Instructional Focus Document
Grade 8 Mathematics

TITLE : Unit 07: Transformational Geometry **SUGGESTED DURATION :** 12 days

UNIT OVERVIEW

Introduction

This unit bundles student expectations that address algebraic and graphical representations of translations, reflections, dilations, and rotations. According to the Texas Education Agency, mathematical process standards including application, a problem-solving model, tools and techniques, communication, representations, relationships, and justifications should be integrated (when applicable) with content knowledge and skills so that students are prepared to use mathematics in everyday life, society, and the workplace. The introduction to the grade level standards state, “While the use of all types of technology is important, the emphasis on algebra readiness skills necessitates the implementation of graphing technology.” Additionally, the availability of graphing technology is required during STAAR testing.

Prior to this Unit

In Grade 4, students illustrated degrees as units used to measure an angle, where $\frac{1}{360}$ of any circle is one degree and an angle that “cuts” $\frac{n}{360}$ out of a circle whose center is at the angle’s vertex has a measure of *n* degrees. In Grade 7, students generalized the critical attributes of similarity as well as solved mathematical and real-world problems involving similar shape and scale drawings.

During this Unit

Students develop transformational geometry concepts as they examine orientation and congruence of transformations. Students extend concepts of similarity to dilations on a coordinate plane as they compare and contrast a shape and its dilation(s). The concept of proportionality is revisited as students generalize the ratio of corresponding sides of a shape and its dilation as well as use an algebraic representation to explain the effect of dilation(s) on a coordinate plane. Properties of orientation and congruence are examined as students generalize the properties as they apply to rotations, reflections, translations, and dilations of two-dimensional figures on a coordinate plane. Students must distinguish between transformations that preserve congruence and those that do not. Students are expected to use an algebraic representation to explain the effect of translations, reflections over the *x*- or *y*- axis, dilations when a positive rational number scale factor is applied to a shape, and rotations limited to 90°, 180°, 270°, and 360°. The relationship between linear and area measurements of a shape and its dilation are also examined as students model the relationship and determine that the measurements are affected by both the scale factor and the dimension (one- or two-dimensional) of the measurement. Students are expected to generalize when a scale factor is applied to all of the dimensions of a two-dimensional shape, the perimeter is multiplied by the same scale factor while the area is multiplied by the scale factor squared.

Other considerations: Reference the Mathematics COVID-19 Gap Implementation Tool Grade 8

After this Unit

In Algebra I, students will apply the concept of transformations as they examine parameter changes to linear and quadratic parent functions. In Geometry, students will generate and describe rigid and non-rigid transformations as they describe and perform transformations of figures in a plane using coordinate notations, and determine the image or pre-image of a given two-dimensional figure under a composition of rigid and/or non-rigid transformations. Students will also identify and distinguish between reflection and rotational symmetry in a plane figure as well as apply the definition of congruence, in terms of rigid transformations, to identify congruent figures and their corresponding sides and angles.

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Additional Notes

In Grade 8, generalizing that the ratio of corresponding sides of similar shapes are proportional, including a shape and its dilation, comparing and contrasting the attributes of a shape and its dilation on a coordinate plane, and modeling the effect on linear and area measurements of dilated two-dimensional shapes are identified as STAAR Supporting Standards 8.3A, 8.3B and 8.10D. Using an algebraic representation to explain the effect of a given positive rational scale factor applied to two-dimensional figures on a coordinate plane with the origin as the center of dilation is identified as STAAR Readiness Standard 8.3C. All of these standards are part of the Grade 8 *Texas Response to Curriculum Focal Points* (TxRCFP): Representing, applying, and analyzing proportional relationships. Generalizing the properties of orientation and congruence of rotations, reflections, translations, and dilations of two-dimensional shapes on a coordinate plane and differentiating between transformations that preserve congruence and those that do not are STAAR Supporting Standards 8.10A and 8.10B. Explaining the effect of translations, reflections over the *x*- or *y*-axis, and rotations limited to 90°, 180°, 270°, and 360° as applied to two-dimensional shapes on a coordinate plane using an algebraic representation is identified as STAAR Readiness Standard 8.10C. These standards are within the Grade 8 Focal Point: Grade Level Connections (TxRCFP) which reinforces previous learning and/or provides development for future learning. All of the standards within this unit are subsumed under the Grade 8 STAAR Reporting Category: Geometry and Measurement. This unit is supporting the development of the *Texas College and Career Readiness Standards* (TxCCRS): I. Numeric Reasoning B1, C1; II. Algebraic Reasoning D1, D2; III. Geometric and Spatial Reasoning B1, B2, C1, D1, D2, D3; V. Statistical Reasoning A1, C2; VII. Problem Solving and Reasoning A1, A2, A3, A4, A5, B1, C1, D1, D2; VIII. Communication and Representation A1, A2, A3, B1, B2, C1, C2, C3; IX. Connections A1, A2, B1, B2, B3.

Research

According to research published by the National Council of Teachers of Mathematics (2010), “In Grade 8, students are laying the foundation for many of the more sophisticated concepts they will learn in later grades. For example, students’ work with congruence and similarity will be applied when students learn about the various combinations of conditions that ensure congruent and similar triangles, such as the postulates and theorems” (p. 92). They go on to state that, “Students apply transformations and use symmetry to analyze mathematical situations” (p. 50). As students experience dilations, they are extending their work with proportionality. According to Van de Walle, Karp, and Bay-Williams (2010), “Proportional reasoning has been referred to as the capstone of the elementary curriculum and the cornerstone of algebra and beyond…The connection between proportional reasoning and the geometric concept of similarity is very important. Similar figures provide a visual representation of proportions, and proportional thinking enhances the understanding of similarity” (p. 348 – 360).

National Council of Teachers of Mathematics. (2010). *Focus in grade 8: Teaching with curriculum focal points*. Reston, VA: National Council of Teachers of Mathematics, Inc.
Texas Education Agency & Texas Higher Education Coordinating Board. (2009). *Texas college and career readiness standards.* Retrieved from http://www.thecb.state.tx.us/institutional-resources-programs/public-community-technical-state-colleges/texas-college-and-career-readiness-standards/
Texas Education Agency. (2013). *Texas response to curriculum focal points for kindergarten through grade 8 mathematics.* Retrieved from https://www.texasgateway.org/resource/txrcfp-texas-response-curriculum-focal-points-k-8-mathematics-revised-2013
Van de Walle, J., Karp, K., & Bay-Williams, J. (2010). *Elementary and middle school mathematics: Teaching developmentally*. Boston, MA: Pearson Education, Inc.

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OVERARCHING UNDERSTANDINGS AND QUESTIONS

Quantitative relationships model problem situations efficiently and can be used to make generalizations, predictions, and critical judgements in everyday life.

- What patterns exist within different types of quantitative relationships and where are they found in everyday life?
- Why is the ability to model quantitative relationships in a variety of ways essential to solving problems in everyday life?

Geometric, spatial, and measurement reasoning are foundational to visualizing, analyzing, and applying relationships within and between scale, shapes, quantities, and spatial relations in everyday life.

- Why is developing geometric, spatial, and measurement reasoning essential?
- How does geometric, spatial, and measurement reasoning affect how one sees and works in the world?

