Kentucky Academic Standards for Mathematics: Conceptual Category Geometry

Geometry Overview

Congruence	Similarity, Right Triangles and Trigonometry	Circles	Expressing Geometric Properties with Equations	Geometric Measurement and Dimensions	Modeling with Geometry
• Experiment with transformations in the plane. • Understand congruence in terms of rigid motions. • Prove geometric theorems. • Make geometric constructions.	• Understand similarity in terms of similarity transformations. • Prove theorems involving similarity. • Define trigonometric ratios and solve problems involving right triangles. • Apply trigonometry to general triangles.	• Understand and apply theorems about circles. • Find arc lengths and areas of sectors of circles.	• Translate between the geometric description and the equation for a conic section. • Use coordinates to prove simple geometric theorems algebraically.	• Explain volume formulas and use them to solve problems. • Visualize relationships between two-dimensional and three-dimensional objects.	• Apply geometric concepts in modeling situations.

Modeling Standards: Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards. Making mathematical models is a Standard for Mathematical Practice and specific modeling standards appear throughout the high school standards indicated by a star symbol (★). The star symbol sometimes appears on the heading for a group of standards; in that case, it should be understood to apply to all standards in that group.

Plus (+) Standards: Additional mathematics concepts students should learn in order to take advanced courses such as calculus, advanced statistics or discrete mathematics are indicated by (+) symbol.

Geometry-Congruence	
Standards for Mathematical Practice	
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.

Cluster: Experiment with transformations in the plane.

Standards	Clarifications
KY.HS.G.1 Know and apply precise definitions of the language of Geometry: a. Understand properties of line segments, angles and circle. b. Understand properties of and differences between perpendicular and parallel lines. **MP.3**, **MP.6**	Students in high school start to formalize the intuitive geometric notions they developed in grades 6–8 and give specificity to geometric concepts that can serve as a good basis for developing precise definitions and arguments. a. Students understand a more formal knowledge of postulates, theorems and various properties relating to line segments, angles and circles. This knowledge is based on the undefined notions of point, line, distance along a line and distance around a circular arc. b. Students understand important properties of both parallel and perpendicular lines, prior to making the connections between these types of lines and how they relate to their calculated or given slope.
KY.HS.G.2 Representing transformations in the plane. a. Describe transformations as functions that take points in the plane as inputs and give other points as outputs b. Compare transformations that preserve distance and angle measures to those that do not. c. Given a rectangle, parallelogram, trapezoid, or regular polygon, formally describe the rotations and reflections that carry it onto itself, using properties of these figures. **MP.5**, **MP.7**	Software, transparencies, etc. may be used to accurately represent congruence transformations in the plane. a. Students understand any point (a,b) can be thought of as an input and any image of point (a,b) can be thought of as the output of a specific transformation function. b. Students make connections between which transformations are a rigid motion (isometry) and which transformations do not have that characteristic. c. Students practice and understand the procedures needed to carry out multiple transformations that carry the figure onto itself, recognizing the important properties of these figures.

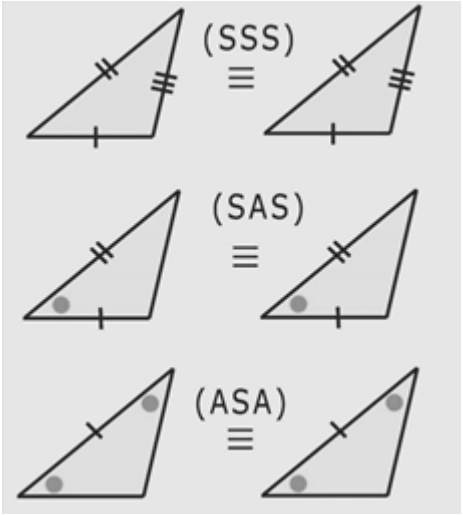
Standards	Clarifications
KY.HS.G.3 (+) Develop formal definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments. **MP.6**, **MP.7**	Students understand and recognize characteristics of various transformations of multiple different geometric figures. Students develop formal definitions that reflect those transformations.
KY.HS.G.4 Understand the effects of transformations of geometric figures. a. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. b. Specify a sequence of transformations that will carry a given figure onto another. c. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure. Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. **MP.2**, **MP.8**	Students understand a figure, called a pre-image, is congruent to another figure, called the image, if that second figure can be obtained by a sequence of congruence transformations performed on the first figure. Students can draw the image of a transformed pre-image using a variety of tools, including but not limited to: • graph paper • manipulatives • tracing paper • computer programs Students perform such sequences and describe the sequence of congruence transformations necessary to transform one figure to an congruent second figure.

