| **Unit 3 Title** | **Estimated Time Frame** |
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| **Quadrilaterals, Similarity, Right Triangles and Trigonometry** | **40 days or 20 block days** |

**Big Idea (s)**

Once an essential number of facts are known, figures can be found to be similar, which means that all corresponding sides are proportional and all corresponding angles are congruent.
Algebraic techniques and coordinate systems can be applied to solve problems with geometric figures.
The angle measures and side lengths within a right triangle have many special relationships (Pythagorean Theorem, trigonometric ratios).
Dilations and similarity allow for applying trigonometric ratios in solving various real-world problems.

**Essential Question(s)**

What can I discover about the relationship between sides and angle sum in a convex polygon?
How are properties of parallelograms used to solve problems?
How are diagonals and angle measures related in kites and trapezoids?
How are diagonals and angle measures related in rectangles, rhombuses, and squares?

What is the relationship between the sides and angles of similar figures?
How can I use the properties of similar figures to find and solve algebraic and real-world problems?
How can I prove two triangles are similar?
How can I generalize the properties of similar triangles to solve problems involving parallel segments and angle bisectors?
How might the features of one figure be helpful when solving problems about other similar figures?
How much information is needed to determine that the two figures are similar?
In what ways can similarity be useful?

How can algebra be used to express geometric properties?
What relationships exist among the sides and angles of a right triangle?
How can right triangles be used to model and solve real-world problems?
How are the Pythagorean Theorem and trigonometry useful?
How do trigonometric ratios relate angle measures to side lengths of right triangles?

| **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. |
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| MP.1. Make sense of problems and persevere in | KILP.1 Recognize that text is anything that communicates a message. |

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| solving them.<br>**MP.2. Reason abstractly and quantitatively.**<br>**MP.3. Construct viable arguments and critique the reasoning of others.**<br>**MP.4. Model with mathematics.**<br>**MP.5. Use appropriate tools strategically.**<br>MP.6. Attend to precision.<br>**MP.7. Look for and make use of structure.**<br>**MP.8. Look for and express regularity in repeated reasoning.** | KLIP.2 Employ, develop, and refine schema to understand and create text.<br>KILP.3 View literacy experiences as transactional, interdisciplinary and transformational.<br>KILP.4 Utilize receptive & expressive language arts to better understand self, others, and the world.<br>KILP.5 Apply strategic practices, with scaffolding & then independently, to approach new literacy tasks.<br>**KILP.6 Collaborate with others to create new meaning.**<br>**KILP.7 Utilize digital resources to learn and share with others.**<br>**KILP.8 Engage in specialized, discipline specific literacy practices.**<br>**KILP.9 Apply high level cognitive processes to think deeply and critically about text.**<br>KILP.10.Develop a literacy identity that promotes lifelong learning. |

**Common Preconceptions/Misconceptions**

Students use previously learned definitions, theorems, postulates, and properties of lines, angles, and triangles to draw conclusions and to make inferences.

Students may need help with setting up the geometric mean. Point out to students that the geometric mean always appears twice in the proportion, once as the numerator and once as the denominator.

| KAS Standards | Considerations | Samples of Learning Intentions and Success Criteria |
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| **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.<br><br>**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. | We are learning to apply properties of polygons. **(Lesson 6-1)**<br>● I can use theorems related to polygon sum to find the measure of interior and exterior angles (and sums).<br><br>We are learning to apply properties of kites and trapezoids. **(Lesson 6-2)**<br>● I can use properties of the diagonals of a kite to prove relationships and solve problems.<br>● I can use the properties of an isosceles trapezoid to solve problems.<br>● I can use the relationship between the lengths of the bases and midsegment of a trapezoid to solve problems. |

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| | | We are learning to prove and apply parallelogram theorems. **(Lesson 6-3)**<br>● I can show that consecutive angles of a parallelogram are supplementary and opposite angles are congruent.<br>● I can show that diagonals of a parallelogram bisect each other.<br>● I can use the properties of a parallelogram to find missing values and solve problems.<br><br>We are learning to prove and apply the properties of special parallelograms: rhombuses, rectangles, and squares. (**Lesson 6-3, 6-4 6-5, 6-6, 6-2**)<br>● I can prove that the diagonals of rhombuses are perpendicular bisectors of each other and angle bisectors of the angles of a rhombus.<br>● I can prove that the diagonals of a rectangle are congruent.<br>● I can solve problems involving the properties of rectangles, rhombuses. and squares.<br>● I can identify rhombuses, rectangles, and squares by the characteristics of diagonals of parallelograms. |
| **KY.HS.G.7** Prove theorems about geometric figures.<br>a. Construct formal proofs to justify theorems for lines, angles, and triangles.<br>b. (+) Construct formal proofs to justify theorems for parallelograms. (Advanced Geometry)<br>**MP.6, MP.7** | Students recall definitions, theorems, postulates and properties to construct formal proofs based on theorems established in other standards.<br><br>(+)Theorems include:<br>● opposite sides are congruent,<br>● opposite angles are congruent,<br>● the diagonals of a parallelogram bisect each other, and conversely,<br>● rectangles are parallelograms with congruent diagonals. | We are learning to recall definitions, theorems, postulates, and properties to construct formal proofs based on theorems established previously.<br>● I can experiment with lines, angles, triangles, and parallelograms to make connections and conjectures about their properties,<br>● I can use geometry software, including Desmos, when appropriate.<br>● I can use various forms of proof (formal, informal, direct, and indirect) to outline logic and defend conjectures.<br>● I can consider alternative approaches to a proof or a conjecture. |