UNIT UNDERSTANDINGS AND QUESTIONS	OVERARCHING CONCEPTS AND UNIT CONCEPTS	PERFORMANCE ASSESSMENT(S)
Understanding how two quantities vary together (covariation) and can be reasoned up and down in situations involving invariant (constant) relationships builds flexible proportional reasoning in order to make	Proportionality • Ratios and Rates • Scale factors • Relationships and Generalizations	Mathematics Grade 8 Unit 07 PA 01 **Click on the PA title to view related rubric.** *Provide students with markers or colored pencils, as needed.*

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UNIT UNDERSTANDINGS AND QUESTIONS	OVERARCHING CONCEPTS AND UNIT CONCEPTS	PERFORMANCE ASSESSMENT(S)

predictions and critical judgements about the relationship.
• Proportional relationships can be used to describe dilations by generalizing the ratios of corresponding sides of similar shapes and the relationship between the attributes of shape and its dilation in order to explain the effect of scale factor applied to two-dimensional figures algebraically.
  • What is the relationship between and within corresponding sides of similar figures?
  • Why is the ratio of corresponding sides of similar shapes proportional?
  • What is the relationship between the …
  ◦ corresponding sides
  ◦ corresponding angles
  … of a shape and its dilation?
  • How is the algebraic representation used to describe the effect of a dilation affected when a scale factor …
  ◦ greater than 0 but less than 1
  ◦ equal to 1
  ◦ greater than 1
  … is applied to a shape?
	• Equivalence
	• Proportional
	• Geometric similarity
	• Dilations
	• Representations
	
	Two-Dimensional Shapes
	• Coordinate Plane
	  • Ordered Pairs
	  • Location
	• Properties of Transformations
	  • Preserved orientation
	  • Preserved congruence
	• Transformations and Effects
	  • Translations
	  • Rotations
	  • Reflections
	  • Dilations
	  • Algebraic representations
	  • Proportional dimensional change
	
	<u>Associated Mathematical Processes</u>
	• Application
	• Problem Solving Model
		Analyze the problem situation(s) described below. Organize and record your work for each of the following tasks. Using precise mathematical language, justify and explain each solution process.
		
		Elise is making a quilt for the Texas State Fair. She has planned her design for one quilt pattern using all four quadrants of a coordinate plane. The pattern will be formed from the shape or figure she creates and transforms.
		
		1. Elise created a figure on the coordinate plane and then performed three transformations on the figure to complete the quilt pattern.
		  a. Use graph paper to create Elise's completed quilt pattern. Use a different color for the original figure and each transformation.
		  • Use the coordinates $A(0, 9)$, $B(0, 18)$, $C(12, 9)$, and $D(12, 0)$ to create a figure that will be used throughout the quilt pattern. Label each vertex of the figure appropriately.
		  • Rotate the image in Quadrant I 180° clockwise about the origin, labeling the vertices of the rotated image using prime notation. Then determine the ordered pairs of each vertex of the rotated image.

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UNIT UNDERSTANDINGS AND QUESTIONS	OVERARCHING CONCEPTS AND UNIT CONCEPTS	PERFORMANCE ASSESSMENT(S)

Illustrating and analyzing geometric relationships in models and diagrams aid in representing attributes of geometric figures with quantifiable measures and equations in order to generalize geometric relationships and solve problems.
• When describing figures that preserve orientation, what is the difference between orientation of a figure and orientation of the vertices?
• Which transformations preserve …
  ◦ orientation of a figure?
  ◦ orientation of the vertices?
  ◦ congruence of a figure?
  ◦ orientation and congruence of a figure?
• What is the difference between transformations that preserve congruence and those that do not?
• What generalizations can be made about the properties of a figure in regard to …
	• Tools and Techniques
	• Communication
	• Representations
	• Relationships
	• Justification
		• Reflect the image in Quadrant I over the *x*-axis, labeling the vertices of the reflected image using the letters *E*, *F*, *G*, and *H*. Then determine the ordered pairs of each vertex of the reflected image.
		• Translate the image in Quadrant IV up 18 units and 12 units to the left, labeling the vertices of the translated image using prime notation. Then determine the ordered pairs of each vertex of the translated image.
		2. Mariah asked Elise to create a quilt pattern similar to the one she made for the fair. Mariah wants her quilt pattern to be a dilation of Elise's pattern. The figure *ABCD* used throughout Elise's pattern is similar to the figure *QRST* used throughout Mariah's pattern.
		  a. Use another sheet of graph paper to create a dilation of Elise's quilt pattern for Mariah.

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UNIT UNDERSTANDINGS AND QUESTIONS	OVERARCHING CONCEPTS AND UNIT CONCEPTS	PERFORMANCE ASSESSMENT(S)
◦ its orientation? ◦ those that preserve congruence? • When a figure is translated, why would the orientation always be preserved? • When a figure is dilated, why would the orientation always be preserved? • When a figure is rotated, translated, or dilated, why is the orientation of the vertices always preserved? • When a figure is reflected, why is the orientation of the vertices never preserved? • When a figure is translated or dilated, why is the orientation of the figure always preserved? • When reflecting a figure across the *x*-axis, why does the *y*-value always changes signs? • When reflecting a figure across the *y*-axis, why does the *x*-value always changes signs? • What algebraic representations generalize the effect of … ◦ translations over the *x*-axis? ◦ translations over the *y*-axis? ◦ reflections over the *x*-axis? ◦ reflections over the *y*-axis? ◦ rotations of 90°, 180°, 270°, and 360°? • When a shape is dilated by a scale factor proportionally to each side of the shape, what effect		• The coordinates for the original figure in Mariah's pattern are *Q*(0, 6), *R*(0, 12), *S*(8, 6), and *T*(8, 0). Create the figure that will be used throughout Mariah's quilt pattern. Label each vertex of the figure appropriately. • Rotate the image in Quadrant I 180° clockwise about the origin, labeling the vertices of the rotated image using prime notation. Then determine the ordered pairs of each vertex of the rotated image. • Reflect the image in Quadrant I over the *x*-axis, labeling the vertices of the reflected image using the letters *U*, *V*, *W*, and *Z*. Then determine the ordered pairs of each vertex of the reflected image. • Translate the image in Quadrant IV up 12 units and 8 units to the left, labeling the vertices of the translated image using prime notation. Then determine the ordered pairs of each vertex of the translated image. b. Compare and contrast the attributes of Elise's and Mariah's quilt patterns, identifying the center of dilation and the scale factor that was used to create Mariah's image.

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UNIT UNDERSTANDINGS AND QUESTIONS	OVERARCHING CONCEPTS AND UNIT CONCEPTS	PERFORMANCE ASSESSMENT(S)
does it have on the … ◦ perimeter ◦ area … of the dilated shape?		c. Identify the corresponding sides of Elise's and Mariah's quilt patterns and verify that the ratio of the corresponding sides within and between the two similar shapes is proportional. Describe the relationship between the reciprocal of the ratio of one side of Elise's figure to the corresponding side of Mariah's figure. d. Complete the chart below summarizing the transformations used to complete Elise's and Mariah's quilt patterns.