Attending to the Standards for Mathematical Practice

Students make careful calculations when transforming figures by hand (**MP.6**) and use technology (**MP.5**) to analyze more complicated cases and to make generalizations (**MP.7**). Students use correct terminology when discussing figures and the effects of their transformed figure (**MP.3, MP.6**), identifying congruent, distance-preserving, figures when possible. For example, students connect geometric transformations with algebra when comparing a figure *F* and the transformed figure *T(F)* or a figure that has undergone multiple transformations *T(R(F))* (**MP.2**).

Geometry-Congruence	
Standards for Mathematical Practice	
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.

Cluster: Understand congruence in terms of rigid motions.

Standards	Clarifications
KY.HS.G.5 Know and apply the concepts of triangle congruence: a. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. b. Explain how the criteria for triangle congruence (ASA, SAS and SSS) follow from the definition of congruence in terms of rigid motions. **MP.3**, **MP.6**	

Attending to the Standards for Mathematical Practice
Students fluently and intentionally select and/or calculate measures (**MP.6**) when deliberating criteria for triangle congruence (**MP.3**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Congruence	
Standards for Mathematical Practice	
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.

Cluster: Prove geometric theorems.

Standards	Clarifications
KY.HS.G.6 Apply theorems for lines, angles, triangles, parallelograms. **MP.2**, **MP.3**	Students use previously learned definitions, theorems, postulates and properties of lines, angles, triangles and parallelograms to draw conclusions and to make inferences. Theorems for lines and angles include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints. Theorems for triangles include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point. Theorems for parallelograms include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other and conversely, rectangles are parallelograms with congruent diagonals.
KY.HS.G.7 Prove theorems about geometric figures. a. Construct formal proofs to justify theorems for lines, angles and triangles. b. (+) Construct formal proofs to justify theorems for parallelograms. **MP.6**, **MP.7**	Students recall definitions, theorems, postulates and properties to construct formal proofs based on theorems established in other standards. (+)Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other and conversely, rectangles are parallelograms with congruent diagonals.

Attending to the Standards for Mathematical Practice
Students experiment with lines, angles, triangles and parallelograms to make connections and conjectures about their properties (**MP.7**), using dynamic software when appropriate (**MP.5**). Students routinely use various forms of proof (formal, informal, direct and indirect) to outline their logic and defend their conjectures (**MP.3**). Students consider alternate approaches to a proof or a conjecture and debate the alternatives for effectiveness and accuracy (**MP.2**, **MP.3**).

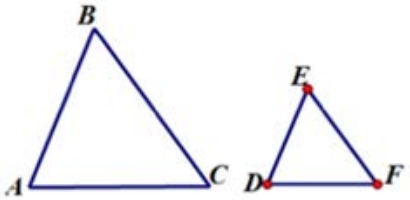
The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Congruence	
Standards for Mathematical Practice	
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.
Cluster: Make geometric constructions.	
Standards	**Clarifications**
KY.HS.G.8 Create and apply geometric constructions. a. Make formal geometric constructions with a variety of tools and methods. b. Apply basic construction procedures to construct more complex figures. **MP.5**, **MP.6**	Methods for formal constructions may include but are not limited to: • compass and straightedge • string • reflective devices • paper folding • technology Students demonstrate the ability to copy a segment, copy an angle, bisect a segment, bisect an angle, construct perpendicular lines which includes the perpendicular bisector of a line segment and construct a line parallel to a given line through a point not on the line.
Attending to the Standards for Mathematical Practice	
Students select and use a variety of tools to generate geometric constructions (**MP.5**). Students use precision when constructing shapes and figures by hand and select and use appropriate technology for complicated constructions (**MP.5, MP.6**).	