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| **KY.HS.G.9** Understand the properties of dilations.<br><br>a. Verify the properties that result from the dilations given by a center and a scale factor.<br><br>b. Verify that a dilation produces an image that is similar to the pre-image.<br>**MP.5, MP.7** | Methods to verify properties could include but are not limited to: scale models, moving an object closer to a light source and examining changes, and changing the scale factor on a copier.<br><br>Students explain the effect of dilations on objects that pass through the center versus those that do not pass through the center of a figure.<br><br>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. | We are learning to understand the properties of dilations. **(Lesson 7-1)**<br>● I can dilate a figure by a scale factor with a fixed center called the center of dilation.<br>● I can analyze a dilation on a coordinate plane by comparing the angles and the side lengths.<br>● I can find the scale factor of similar figures using the ratio of side lengths of the image to the corresponding side lengths of the preimage.<br>● I can use a scale factor of similar figures to find the length and area of spaces in real-life situations.<br><br>We are learning to use the properties of dilations to solve problems. **(Lesson 7-2)**<br>● I can identify a combination of rigid motions and dilation that maps one figure to a similar figure.<br>● I can identify the coordinates of an image under a similarity transformation. |
| **KY.HS.G.10** Apply the properties of similarity transformations to establish the AA criterion for two triangles to be similar.<br>**MP.3, MP.6** | **The AA Similarity Theorem**<br>If $\angle A \cong \angle D$, *and* $\angle B \cong \angle E$, then $\Delta ABC \sim \Delta DEF$. | We are learning how to prove two triangles are similar by AA~. **(Lesson 7-3)**<br>● I can use dilations and rigid motions to prove triangles are similar.<br>● I can use properties of similar triangles to establish the Angle-Angle Similarity Theorem. |
| **KY.HS.G.11** Understand theorems about triangles.<br>a. Apply theorems about triangles.<br><br>b. (+) Prove theorems about triangles.<br><br>c. Use similarity criteria for triangles to solve problems and to prove relationships in geometric figures.<br>**MP.1, MP.3** | Triangle Similarity Postulate and Theorems:<br>AA Similarity Postulate: Two triangles are similar if they have two pairs of congruent angles.<br>SSS Similarity Theorem: Two triangles are similar if they have three pairs of proportional sides.<br>SAS Similarity Theorem: Two triangles are similar if they have two pairs of proportional sides with a congruent included angle. | We are learning how to prove two triangles are similar. **(Lesson 7-3)**<br>● I can verify triangle similarity by using one of the following: SSS ~, SAS~, AA~.<br>● I can use triangle similarity criteria to solve problems of missing angle measures and lengths. |

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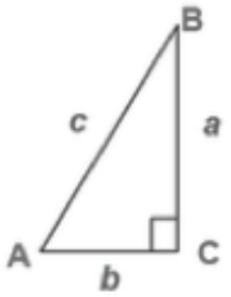
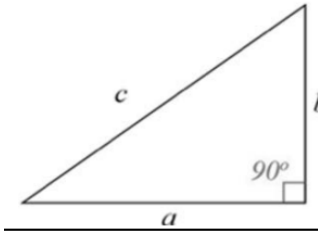
| | Theorems include the Pythagorean Theorem, "a line parallel to one side of a triangle divides the other two proportionally and conversely," and "a segment joining midpoints of a triangle is parallel to the third side and and half the length."<br><br>Students demonstrate the ability to copy a segment, 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. | We are learning to use triangle theorems to solve problems. **(Lesson 7-4 and 7-5)**<br>● I can use the geometric mean to solve problems with right triangles.<br>● I can use the similarity of triangles divided by a segment parallel to one side to divide the sides of triangles in proportion.<br>● I can use similarity to divide one side of a triangle in proportion to the other two sides. |
| **KY.HS.G.12** Understand the properties of right triangles.<br>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).<br><br>b. Explain and use the relationship between the sine and cosine of complementary angles.<br><br>c. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★<br>**MP.3, MP.4** |  <br>$\sin A = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{a}{c}$<br>$\cos A = \frac{\text{adjacent side}}{\text{hypotenuse}} = \frac{b}{c}$<br>$\tan A = \frac{\text{opposite side}}{\text{adjacent side}} = \frac{a}{b}$<br>  <br>$c^2 = a^2 + b^2$ | We are learning to apply triangle theorems to solve problems involving right angles. (**Lesson 8-1a, 8-1b, 8-1c, 8-2a**)<br>● I can use the Pythagorean Theorem to find missing sides in right triangles.<br>● I can use the Converse of the Pythagorean Theorem to classify a triangle as acute, right, or obtuse.<br>● I can find missing sides in 30°-60°-90° special right triangles.<br>● I can find missing sides in 45°-45°-90° special right triangles.<br><br>We are learning to apply trigonometric ratios to solve problems involving right triangles. **(Lesson 8-1b, 8-1c, 8-2a, 8-2b)**<br>● I can use trigonometry to find missing sides in right triangles.<br>● I can use trigonometry to find missing angles in right triangles.<br>● I can use SOH-CAH-TOA to find the sine, cosine, and tangent of an acute angle of a triangle. |