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	Original Figure Coordinates	Transformed Figure Coordinates	Algebraic Rule	Preserves Congruence From Original Figure to Transformed Figure?	Preserves Orientation from Original Figure to Transformed Figure?
Elise's Original Figure	(0, 9) (0, 18) (12, 9) (12, 0)	-----	(x, y)	-----	-----
Rotation 180° of Elise's Original Figure	(0, 9) (0, 18) (12, 9) (12, 0)	(0, –9) (0, –18) (–12, –9) (–12, 0)			
Reflection over x-axis of Elise's Original Figure	(0, 9) (0, 18) (12, 9) (12, 0)			yes	
Translation of Elise's Reflected Figure	(0, – 9) (0, –18) (12, –9) (12, 0)		$(x – 12, y + 18)$		
Mariah's Shape Dilated from Elise's Original Figure	Elise's (0, 9) (0, 18) (12, 9) (12, 0)	Mariah's			yes

e. Generalize the properties of orientation and congruence describing when each property is or is not preserved for rotations, reflections, translations, and dilations.

f. Calculate the area of Elise's entire quilt pattern and Mariah's entire quilt pattern.

g. The perimeter of Elise's entire quilt pattern is 96

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		centimeters. Calculate the perimeter of Mariah's quilt pattern. h. Compare the perimeter and area of Elise's quilt pattern to the perimeter and area of Mariah's quilt pattern. Determine and describe the relationship between the scale factor used to create Mariah's quilt pattern from Elise's quilt pattern and the perimeter and area measurements of both patterns. Standard(s): **8.1A**, **8.1B**, **8.1C**, **8.1D**, **8.1E**, **8.1F**, **8.1G**, **8.3A**, **8.3B**, **8.3C**, **8.10A**, **8.10B**, **8.10C**, **8.10D**, **ELPS.c.1A**, **ELPS.c.2C**, **ELPS.c.2D**, **ELPS.c.2E**, **ELPS.c.3C**, **ELPS.c.3D**, **ELPS.c.3H**, **ELPS.c.4C**, **ELPS.c.4D**, **ELPS.c.4F**, **ELPS.c.4H**, **ELPS.c.5B**, **ELPS.c.5F**, **ELPS.c.5G**

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MISCONCEPTIONS / UNDERDEVELOPED CONCEPTS

Misconceptions:

- Some students may think a translation or a reflection does not create a congruent image.
- Some students may not correctly match corresponding sides and angles of two similar shapes rather than using the name of the shape to determine which sides and angles are corresponding.
- Some students may think the original figure is the image or vice versa, especially when dealing with dilations from a larger figure to a smaller figure.
- Some students may think a dilation does not produce a similar image.
- Some students may not associate that sequence of vertices when naming transformed figures and their images also names the corresponding sides and angles of the two shapes (e.g., If figure *ABCD* is transformed to image *QRST*, then $\overline{AB}$ corresponds to $\overline{QR}$ and $\angle A$ corresponds to $\angle Q$, etc.)
- Some students may not interpret prime notation correctly when referring to the image of a transformed figure.

Underdeveloped Concepts:

- Students may think that the scale factor also applies to the angle measure rather than understanding that corresponding angles are congruent.
- Some students may think that all figures and images are drawn to scale rather than using given measurements.

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UNIT VOCABULARY

- **Area** – the measurement attribute that describes the number of square units a figure or region covers
- **Center of dilation** – a coordinate point that serves as the focal point for generating a dilation
- **Circumference** – a linear measurement of the distance around a circle
- **Congruent** – of equal measure, having exactly the same size and same shape
- **Dilation** – a transformation in which an image is usually enlarged or reduced, depending on the scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are proportional creating similar figures
- **Perimeter** – a linear measurement of the distance around the outer edge of a figure
- **Positive rational numbers** – the set of numbers that can be expressed as a fraction $\frac{a}{b}$, where *a* and *b* are counting (natural) numbers
- **Reflection** – a transformation frequently described as a flip or a mirror image of the original figure
- **Rotation** – a transformation frequently described as a turn of a figure around a designated point
- **Scale factor** – the common multiplicative ratio between pairs of related data which may be represented as a unit rate
- **Similar shapes** – shapes whose angles are congruent and side lengths are proportional (equal scale factor)
- **Translation** – a transformation frequently described as a slide of a figure

Related Vocabulary:

- Attribute
- Congruence
- Coordinate plane
- Dimension
- Enlargement
- Figure
- Image
- Linear dimension
- One-dimensional
- Orientation
- Orientation of figure
- Orientation of vertices
- Origin
- Preserve
- Prime notation
- Proportional
- Ratio
- Reciprocal
- Reduction
- Symmetry
- Transformation
- Two-dimensional
- *x*-axis
- *y*-axis

UNIT ASSESSMENT ITEMS	SYSTEM RESOURCES	OTHER RESOURCES
Unit Assessment Items that have been published by	Mathematics Concepts Charts	Texas Higher Education Coordinating Board – Texas

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your district may be accessed through **Search All Components** in the District Resources tab. Assessment items may also be found using the Assessment Center if your district has granted access to that tool.	**Mathematics COVID-19 Gap Implementation Tool Grade 8** **Mathematics COVID-19 Gap Implementation Tool Instructions** **Mathematics Grade 8 Backward Design Document** **Mathematics Grade 8 Enhanced TEKS Clarification** **Mathematics Grade 8 Focal Points with Aligned Standards and TEKS Introduction** **Mathematics Grade 8 STAAR Analysis Resources** **Mathematics Grade 8 STAAR Blueprint and Item Percentages** **Mathematics Grade 8 STAAR Enhanced Blueprint** **Mathematics Grade 8 Vertical Alignment** **Mathematics Grade 8_Unit 07_TEKS Resource System STAAR Analysis** **Mathematics K-HS Overarching Understandings and Questions** **Mathematics Long Term Transfer Goals** **Mathematics Suggested Basic Manipulatives by**	**College and Career Readiness Standards** Texas Education Agency – **Texas Response to Curriculum Focal Points for K-8 Mathematics Revised 2013** Texas Education Agency – **Mathematics Curriculum** Texas Education Agency – **STAAR Mathematics Resources** Texas Education Agency Texas Gateway – **Revised Mathematics TEKS: Vertical Alignment Charts** Texas Education Agency Texas Gateway – **Mathematics TEKS: Supporting Information** Texas Education Agency Texas Gateway – **Interactive Mathematics Glossary** Texas Education Agency Texas Gateway – **Resources Aligned to Grade 8 Mathematics TEKS** Texas Instruments – **Graphing Calculator Tutorials**

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	Grade Level **Mathematics Suggested Engaging Literature** **Mathematics Texas Education Agency Grade 8 TEKS Supporting Information (with TEKS Resource System Comments)** **Mathematics Vertical Quick Guide**	

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TAUGHT DIRECTLY TEKS

TEKS INTENDED TO BE EXPLICITLY TAUGHT IN THIS UNIT.