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Similarity, Right Triangles and Trigonometry	
Standards for Mathematical Practice	
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.

Cluster: Understand similarity in terms of similarity transformations.

Standards	Clarifications
KY.HS.G.9 Understand properties of dilations. a. Verify the properties that result from that dilations given by a center and a scale factor. b. Verify that a dilation produces an image that is similar to the pre-image. **MP.5**, **MP.7**	• Methods to verify properties could include, but not limited to: scale models, moving an object closer to a light source and examining changes, changing the scale factor on a copier. • Students explain the effect of dilations on objects that pass through the center verses those that do not pass through the center of a figure. • Students understand within this standard, the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides is a result that occurs because two objects are similar.
KY.HS.G.10 Apply the properties of similarity transformations to establish the AA criterion for two triangles to be similar. **MP.3**, **MP.6**	The AA Similarity Theorem  If $\angle A \cong \angle D, and\ \angle B \cong \angle E,$ Then $\Delta ABC \sim \Delta DEF.$

Attending to the Standards for Mathematical Practice

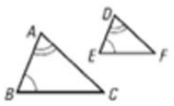
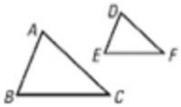
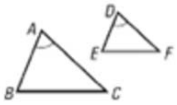
With the aid of physical models, transparencies and geometry software, students verify whether figures are similar or not (**MP.5**, **MP.6**). As they compare similar shapes, they make generalizations about what changes and what stays the same when, and use this information to do dilations (**MP.7**). Students prepare illustrations and explanations related to the AA triangle similarity criterion, as well as by considering and discussing properties of similar triangles (**MP.3**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Similarity, Right Triangles and Trigonometry	
Standards for Mathematical Practice	
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.

Cluster: Prove theorems involving similarity.

Standards	Clarifications
KY.HS.G.11 Understand theorems about triangles. a. Apply theorems about triangles. b. (+) Prove theorems about triangles. c. Use similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **MP.1**, **MP.3**	Theorems include the Pythagorean Theorem and "a line parallel to one side of a triangle divides the other two proportionally and conversely." Students demonstrate the ability to copy a segment, copy an angle, bisect a segment, bisect an angle, construct perpendicular lines, which includes the perpendicular bisector of a line segment and construct a line parallel to a given line through a point not on the line. Triangle Similarity Postulate and Theorems:

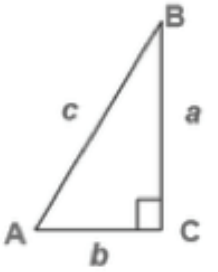
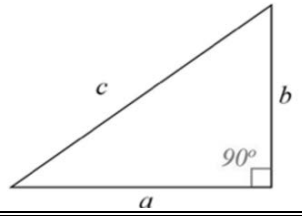
AA Similarity Postulate	SSS Similarity Theorem	SAS Similarity Theorem
		
Two triangles are similar if they have two pairs of congruent angles.	Two triangles are similar if they have three pairs of proportional sides.	Two triangles are similar if they have two pairs of proportional sides with a congruent included angle.

Attending to the Standards for Mathematical Practice

Students identify cases where the AA triangle similarity criterion can be used (**MP.1**) and routinely use various methods of proof (formal, informal, direct and indirect) to outline their logic in order to defend their conjectures (**MP.3**).

Geometry-Similarity, Right Triangles and Trigonometry	
Standards for Mathematical Practice	
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.

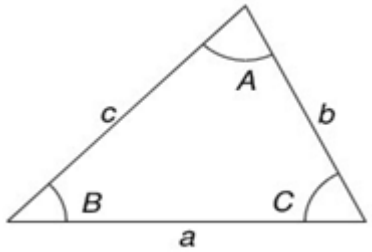
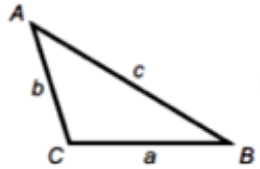
Cluster: Define trigonometric ratios and solve problems involving right triangles.

