILC -** MILC Topic 8 resources **MILC Surface Area and Volume Resources** Move 8-1 to end of the unit (after 8-4) **3-Act Math: Measure Up**	**MILC -** MILC Topic 4 resources **MILC Topic 4 Resources**

*Disclaimer: Success Criteria is the evidence students must produce to demonstrate learning. This example is not comprehensive.

** Mathematical Practices (A.MP.1- 8) should be evidenced throughout each unit, depending on the explored tasks.