Core Content

Cluster Title: Understand congruence and similarity using physical models, transparencies, or geometry software.
Standard: Verify experimentally the properties of rotations, reflections, and translations: a) Lines are taken to lines, and line segments to line segments of the same length. b) Angles are taken to angles of the same measure. c) Parallel lines are taken to parallel lines.
Concepts and Skills to Master
• Verify that congruence of line segments and angles is maintained through rotation, reflection, and translation. • Verify that lines remain lines through rotation, reflection, and translation. • Verify that when parallel lines are rotated, reflected, or translated, each in the same way, they remain parallel lines.

Supports for Teachers

Critical Background Knowledge	
• Know definitions and properties of angles, segments, lines, and parallel lines. • Measure angles and line segments.	
Academic Vocabulary	
line, angle, segment, parallel line, rigid motion, congruent, center of rotation, line of reflection, rotation, reflection, translation, transformation	
Suggested Instructional Strategies	**Resources**
• Use dynamic geometry software or Excel to explore properties of rotations, reflections, and translations. • Use a coordinate grid and apply rules such as (-*x, y*) or (*x, y*+7) to the coordinates of a given figure. Compare the resulting image to the original.	*illuminations.nctm.org/LessonDetail.aspx?ID=U139*. NCTM. (9-12 Lessons: Symmetries II)
Sample Formative Assessment Tasks	
Skill-Based Task Verify that a triangle, when rotated, remains a triangle.	**Problem Task** Create a tessellation using rotations, reflections, and translations.

Core Content

Cluster Title: Understand congruence and similarity using physical models, transparencies, or geometry software.
Standard: Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
Concepts and Skills to Master
• Understand that the congruency of two dimensional figures is maintained while undergoing rigid transformations. • Describe the transformation of a figure as a rotation, reflection, translation or a combination of transformations.

Supports for Teachers

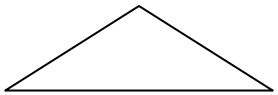
Critical Background Knowledge	
• Identify rotations, reflections, and translations with lines, segments and angles.	
Academic Vocabulary	
rotation, reflection, translation, congruent, center of rotation, line of reflection, angle of rotation	
Suggested Instructional Strategies	**Resources**
• Use geometry software to explore rotations, reflections and translations of two-dimensional figures. • Use digital photographs with at least two congruent shapes and discuss the needed transformations to map one to the other.	*http://illuminations.nctm.org/LessonDetail.aspx?ID=U139.* NCTM. (9-12 Lessons: Symmetries II)

Sample Formative Assessment Tasks

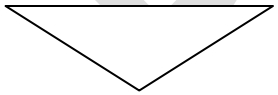
Skill-Based Task

Triangle *x* was transformed to *x*'. Describe the sequence of transformations that was used to show that Triangle *x* is congruent to Triangle *x*'.

Triangle *x*

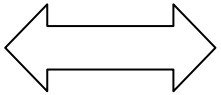


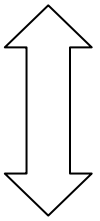
Triangle *x*'



Problem Task

Find at least two different ways to describe the transformation(s) that map the first figure onto the second.





Core Content

Cluster Title: Understand congruence and similarity using physical models, transparencies, or geometry software.
Standard: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
Concepts and Skills to Master
• Understand how to dilate, translate, rotate, and reflect two-dimensional figures on the coordinate plane. • Describe the effects of dilations, translations, rotations, and reflections using coordinate notation. • Given an image and its transformed image, use coordinate notation to describe the transformation.

Supports for Teachers

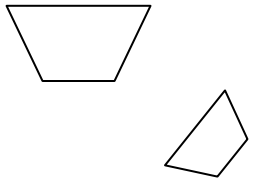
Critical Background Knowledge	
• Plot or identify points on the coordinate plane.	
Academic Vocabulary	
transformation, coordinate, dilation, rotation, reflection, translation, image, center of rotation, line of reflection, angle of rotation	
Suggested Instructional Strategies	**Resources**
• Have students take pictures of transformations they see in the world around them, then overlay the picture with the coordinate plane and describe the transformation using coordinate notation. • Use a coordinate grid and apply rules such as (-*x*, *y*) or (*x*, *y*+7) to the coordinates of a given figure. Compare the resulting image to the original.	*shodor.org.* Shodor. The Transmographer

Sample Formative Assessment Tasks	
Skill-Based Task Given a triangle with vertices at (5, 2), (-7, 8) and (0, 4), find the new vertices of the triangle after undergoing the transformation described as follows: $(x, y) \rightarrow (x+6, y-3)$	**Problem Task** Given an original shape and its image on a coordinate plane, determine the rule or rules that translated the original to the resulting image. The vertices of Triangle A are (1,0), (1,1), (0,0) and Triangle A' are (2,1), (2,2), (3,1). Describe the series of transformations performed on Triangle A that result in Triangle A'.

Core Content

Cluster Title: Understand congruence and similarity using physical models, transparencies, or geometry software.
Standard: Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
Concepts and Skills to Master
• Understand that any combination of transformation will result in similar figures. • Describe the sequence of transformations needed to show how one figure is similar to another. • Make dilations of figures by a given scale factor.

Supports for Teachers

Critical Background Knowledge	
• Perform rotations, translations, reflections, and dilations. • Understand proportions.	
Academic Vocabulary	
similar, similarity, dilation, rotation, reflection, translation, transformation	
Suggested Instructional Strategies	**Resources**
• Use Patty Paper transformations. • Use dynamic geometry software to make transformations and compare transformations.	
Sample Formative Assessment Tasks	
Skill-Based Task. Which of the following transformations will result in a similar figure? A) $(3x, 2y)$ B) $(-x+2, y-2)$ C) $(5x, y+5)$ D) $(3x, x+y)$	**Problem Task** List the sequence of transformations that verifies the similarity of the two figures. 

Core Content

Cluster Title: Understand congruence and similarity using physical models, transparencies, or geometry software.
Standard: Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.
Concepts and Skills to Master
• Understand that the measure of an exterior angle of a triangle is equal to the sum of the measures of the non-adjacent angles. • Know that the sum of the angles of a triangle equals 180^{o}. • Determine the relationship between corresponding angles, alternate interior angles, alternate exterior angles, vertical pairs, and supplementary pairs when parallel lines are cut by a transversal. • Recognize that if two triangles have two congruent angles, then they are similar triangles (angle-angle).

Supports for Teachers

Critical Background Knowledge	
• Understand the definition of similar figures. • Know how to measure angles.	
Academic Vocabulary	
corresponding angles, alternate interior angles, alternate exterior angles, consecutive interior angles, supplementary pairs, vertical pairs, transversal, adjacent, non-adjacent, exterior angle of a triangle, remote interior angles of a triangle	
Suggested Instructional Strategies	**Resources**
• Use a series of transformations of triangles to produce parallel lines and examine the properties of resultant angles and triangles. 	

Sample Formative Assessment Tasks	
Skill-Based Task Identify and name sets of angles of parallel lines cut by a transversal and tell which are congruent.	**Problem Task** The streets 400 E and 900 E run north and south. Euclid Drive cuts both of these streets at an angle from SE to NW. Pythagoras Way passes through all three streets SW to NE. Are all possible triangles created by the intersection of the streets similar? Justify.