Standards	Clarifications
KY.HS.G.12 Understand properties of right triangles. a. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles (sine, cosine and tangent). b. Explain and use the relationship between the sine and cosine of complementary angles. c. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★ **MP.3**, **MP.4**	 $\sin A = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{a}{c}$ $\cos A = \frac{\text{adjacent side}}{\text{hypotenuse}} = \frac{b}{c}$ $\tan A = \frac{\text{opposite side}}{\text{adjacent side}} = \frac{a}{b}$  $c^2 = a^2 + b^2$

Attending to the Standards for Mathematical Practice

Given a variety of similar triangles, students compare ratios of corresponding pairs of sides in order to discover the definitions of trigonometric ratios for acute angles (**MP.3**). Students use these trigonometric ratio definitions to solve real-world problems involving right triangles, connecting their solutions to the problem posed (**MP.4**).

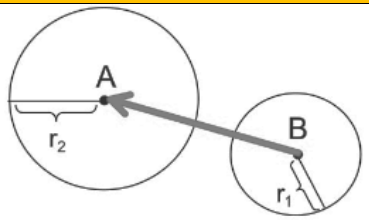
The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Similarity, Right Triangles and Trigonometry	
Standards for Mathematical Practice	
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.
Cluster: Apply trigonometry to general triangles.	
Standards	**Clarifications**
KY.HS.G.13 (+) Derive the formula $A = 1/2\ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. **MP.6**, **MP.7**	 Area of triangle = ½ ab sin(C)
KY.HS.G.14 (+) Understand and apply the Law of Sines and the Law of Cosines. a. Use the Law of Sines and Cosines to find unknown measurements in right and non-right triangles. b. Prove the Laws of Sines and Cosines and use them to solve problems. **MP.1**, **MP.3**	Law of Sines $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$ Law of Cosines $a^2 = b^2 + c^2 - 2bc\cos A$ 

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Circles	
Standards for Mathematical Practice	
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.

Cluster: Understand and apply theorems about circles.

Standards	Clarifications
KY.HS.G.15 Verify using dilations that all circles are similar. **MP.5**, **MP.8**	
KY.HS.G.16 Identify and describe relationships among angles and segments within the context of circles involving: a. Recognize differences between and properties of inscribed, central and circumscribed angles. b. Understand relationships between inscribed angles and the diameter of a circle. c. Understand the relationship between the radius of a circle and the line drawn through the point of tangency on that radius. **MP.3, MP.5, MP.7**	Students recognize and apply relationships including the relationship between central, inscribed and circumscribed angles, inscribed angles on a diameter are right angles, the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
KY.HS.G.17 (+) Apply basic construction procedures within the context of a circle. a. Construct the inscribed and circumscribed circles of a triangle. b. Construct a tangent line from a point outside a given circle to the circle. **MP.5**, **MP.6**	Students build upon skills from other standards regarding construction procedures in the context of circles.

Attending to the Standards for Mathematical Practice

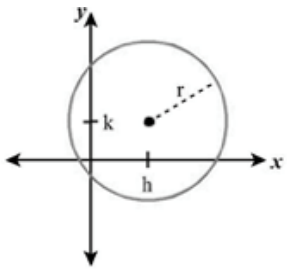
Students compare properties of a variety of circles to verify that all circles are similar (**MP.8**). Students use technology and drawings of circles to analyze properties of angles, radii and diameters that hold true across all circles (**MP.5**) and can explain these properties (**MP.3**).

Geometry-Circles	
Standards for Mathematical Practice	
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.

Cluster: Find arc lengths and areas of sectors of circles.