TEKS/SE Legend:

- ***Knowledge and Skills Statements (TEKS) identified by TEA are in italicized, bolded, black text.***
- **Student Expectations (TEKS) identified by TEA are in bolded, black text.**
- ***Student Expectations (TEKS) are labeled Readiness as identified by TEA of the assessed curriculum.***
- ***Student Expectations (TEKS) are labeled Supporting as identified by TEA of the assessed curriculum.***
- ***Student Expectations (TEKS) are labeled Process standards as identified by TEA of the assessed curriculum.***
- Portions of the Student Expectations (TEKS) that are not included in this unit but are taught in previous or future units are indicated by a ~~strike-through~~.

Specificity Legend:

- Supporting information / clarifications (specificity) written by TEKS Resource System are in blue text.
- *Unit-specific clarifications are in italicized, blue text.*
- Information from Texas Education Agency (TEA), Texas College and Career Readiness Standards (TxCCRS), Texas Response to Curriculum Focal Points (TxRCFP) is labeled.

TEKS# / SE#	TEKS	SPECIFICITY
8.1	***Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:***	
8.1A	**Apply mathematics to problems arising in everyday life, society, and the workplace.** ***Process Standard***	Apply MATHEMATICS TO PROBLEMS ARISING IN EVERYDAY LIFE, SOCIETY, AND THE WORKPLACE

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TEKS# / SE#	TEKS	SPECIFICITY

		Including, but not limited to:
		• Mathematical problem situations within and between disciplines
		  ◦ Everyday life
		  ◦ Society
		  ◦ Workplace
		
		Note(s):
		• The mathematical process standards may be applied to all content standards as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		  ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem
		  ◦ Making inferences from data
		• TxCCRS:
		  ◦ VII.D. Problem Solving and Reasoning – Real-world problem solving
		  • VII.D.1. Interpret results of the mathematical problem in terms of the original real-world situation.
		  ◦ IX.A. Connections – Connections among the strands of mathematics
		  • IX.A.1. Connect and use multiple key concepts of mathematics in situations and problems.
		  • IX.A.2. Connect mathematics to the study of other disciplines.
		  ◦ IX.B. Connections – Connections of mathematics to nature, real-world situations, and everyday life
		  • IX.B.1. Use multiple representations to demonstrate links between mathematical and real-world situations.
		  • IX.B.2. Understand and use appropriate mathematical models in the natural, physical, and social sciences.

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TEKS# / SE#	TEKS	SPECIFICITY
		• IX.B.3. Know and understand the use of mathematics in a variety of careers and professions.

8.1B	**Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.** ***Process Standard***	Use
		
		A PROBLEM-SOLVING MODEL THAT INCORPORATES ANALYZING GIVEN INFORMATION, FORMULATING A PLAN OR STRATEGY, DETERMINING A SOLUTION, JUSTIFYING THE SOLUTION, AND EVALUATING THE PROBLEM-SOLVING PROCESS AND THE REASONABLENESS OF THE SOLUTION
		
		Including, but not limited to:
		
		• Problem-solving model
		  ◦ Analyze given information
		  ◦ Formulate a plan or strategy
		  ◦ Determine a solution
		  ◦ Justify the solution
		  ◦ Evaluate the problem-solving process and the reasonableness of the solution
		
		Note(s):
		
		• The mathematical process standards may be applied to all content standards as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		  ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem
		  ◦ Making inferences from data
		• TxCCRS:
		  ◦ I.B. Numeric Reasoning – Number sense and number concepts

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TEKS# / SE#	TEKS	SPECIFICITY
		• I.B.1. Use estimation to check for errors and reasonableness of solutions. ◦ V.A. Statistical Reasoning – Design a study • V.A.1. Formulate a statistical question, plan an investigation, and collect data. ◦ VII.A. Problem Solving and Reasoning – Mathematical problem solving • VII.A.1. Analyze given information. • VII.A.2. Formulate a plan or strategy. • VII.A.3. Determine a solution. • VII.A.4. Justify the solution. • VII.A.5. Evaluate the problem-solving process. ◦ VII.D. Problem Solving and Reasoning – Real-world problem solving • VII.D.2. Evaluate the problem-solving process.
8.1C	**Select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems.** ***Process Standard***	Select TOOLS, INCLUDING REAL OBJECTS, MANIPULATIVES, PAPER AND PENCIL, AND TECHNOLOGY AS APPROPRIATE, AND TECHNIQUES, INCLUDING MENTAL MATH, ESTIMATION, AND NUMBER SENSE AS APPROPRIATE, TO SOLVE PROBLEMS Including, but not limited to: • Appropriate selection of tool(s) and techniques to apply in order to solve problems ◦ Tools • Real objects • Manipulatives • Paper and pencil • Technology ◦ Techniques • Mental math • Estimation

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TEKS# / SE#	TEKS	SPECIFICITY

		• Number sense
		
		Note(s):
		
		• The mathematical process standards may be applied to all content standards as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		  ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem
		  ◦ Making inferences from data
		• TxCCRS:
		  ◦ I.B. Numeric Reasoning – Number sense and number concepts
		  • I.B.1. Use estimation to check for errors and reasonableness of solutions.
		  ◦ V.C. Statistical Reasoning – Analyze, interpret, and draw conclusions from data
		  • V.C.2. Analyze relationships between paired data using spreadsheets, graphing calculators, or statistical software.

8.1D	**Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.**
	Process Standard
		Communicate
		
		MATHEMATICAL IDEAS, REASONING, AND THEIR IMPLICATIONS USING MULTIPLE REPRESENTATIONS, INCLUDING SYMBOLS, DIAGRAMS, GRAPHS, AND LANGUAGE AS APPROPRIATE
		
		Including, but not limited to:
		
		• Mathematical ideas, reasoning, and their implications
		  ◦ Multiple representations, as appropriate
		  • Symbols
		  • Diagrams

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TEKS# / SE#	TEKS	SPECIFICITY

		• Graphs
		• Language
		
		Note(s):
		
		• The mathematical process standards may be applied to all content standards as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		  ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem
		  ◦ Making inferences from data
		• TxCCRS:
		  ◦ II.D. Algebraic Reasoning – Representing relationships
		  • II.D.1. Interpret multiple representations of equations, inequalities, and relationships.
		  • II.D.2. Convert among multiple representations of equations, inequalities, and relationships.
		  ◦ VIII.A. Communication and Representation – Language, terms, and symbols of mathematics
		  • VIII.A.1. Use mathematical symbols, terminology, and notation to represent given and unknown information in a problem.
		  • VIII.A.2. Use mathematical language to represent and communicate the mathematical concepts in a problem.
		  • VIII.A.3. Use mathematical language for reasoning, problem solving, making connections, and generalizing.
		  ◦ VIII.B. Communication and Representation – Interpretation of mathematical work
		  • VIII.B.1. Model and interpret mathematical ideas and concepts using multiple representations.
		  • VIII.B.2. Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.

