Module 1 Overview
Transforming Geometric Objects

"Congruence and similarity are central relational concepts in the study of geometry. An understanding of these relationships provides students with tools to investigate and analyze other relationships among, and properties of, shapes (e.g., transformations and how they function). These geometric relationships help to connect many concepts within geometry and to link geometry itself to other areas of mathematics and to problems in the world around us." (*Focus in High School Mathematics: Reasoning and Sense Making in Geometry*, p. 5)

Why is this Module named Transforming Geometric Objects?

Transforming Geometric Objects engages students in transforming geometric and non-geometric objects using translations, reflections, rotations, and dilations. Students use transformations to develop understanding of congruence and similarity. They then use congruence and similarity, along with transformations, to establish geometric facts about triangles, similar triangles, and the relationships between special angles pairs formed when parallel lines are intersected by a transversal. Throughout the module, students use transformations to build new knowledge and develop conceptual understanding of geometric concepts.

What is the mathematics of Transforming Geometric Objects?

Transforming Geometric Objects contains three topics: *Rigid Motion Transformations, Similarity,* and *Line and Angle Relationships*.

Rigid Motion Transformations uses isometries to establish the meaning of congruence. Students begin by discussing slides, flips, and turns, and then transition to the formal language of translations, reflections, and rotations. They use patty paper and coordinates to investigate properties of the rigid motions and use sequences of rigid motions to map congruent figures onto each other, both on and off the coordinate plane.

Similarity connects scale factors and ratio with dilations. Students learn that dilated figures are also similar figures, with congruent corresponding angles and a constant ratio of corresponding side lengths. They investigate the effect of dilations on the coordinates of figures and use sequences of transformations (translations, rotations, reflections, and dilations) to illustrate the similarity between two figures.

Line and Angle Relationships begins with students exploring different pairs of angles by definition and creating angles with

patty paper in order to understand the relationships between the angles. They also write and solve equations involving angle pairs. Next, the topic requires students to apply transformations, congruence, and similarity to establish important geometric facts about triangles, similar triangles, and the special angle relationships formed when parallel lines are intersected by a transversal. Students use geometric tools to create informal arguments; they use models of triangles, patty paper transformations, and abstract visual transformations. They apply the new geometric facts to determine unknown angle measures, draw conclusions about the relationships between triangle side and angle measures, and determine if triangles are similar.

How is Transforming Geometric Objects connected to prior learning?

Transforming Geometric Objects builds on students' long-developing geometric knowledge. Early on, students learned that an object's name is not dependent on orientation or size, setting the foundation for similarity. Later, students identified lines of symmetry, lighting the way for the study of reflections and congruence. In this module, students also build on their knowledge of operations with

rational numbers, proportionality, scale drawings, uniqueness of triangles, and angles formed when two lines intersect. Students will use their knowledge of operations with rational numbers to determine the effects on coordinates of figures after transformations. Proportional relationships and scale factors are used as students develop understanding of dilations in terms of coordinates and determine if figures are similar. Students' experimentation with triangles and their understanding of supplementary, vertical, and adjacent angles provide the background knowledge for using congruence and similarity to establish geometric facts about triangle properties and special angle relationships.

When will students use knowledge from Transforming Geometric Objects in future learning?

This module provides students with opportunities to build intuition and conceptual understanding of formal transformations and the relationships of figures created from transformations (congruence or similarity).

Transformations and similarity will be revisited in Module 2. Students will use

similar triangles to explain why the slope between any two points on a line is the same. They will then use translations, dilations, and reflections to transform the graph and equation of the line $y = x$, and describe the resulting graph and equation. These connections will be used and expanded upon throughout high school algebra.

In high school, congruence and similarity will be formally developed in coherent ways, providing students with tools to investigate, construct, and prove a wide variety of geometric concepts. Congruence and similarity, including understanding these ideas in the context of transformations, is the major focus of high school geometry.