Standards	Clarifications
KY.HS.G.18 (+) Understand the relationship between an intercepted arc length within a circle and the radius of the circle. a. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius. Derive the formula for the area of a sector. b. Define the radian measure of the angle as the measure of a central angle that intercepts an arc equal in length to the radius of the circle. **MP.2**, **MP.3**	$\frac{\text{Area of Sector}}{\text{Area of Circle}} = \frac{\text{Central Angle}}{2\pi}$ $\frac{\text{Area of Sector}}{\pi r^2} = \frac{\text{Central Angle}}{2\pi}$ Area of Sector = $\frac{\text{Central Angle}}{2\pi} \bullet \pi r^2$ Area of Sector = $\frac{1}{2} \bullet$ Central Angle $\bullet r^2$

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Expressing Geometric Properties with Equations	
Standards for Mathematical Practice	
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.
Cluster: Translate between the geometric description and the equation for a conic section.	
Standards	**Clarifications**
KY.HS.G.19 Understand the relationship between the algebraic form and the geometric representation of a circle. a. Write the equation of a circle of given center and radius using the Pythagorean Theorem. b. (+) Derive and write the equation of a circle of given center and radius using the Pythagorean Theorem. c. (+) Complete the square to find the center and radius of a circle given by an equation. **MP.6**, **MP.8**	 $(x - h)^2 + (y - k^2 = r^2$
KY.HS.G.20 (+) Derive the equations of conic sections. a. Derive the equation of a parabola given a focus and directrix. b. Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant. **MP.2**, **MP.7**	Parabolas: $y - k = a(x - h)^2$ $x - h = a(y - k)^2$ Circles: $(x - h)^2 + (y - k)^2 = r^2$ Ellipse: $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$ Hyperbola: $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$
Attending to the Standards for Mathematical Practice	
Students explain the connection between the Pythagorean Theorem and the equation of a circle (**MP.8**) and use the center and radius accurately within the formula (**MP.6**).	

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry- Expressing Geometric Properties with Equations	
Standards for Mathematical Practice	
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.

Cluster: Use coordinates to prove simple geometric theorems algebraically.

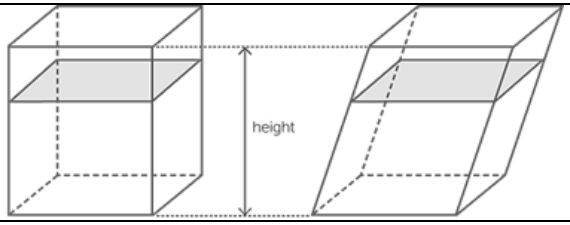
Standards	Clarifications
KY.HS.G.21 Use coordinates to justify and prove simple geometric theorems algebraically. **MP.2**, **MP.6**	Students understand how to prove or disprove a figure defined by four given points in the coordinate plane is a rectangle, as well as prove or disprove the given point lies on the circle centered at the origin and containing an additional given point.
KY.HS.G.22 Justify and apply the slope criteria for parallel and perpendicular lines and use them to solve geometric problems. **MP.3**, **MP.7**	Students understand the relationship between slope and how it relates to both parallel and perpendicular lines. Within this standard, students also understand how to find the equation of a line parallel or perpendicular to a given line that passes through a given point.
KY.HS.G.23 Find measurements among points within the coordinate plane. a. Use points from the coordinate plane to find the coordinates of a midpoint of a line segment and the distance between the endpoints of a line segment. b. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. **MP.2**, **MP.8**	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
KY.HS.G.24 Use coordinates within the coordinate plane to calculate measurements of two dimensional figures. a. Compute the perimeters of various polygons. b. Compute the areas of triangles, rectangles and other quadrilaterals.★ **MP.2**, **MP.4**	Students utilize the distance formula to find distances between points in order to find the area and/or perimeter of various geometric figures.

Attending to the Standards for Mathematical Practice
Students describe the connections between geometric theorems and their algebraic formulas (**MP.2**). They intentionally manipulate coordinates appropriately, fluently selecting criterion and formulas for a given context (**MP.7**). Students use coordinate geometry to model real-world situations, posing their own real-world problems when possible (**MP.4**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry- Geometric Measurement and Dimensions	
Standards for Mathematical Practice	
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.

Cluster: Explain volume formulas and use them to solve problems.