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		◦ VIII.C. Communication and Representation – Presentation and representation of mathematical work • VIII.C.1. Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, models, graphs, and words. • VIII.C.2. Create and use representations to organize, record, and communicate mathematical ideas. • VIII.C.3. Explain, display, or justify mathematical ideas and arguments using precise mathematical language in written or oral communications. ◦ IX.B. Connections – Connections of mathematics to nature, real-world situations, and everyday life • IX.B.1. Use multiple representations to demonstrate links between mathematical and real-world situations.
8.1E	**Create and use representations to organize, record, and communicate mathematical ideas.** ***Process Standard***	Create, Use REPRESENTATIONS TO ORGANIZE, RECORD, AND COMMUNICATE MATHEMATICAL IDEAS Including, but not limited to: • Representations of mathematical ideas ◦ Organize ◦ Record ◦ Communicate • Evaluation of the effectiveness of representations to ensure clarity of mathematical ideas being communicated • Appropriate mathematical vocabulary and phrasing when communicating mathematical ideas Note(s):

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		• The mathematical process standards may be applied to all content standards as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		  ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem
		  ◦ Making inferences from data
		• TxCCRS:
		  ◦ VIII.B. Communication and Representation – Interpretation of mathematical work
		  • VIII.B.1. Model and interpret mathematical ideas and concepts using multiple representations.
		  • VIII.B.2. Summarize and interpret mathematical information provided orally, visually, or in written form within the given context.
		  ◦ VIII.C. Communication and Representation – Presentation and representation of mathematical work
		  • VIII.C.1. Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, models, graphs, and words.
		  • VIII.C.2. Create and use representations to organize, record, and communicate mathematical ideas.

8.1F	**Analyze mathematical relationships to connect and communicate mathematical ideas.**
	Process Standard
		Analyze
		
		MATHEMATICAL RELATIONSHIPS TO CONNECT AND COMMUNICATE MATHEMATICAL IDEAS
		
		Including, but not limited to:
		
		• Mathematical relationships
		  ◦ Connect and communicate mathematical ideas
		  • Conjectures and generalizations from sets of examples and non-examples, patterns, etc.

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		• Current knowledge to new learning
		
		Note(s):
		
		• The mathematical process standards may be applied to all content standards as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		  ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem
		  ◦ Making inferences from data
		• TxCCRS:
		  ◦ VII.A. Problem Solving and Reasoning – Mathematical problem solving
		  • VII.A.1. Analyze given information.
		  ◦ VIII.A. Communication and Representation – Language, terms, and symbols of mathematics
		  • VIII.A.1. Use mathematical symbols, terminology, and notation to represent given and unknown information in a problem.
		  • VIII.A.2. Use mathematical language to represent and communicate the mathematical concepts in a problem.
		  • VIII.A.3. Use mathematical language for reasoning, problem solving, making connections, and generalizing.
		  ◦ VIII.B. Communication and Representation – Interpretation of mathematical work
		  • VIII.B.1. Model and interpret mathematical ideas and concepts using multiple representations.
		  ◦ VIII.C. Communication and Representation – Presentation and representation of mathematical work
		  • VIII.C.1. Communicate mathematical ideas, reasoning, and their implications using symbols, diagrams, models, graphs, and words.
		  • VIII.C.2. Create and use representations to organize, record, and communicate mathematical ideas.

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		• VIII.C.3. Explain, display, or justify mathematical ideas and arguments using precise mathematical language in written or oral communications. ◦ IX.A. Connections – Connections among the strands of mathematics • IX.A.1. Connect and use multiple key concepts of mathematics in situations and problems. • IX.A.2. Connect mathematics to the study of other disciplines.
8.1G	**Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.** ***Process Standard***	Display, Explain, Justify MATHEMATICAL IDEAS AND ARGUMENTS USING PRECISE MATHEMATICAL LANGUAGE IN WRITTEN OR ORAL COMMUNICATION Including, but not limited to: • Mathematical ideas and arguments ◦ Validation of conclusions • Displays to make work visible to others ◦ Diagrams, visual aids, written work, etc. • Explanations and justifications ◦ Precise mathematical language in written or oral communication Note(s): • The mathematical process standards may be applied to all content standards as appropriate. • TxRCFP: ◦ Representing, applying, and analyzing proportional relationships ◦ Using expressions and equations to describe relationships, including the Pythagorean Theorem ◦ Making inferences from data

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		• TxCCRS: ◦ VII.A. Problem Solving and Reasoning – Mathematical problem solving • VII.A.4. Justify the solution. ◦ VII.B. Problem Solving and Reasoning – Proportional reasoning • VII.B.1. Use proportional reasoning to solve problems that require fractions, ratios, percentages, decimals, and proportions in a variety of contexts using multiple representations. ◦ VII.C. Problem Solving and Reasoning – Logical reasoning • VII.C.1. Develop and evaluate convincing arguments. ◦ VIII.A. Communication and Representation – Language, terms, and symbols of mathematics • VIII.A.3. Use mathematical language for reasoning, problem solving, making connections, and generalizing. ◦ VIII.B. Communication and Representation – Interpretation of mathematical work • VIII.B.1. Model and interpret mathematical ideas and concepts using multiple representations. • VIII.B.2. Summarize and interpret mathematical information provided orally, visually, or in written form within the given context. ◦ VIII.C. Communication and Representation – Presentation and representation of mathematical work • VIII.C.3. Explain, display, or justify mathematical ideas and arguments using precise mathematical language in written or oral communications.
8.3	***Proportionality. The student applies mathematical process standards to use proportional relationships to describe dilations. The student is expected to:***	
8.3A	**Generalize that the ratio of corresponding sides of similar shapes are proportional, including a**	Generalize

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	shape and its dilation.
	Supporting Standard
		THAT THE RATIO OF CORRESPONDING SIDES OF SIMILAR SHAPES ARE PROPORTIONAL, INCLUDING A SHAPE AND ITS DILATION
		
		Including, but not limited to:
		
		• Congruent – of equal measure, having exactly the same size and same shape
		• Similar shapes – shapes whose angles are congruent and side lengths are proportional (equal scale factor)
		  ◦ The order of the letters determines corresponding side lengths and angles.
		• Notation for similar shapes
		  ◦ Symbol for similarity (~) read as “similar to”
		• Prime notation of image points
		  ◦ Prime marks
		  • Ex: *ABCD* is the original figure or pre-image and *A'B'C'D'* is the name of the image. *A'B'C'D'* is read as *“A* prime, *B* prime, *C* prime, *D* prime”.
		• Generalizations of similarity
		  ◦ The ratio of corresponding sides of similar shapes is proportional.
		  ◦ Ratios comparing lengths within each shape or between shapes will determine if the shapes are similar.
		  ◦ The reciprocal of the ratio of one side of a figure to the corresponding side of a proportional figure is the scale factor, which represents the change in the size of the figures.
		• Dilation – a transformation in which an image is usually enlarged or reduced, depending on the scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are proportional creating similar figures
		  ◦ Enlargement (scale factor >1)
		  ◦ Reduction (0 < scale factor < 1)
		  ◦ Congruent (scale factor = 1)