## Supporting Standards

**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**

**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 as a rectangle and prove or disprove the given point lies on the circle centered at the origin and containing an additional given point.
**Considerations:** Use coordinate geometry (slope, distance formula, midpoint) to prove theorems about quadrilateral. *Note - NO formal proofs.(Lesson 6-4 is it a parallelogram?)

## Essential Vocabulary, Theorems, and Postulates

| Essential Vocabulary by Topic | Essential Theorems/Postulates by Topic |
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| **Quadrilateral**<br>**Vocabulary:**quadrilateral, pentagon, hexagon, heptagon, octagon, nonagon, decagon, dodecagon, n-gon, diagonal, parallelogram, isosceles trapezoid, kite, trapezoid, midsegment of a trapezoid, parallelogram, rectangle, rhombus, square, diagonal, consecutive angles | •**Polygons and Parallelograms:**<br>•Polygon Interior & Exterior Angle-Sum Theorem<br>•Opposite sides of a parallelogram are parallel<br>•Opposite sides of a parallelogram are congruent<br>•Opposite angles of a parallelogram are congruent<br>•Consecutive angles of a parallelogram are supplementary<br>•Diagonals of a parallelogram bisect each other<br>All properties of parallelograms, rectangles, rhombuses, squares, trapezoids (including isosceles), and kites found on the Quadrilateral Family Tree<br>•Conditions of Special Parallelograms found on p.291 of the textbook |
| **Similarity Vocabulary:** ratio, proportion, reflection, rotation, translation, dilation, similar, scale factor, proportionality statement, similarity statement, transversal, angle bisector, cross-product property, extended proportion, geometric mean, golden ratio, indirect measurement, proportion, scale factor, similar figures, | •Corresponding angles in ~ figures are equal<br>•Corresponding sides in ~ figures are proportional<br>•Ratio of perimeters in ~ figures = scale factor<br>•Ratio of areas in ~ figures = square of scale factor<br>•AA~ Similarity Theorem<br>•SAS~ Similarity Theorem<br>•SSS~ Similarity Theorem<br>•Side–Splitter Theorem<br>•Corollary to Side–Splitter Theorem |

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| Side-Splitter Theorem, Angle Bisector Theorem | •Triangle Angle–Bisector Theorem<br>•Triangle Midsegment Theorem |
| **Triangle and Trig Vocabulary:**<br>Pythagorean Theorem, radical, angle of depression, angle of elevation, 30-60-90 triangle, 45-45-90 triangle, trigonometry, sine, cosine, tangent, Pythagorean triple, trigonometric ratios | **Triangle Theorems/Postulates:**<br>•The Pythagorean Theorem and its Converse<br>•Ratios of sides in 30°-60°-90° special right triangles<br>•Ratios of sides in 45°-45°-90° special right triangles<br>•SOH-CAH-TOA |

**Common Assessment**

Common Assessment Unit 3 Geometry

**Anchor Resources**

| **enVision Topic 6 - Quadrilaterals and Other Polygons** | **enVision Topic 7 - Similarity** | **enVision Topic 8 - Right Triangles and Trigonometry** |
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| **MILC -** MILC Topic 6 resources **Topic 6** continued -Quadrilaterals and Other Polygons<br><br>**FAL** (one per semester)**-** Describing and Defining Quadrilaterals<br><br>**3 Act Math Task** -<br><br>Optional: Assign a self-guided review over proportions and skip Day 10 | **MILC -** MILC Topic Similarity (11 days) resources<br>Review proportions.<br>Review or Teach 7-1 from the Transformations unit.<br><br>Only teach dilations from the origin.<br><br>**3-ACT Math Task** - Make It Right (baseball diamond connections) (after Lesson 7-4)<br><br>**FAL -** Identifying Similar Triangles / Floodlight Shadows | **MILC -** MILC Topic Right Triangles and Trigonometry (11 days) resources<br><br>**FAL -** Proving the Pythagorean Theorem<br><br>**3 ACT Math Task** - The Impossible Measurement (after 8-4)<br><br>Include simplifying single radicals, operations with radicals, and rationalizing the denominator<br><br>**STEM** Activity: "Measure a Distance" (can be completed around ACT date) |

*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.
*** 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.