Standards	Clarifications
KY.HS.G.25 Analyze and determine the validity of arguments for the formulas for the various figures and shapes. a. Finding the circumference and area of a circle. b. Finding the volume of a sphere, prism, cylinder, pyramid and cone. **MP.3**, **MP.7**	Students may use dissection arguments, Cavalieri's principle and informal limit arguments in order to find these values for these figures.
KY.HS.G.26 (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. **MP.2**, **MP.5**	
KY.HS.G.27 Use volume formulas to solve problems for cylinders, pyramids, cones, spheres, prisms ★ **MP.4**, **MP.6**	General Prism: $V = Bh$ Right Circular Cylinder: $V = \pi r^2 h$ Pyramid: $V = \frac{1}{3}Bh$ Right Circular Cone: $V = \frac{1}{3}\pi r^2 h$ Sphere: $V = \frac{4}{3}\pi r^3$

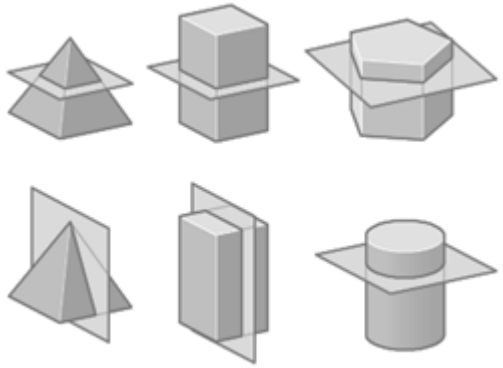
Attending to the Standards for Mathematical Practice

As students analyze volume formulas, they looking for relationships between the shapes and the related formulas (**MP.7**). Students critique different explanations or justifications for the formulas (**MP.3**). Students recognize various situations for which these formulas would apply and use them to solve real-world problems, posing their own real-world problems when possible (**MP.4**).

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Geometric Measurement and Dimensions	
Standards for Mathematical Practice	
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.

Cluster: Visualize relationships between two-dimensional and three-dimensional objects.

Standards	Clarifications
KY.HS.G.28 Identify the shapes of two-dimensional cross-sections of three-dimensional objects and identify three-dimensional objects generated by rotations of two-dimensional objects. **MP.5**, **MP.7**	Students recognize visually the two dimensional shapes created via the cross sections of three dimensional solid figures. Examples include, but are not limited to 

Attending to the Standards for Mathematical Practice

Students use technology to identify the result of cutting a three- dimensional object and the result of rotating two-dimensional objects (**MP.5**). As students analyze two-dimensional and three-dimensional shapes, they gain insights into the structure of specific shapes (**MP.7**). For instance, students consider the two-dimensional figures that result from removing the top of a shoe box or from slicing an orange. Students compare and contrast the two-dimensional cross sections of an orange when sliced at different locations or angles verses slicing. For an extension, students can compare their conjectures from circles when slicing a cone at different locations or angles.

The identified mathematical practices, coherence connections and clarifications are possible suggestions; however, they are not the only pathways.

Geometry-Modeling with Geometry	
Standards for Mathematical Practice	
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.

Cluster: Apply geometric concepts in modeling situations.

Standards	Clarification/Illustration
KY.HS.G.29 Use geometric shapes, their measures and their properties to describe objects in real world settings. **MP.1**, **MP.4**	Students use geometric shapes to model objects, for example, modeling a tree trunk or a human torso as a cylinder).★
KY.HS.G.30 Apply concepts of density based on area and volume in modeling situations, using appropriate units of measurement. **MP.4**, **MP.6**	Students explore scenarios where they find the area of regions and the volume of solid figures. In the process, they appropriately use units of measurement, for example, persons per square mile, BTUs per cubic foot
KY.HS.G.31 Apply geometric methods to solve design problems. ★ **MP.1**, **MP.4**	Students practice modeling techniques in this standard using a variety of strategies and practices, for example, designing an object or structure to satisfy physical constraints or minimize cost, working with typographic grid systems based on ratios

Attending to the Standards for Mathematical Practice

Students recognize various situations for which geometric knowledge would apply and do so to solve real-world problems (**MP.4**). As students use geometric methods to solve design problems, they continually reflect on whether their method and process makes sense for the problem and revise, as needed, until a viable solution has been found (**MP.1**)**.** Students also select appropriate theorems and formulas and report units with appropriate accuracy (**MP.6**).