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		Note(s): • Grade Level(s): ◦ Grade 7 identified the critical attributes of similarity, including the generalization that the ratio of corresponding sides of similar figures are proportional. ◦ Grade 7 solved problems with similar shapes and scale drawings. ◦ Grade 8 introduces the term “dilation” with similar figures. ◦ Various mathematical process standards will be applied to this student expectation as appropriate. • TxRCFP: ◦ Representing, applying, and analyzing proportional relationships • TxCCRS: ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry • III.B.1. Identify transformations and symmetries of figures. • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures. ◦ III.D. Geometric and Spatial Reasoning – Measurements involving geometry and algebra • III.D.3. Determine indirect measurements of geometric figures using a variety of methods. ◦ VII.B. Problem Solving and Reasoning – Proportional reasoning • VII.B.1. Use proportional reasoning to solve problems that require fractions, ratios, percentages, decimals, and proportions in a variety of contexts using multiple representations.
8.3B	**Compare and contrast the attributes of a shape and its dilation(s) on a coordinate plane.** ***Supporting Standard***	Compare, Contrast THE ATTRIBUTES OF A SHAPE AND ITS DILATION(S) ON A COORDINATE PLANE Including, but not limited to:

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		• Dilation – a transformation in which an image is usually enlarged or reduced, depending on the scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are proportional creating similar figures
		  ◦ Enlargement (scale factor >1)
		  ◦ Reduction (0 < scale factor < 1)
		  ◦ Congruent (scale factor = 1)
		• Prime notation of image points
		  ◦ Prime marks
		  • Ex: *ABCD* is the original figure or pre-image and *A'B'C'D'* is the name of the image. *A'B'C'D'* is read as *"A* prime, *B* prime, *C* prime, *D* prime".
		• Coordinate plane (all four quadrants)
		• Similar shapes – shapes whose angles are congruent and side lengths are proportional (equal scale factor)
		  ◦ The order of the letters determines corresponding side lengths and angles.
		• Notation for similar shapes
		  ◦ Symbol for similarity (~) read as "similar to"
		• Attributes of similar shapes
		  ◦ Corresponding sides are proportional.
		  ◦ Corresponding angles are congruent.
		
		Note(s):
		
		• Grade Level(s):
		  ◦ Grade 7 identified the critical attributes of similarity, including the generalization that the ratio of corresponding sides of similar figures are proportional.
		  ◦ Grade 8 introduces comparing and contrasting the attributes of a shape and its dilation(s) on a coordinate plane.
		  ◦ Various mathematical process standards will be applied to this student expectation as

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		appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		• TxCCRS:
		  ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry
		  • III.B.1. Identify transformations and symmetries of figures.
		  • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures.
		  ◦ III.C. Geometric and Spatial Reasoning – Connections between geometry and other mathematical content strands
		  • III.C.1. Make connections between geometry and algebraic equations.
		  ◦ VII.B. Problem Solving and Reasoning – Proportional reasoning
		  • VII.B.1. Use proportional reasoning to solve problems that require fractions, ratios, percentages, decimals, and proportions in a variety of contexts using multiple representations.

8.3C	**Use an algebraic representation to explain the effect of a given positive rational scale factor applied to two-dimensional figures on a coordinate plane with the origin as the center of dilation.** ***Readiness Standard***	Use AN ALGEBRAIC REPRESENTATION TO EXPLAIN THE EFFECT OF A GIVEN POSITIVE RATIONAL SCALE FACTOR APPLIED TO TWO-DIMENSIONAL FIGURES ON A COORDINATE PLANE WITH THE ORIGIN AS THE CENTER OF DILATION Including, but not limited to: • Positive rational numbers – the set of numbers that can be expressed as a fraction $\frac{a}{b}$, where *a* and *b* are counting (natural) numbers • Various forms of positive rational numbers ◦ Counting (natural) numbers

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		◦ Decimals ◦ Fractions ◦ Percents • Scale factor – the common multiplicative ratio between pairs of related data which may be represented as a unit rate ◦ Dilation – a transformation in which an image is usually enlarged or reduced, depending on the scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are proportional creating similar figures ◦ Enlargement (scale factor >1) ◦ Reduction (0 < scale factor < 1) ◦ Congruent (scale factor = 1) • Coordinate plane (all four quadrants) • Center of dilation – a coordinate point that serves as the focal point for generating a dilation ◦ The ratio of the distance from the center of dilation to any point on the image compared to the distance from the center of dilation to the corresponding point on the pre-image will result in the scale factor, k. ◦ Lines drawn through each point on the pre-image and its corresponding image point will intersect at the center of dilation. ◦ Origin as center of dilation • Algebraic representation to describe effects of dilations ◦ $(x, y) \rightarrow (kx, ky)$, where k is the scale factor used to dilate a figure about the origin • Various representations of dilations ◦ Verbal ◦ Graphical ◦ Tabular ◦ Algebraic Note(s):

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		• Grade Level(s):
		  ◦ Grade 8 introduces using an algebraic representation to explain the effect of a given positive rational scale factor applied to two-dimensional figures on a coordinate plane with the origin as the center of dilation.
		  ◦ Various mathematical process standards will be applied to this student expectation as appropriate.
		• TxRCFP:
		  ◦ Representing, applying, and analyzing proportional relationships
		• TxCCRS:
		  ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry
		  • III.B.1. Identify transformations and symmetries of figures.
		  • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures.
		  ◦ III.C. Geometric and Spatial Reasoning – Connections between geometry and other mathematical content strands
		  • III.C.1. Make connections between geometry and algebraic equations.
		  ◦ VII.B. Problem Solving and Reasoning – Proportional reasoning
		  • VII.B.1. Use proportional reasoning to solve problems that require fractions, ratios, percentages, decimals, and proportions in a variety of contexts using multiple representations.

8.10	***Two-dimensional shapes. The student applies mathematical process standards to develop transformational geometry concepts. The student is expected to:***	
8.10A	**Generalize the properties of orientation and congruence of rotations, reflections, translations,**	Generalize

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	and dilations of two-dimensional shapes on a coordinate plane. ***Supporting Standard***	THE PROPERTIES OF ORIENTATION AND CONGRUENCE OF ROTATIONS, REFLECTIONS, TRANSLATIONS, AND DILATIONS OF TWO-DIMENSIONAL SHAPES ON A COORDINATE PLANE Including, but not limited to: • Properties of orientation ◦ Orientation of the vertices • Orientation of the vertices of an image is determined by naming the vertices in the same order as the corresponding vertices of its pre-image and not determined by a figure's direction or a figure's size. • Orientation of the vertices is preserved when a two-dimensional figure is transformed and the pre-image and image either both have clockwise orientation or both have counterclockwise orientation. ◦ Translations preserve orientation of the vertices. ◦ Rotations preserve orientation of the vertices. ◦ Dilations preserve orientation of the vertices. • Orientation of the vertices is not preserved when a two-dimensional figure is transformed and the pre-image and image are such that one has clockwise orientation and the other has counterclockwise orientation. ◦ Reflections do not preserve orientation of the vertices. • A change in orientation of the vertices implies a change in the orientation of the figure. ◦ Orientation of the figure • Orientation of a figure is determined by the position of the figure on the plane. It is determined by how the figure appears on the plane including the position of the vertices of the figure or any distinguishing mark. • Orientation of the figure is preserved when a two-dimensional figure is transformed and the pre-image and image both face the same direction on the plane. ◦ Translations preserve orientation of the figure.

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		◦ Dilations preserve orientation of the figure. • Orientation of the figure is not preserved when a two-dimensional figure is transformed and the pre-image and image are such that they do not face the same direction on the plane. ◦ Rotations do not preserve orientation of the figure. • Exception, rotations of 360° do preserve orientation of the figure. ◦ Reflections do not preserve orientation of the figure. • A change in the orientation of the figure may not mean a change in the orientation of the vertices. • Property of congruence ◦ Congruence is preserved when a two-dimensional figure is transformed and the image is identical in shape and identical in size. ◦ Congruence is not preserved when a two-dimensional figure is transformed and the image is not identical in shape and/or identical in size. • Prime notation of image points ◦ Prime marks • Ex: *ABCD* is the original figure or pre-image and *A'B'C'D'* is the name of the image. *A'B'C'D'* is read as *"A* prime, *B* prime, *C* prime, *D* prime". • Coordinate plane (all four quadrants) • Transformation and properties of orientation and congruence ◦ Rotation – a transformation frequently described as a turn of a figure around a designated point • Origin as center of rotation ◦ Reflection – a transformation frequently described as a flip or a mirror image of the original figure ◦ Translation – a transformation frequently described as a slide of a figure ◦ Dilation – a transformation in which an image is usually enlarged or reduced, depending on the scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are

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		proportional creating similar figures • Enlargement (scale factor > 1) • Reduction (0 < scale factor < 1) • Congruent (scale factor = 1) • Generalizations of the properties of orientation considering only one transformation ◦ Orientation of the vertices is preserved for rotations, translations, and dilations. ◦ Orientation of the vertices is not preserved for reflections. ◦ Orientation of the figure is preserved for translations and dilations. ◦ Orientation of the figure is not preserved for reflections and rotations, except for rotations of 360°. • Generalization of the property of congruence considering only one transformation ◦ Congruence is preserved for rotations, reflections, translations, and dilations with a scale factor of 1. ◦ Congruence is not preserved for dilations • Enlargements for positive scale factors greater than 1 • Reductions for positive scale factors greater than 0 but less than 1 Note(s): • Grade Level(s): ◦ Grade 8 introduces generalizing the properties of orientation and congruence of rotations, reflections, translations, and dilations of two-dimensional shapes on a coordinate plane. ◦ Geometry introduces rotations and dilations that may or may not be about the origin. ◦ Various mathematical process standards will be applied to this student expectation as appropriate. • TxRCFP: ◦ Grade Level Connections (reinforces previous learning and/or provides development for future learning) • TxCCRS: ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry

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		• III.B.1. Identify transformations and symmetries of figures. • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures. ◦ III.C. Geometric and Spatial Reasoning – Connections between geometry and other mathematical content strands • III.C.1. Make connections between geometry and algebraic equations.
8.10B	**Differentiate between transformations that preserve congruence and those that do not.** ***Supporting Standard***	Differentiate BETWEEN TRANSFORMATIONS THAT PRESERVE CONGRUENCE AND THOSE THAT DO NOT Including, but not limited to: • Property of congruence ◦ Congruence is preserved when a two-dimensional figure is transformed and the image is identical in shape and identical in size. ◦ Congruence is not preserved when a two-dimensional figure is transformed and the image is not identical in shape and/or identical in size. • Generalization of the property of congruence considering only one transformation ◦ Congruence is preserved for rotations, reflections, translations, and dilations with a scale factor of 1. ◦ Congruence is not preserved for dilations • Enlargements for positive scale factors greater than 1 • Reductions for positive scale factors greater than 0 but less than 1 • Prime notation of image points ◦ Prime marks • Various representations of transformations to determine congruence (verbal, graphical, tabular, algebraic) ◦ Rotation – a transformation frequently described as a turn of a figure around a

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		designated point • Origin as center of rotation • Algebraic notation ◦ Rotation of 90° counterclockwise around the origin: $(x, y) \rightarrow (-y, x)$, • Same as a rotation of 270° clockwise around the origin: $(x, y) \rightarrow (-y, x)$ ◦ Rotation of 180º counterclockwise around the origin: $(x, y) \rightarrow (-x, -y)$ • Same as a rotation of 180º clockwise around the origin: $(x, y) \rightarrow (-x, -y)$ ◦ Rotation of 270º counterclockwise around the origin: $(x, y) \rightarrow (y, -x)$ • Same as a rotation of 90º clockwise around the origin: $(x, y) \rightarrow (y, -x)$ ◦ Rotation of 360° counterclockwise or clockwise around the origin: $(x, y) \rightarrow (x, y)$ ◦ Reflection – a transformation frequently described as a flip or a mirror image of the original figure • Algebraic notation ◦ Reflection across the vertical axis • $(x, y) \rightarrow (-x, y)$ ◦ Reflection across the horizontal axis • $(x, y) \rightarrow (x, -y)$ ◦ Translation – a transformation frequently described as a slide of a figure • Algebraic notation ◦ Translation h units horizontally • $(x, y) \rightarrow (x + h, y)$ ◦ Translation k units vertically • $(x, y) \rightarrow (x, y + k)$ ◦ Translation h units horizontally and k units vertically • $(x, y) \rightarrow (x + h, y + k)$

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		◦ Dilation – a transformation in which an image is usually enlarged or reduced, depending on the scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are proportional creating similar figures • Enlargement (scale factor > 1) • Reduction (0 < scale factor < 1) • Congruent (scale factor = 1) • Positive, rational number scale factors • Algebraic notation ◦ Dilation of scale factor k • $(x, y) \rightarrow (kx, ky)$ Note(s): • Grade Level(s): ◦ Grade 8 introduces differentiating between transformations that preserve congruence and those that do not. ◦ Geometry introduces rotations and dilations that may or may not be about the origin. ◦ Various mathematical process standards will be applied to this student expectation as appropriate. • TxRCFP: ◦ Grade Level Connections (reinforces previous learning and/or provides development for future learning) • TxCCRS: ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry • III.B.1. Identify transformations and symmetries of figures. • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures. ◦ III.C. Geometric and Spatial Reasoning – Connections between geometry and other mathematical content strands

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		• III.C.1. Make connections between geometry and algebraic equations.

8.10C	**Explain the effect of translations, reflections over the *x*- or *y*-axis, and rotations limited to 90°, 180°, 270°, and 360° as applied to two-dimensional shapes on a coordinate plane using an algebraic representation.** ***Readiness Standard***	Explain
		
		THE EFFECT OF TRANSLATIONS, REFLECTIONS OVER THE *x*- OR *y*-AXIS, AND ROTATIONS LIMITED TO 90°, 180°, 270°, AND 360° AS APPLIED TO TWO-DIMENSIONAL SHAPES ON A COORDINATE PLANE USING AN ALGEBRAIC REPRESENTATION
		
		Including, but not limited to:
		
		• Prime notation of image points
		  ◦ Prime marks
		• Coordinate plane (all four quadrants)
		• Single transformations
		• Effects of transformations as algebraic representations
		  ◦ Translation – a transformation frequently described as a slide of a figure
		  • Algebraic notation
		  ◦ Translation *h* units horizontally
		  • $(x, y) \rightarrow (x + h, y)$
		  ◦ Translation *k* units vertically
		  • $(x, y) \rightarrow (x, y + k)$
		  ◦ Translation *h* units horizontally and *k* units vertically
		  • $(x, y) \rightarrow (x + h, y + k)$
		  ◦ Reflection – a transformation frequently described as a flip or a mirror image of the original figure
		  • Algebraic notation
		  ◦ Reflection across a vertical axis (*y*-axis)
		  • $(x, y) \rightarrow (-x, y)$
		  ◦ Reflection across a horizontal axis (*x*-axis)

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		• $(x, y) \rightarrow (x, -y)$ ◦ Rotation – a transformation frequently described as a turn of a figure around a designated point • Origin as center of rotation ◦ Algebraic notation • Rotation of 90° counterclockwise around the origin: $(x, y) \rightarrow (-y, x)$ ◦ Same as a rotation of 270° clockwise around the origin: $(x, y) \rightarrow (-y, x)$ • Rotation of 180º counterclockwise around the origin: $(x, y) \rightarrow (-x, -y)$ ◦ Same as a rotation of 180º clockwise around the origin: $(x, y) \rightarrow (-x, -y)$ • Rotation of 270º counterclockwise around the origin: $(x, y) \rightarrow (y, -x)$ ◦ Same as a rotation of 90º clockwise around the origin: $(x, y) \rightarrow (y, -x)$ • Rotation of 360° counterclockwise or clockwise around the origin: $(x, y) \rightarrow (x, y)$ • Determine the transformation performed from a graphed set of figures. • Graph a transformation based on a given rule. Note(s): • Grade Level(s): ◦ Grade 8 introduces explaining the effect of translations, reflections over the *x*- or *y*-axis, and rotations limited to 90°, 180°, 270°, and 360° as applied to two-dimensional shapes on a coordinate plane using an algebraic representation. ◦ Geometry introduces rotations and dilations that may or may not be about the origin. ◦ Geometry introduces composite transformations. ◦ Various mathematical process standards will be applied to this student expectation as appropriate.

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		• TxRCFP:
		  ◦ Grade Level Connections (reinforces previous learning and/or provides development for future learning)
		• TxCCRS:
		  ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry
		  • III.B.1. Identify transformations and symmetries of figures.
		  • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures.
		  ◦ III.C. Geometric and Spatial Reasoning – Connections between geometry and other mathematical content strands
		  • III.C.1. Make connections between geometry and algebraic equations.

8.10D	**Model the effect on linear and area measurements of dilated two-dimensional shapes.**
	Supporting Standard
		Model
		
		THE EFFECT ON LINEAR AND AREA MEASUREMENTS OF DILATED TWO-DIMENSIONAL SHAPES
		
		Including, but not limited to:
		
		• Linear measurement
		  ◦ Perimeter – a linear measurement of the distance around the outer edge of a figure
		  ◦ Circumference – a linear measurement of the distance around a circle
		  ◦ Perimeter and circumference are one-dimensional linear measures.
		  ◦ Positive rational number side lengths
		• Area – the measurement attribute that describes the number of square units a figure or region covers
		  ◦ Area is a two-dimensional square unit measure.
		  ◦ Positive rational number side lengths
		• Dilation – a transformation in which an image is usually enlarged or reduced, depending on the

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TEKS# / SE#	TEKS	SPECIFICITY
		scale factor, in such a way that the angles of the original figure and the dilated figure are congruent and the sides of the original figure and the dilated figure are proportional creating similar figures ◦ Enlargement (scale factor >1) ◦ Reduction (0 < scale factor < 1) ◦ Congruent (scale factor = 1) • Model of the effect on linear and area measurements of dilated two-dimensional figures ◦ Dilating a two-dimensional figure by a scale factor, recording the linear and area measurements of the figure and image, and determining the relationship between the scale factor and measurements • Multiplying linear dimensions of a two-dimensional figure by a constant scale factor results in a proportional one-dimensional measure (perimeter/circumference). • Multiplying linear dimensions of a two-dimensional figure by a constant scale factor results in a two-dimensional measure (area) that is equivalent to the original area multiplied by the scale factor squared. • Generalizations of the effects on linear and area measurements of dilated two-dimensional figures ◦ Linear measurements of a figure dilated by a scale factor of *a*, result in linear measurements of its image multiplied by *a*. ◦ Linear measurements of a figure dilated by a scale factor of *a*, result in area measurements of its image multiplied by a^2. Note(s): • Grade Level(s): ◦ Grade 8 introduces modeling the effect on linear and area measurements of dilated two-dimensional shapes. ◦ Geometry describes how changes in the linear dimensions of a shape affect the two- and three-dimensional measures.

TITLE : Unit 07: Transformational Geometry **SUGGESTED DURATION :** 12 days

TEKS# / SE#	TEKS	SPECIFICITY
		◦ Various mathematical process standards will be applied to this student expectation as appropriate. • TxRCFP: ◦ Representing, applying, and analyzing proportional relationships. • TxCCRS: ◦ I.C. Numeric Reasoning – Systems of measurement • I.C.1. Select or use the appropriate type of method, unit, and tool for the attribute being measured. ◦ III.B. Geometric and Spatial Reasoning – Transformations and symmetry • III.B.1. Identify transformations and symmetries of figures. • III.B.2. Use transformations to investigate congruence, similarity, and symmetries of figures. ◦ III.C. Geometric and Spatial Reasoning – Connections between geometry and other mathematical content strands • III.C.1. Make connections between geometry and algebraic equations. ◦ III.D. Geometric and Spatial Reasoning – Measurements involving geometry and algebra • III.D.1. Find the perimeter and area of two-dimensional figures. • III.D.2. Determine the surface area and volume of three-dimensional figures. • III.D.3. Determine indirect measurements of geometric figures using a variety of methods. ◦ VII.B. Problem Solving and Reasoning – Proportional reasoning • VII.B.1. Use proportional reasoning to solve problems that require fractions, ratios, percentages, decimals, and proportions in a variety of contexts using multiple representations.

Instructional Focus Document
Grade 8 Mathematics

TITLE : Unit 07: Transformational Geometry **SUGGESTED DURATION :** 12 days

ELPS#	SUBSECTION C: CROSS-CURRICULAR SECOND LANGUAGE ACQUISITION ESSENTIAL KNOWLEDGE AND SKILLS.

The English Language Proficiency Standards (ELPS), as required by 19 Texas Administrative Code, Chapter 74, Subchapter A, §74.4, outline English language proficiency level descriptors and student expectations for English language learners (ELLs). School districts are required to implement ELPS as an integral part of each subject in the required curriculum.

School districts shall provide instruction in the knowledge and skills of the foundation and enrichment curriculum in a manner that is linguistically accommodated commensurate with the student's levels of English language proficiency to ensure that the student learns the knowledge and skills in the required curriculum.

School districts shall provide content-based instruction including the cross-curricular second language acquisition essential knowledge and skills in subsection (c) of the ELPS in a manner that is linguistically accommodated to help the student acquire English language proficiency.
http://ritter.tea.state.tx.us/rules/tac/chapter074/ch074a.html#74.4

Choose appropriate ELPS to support instruction.

Last Updated 08/01/2018