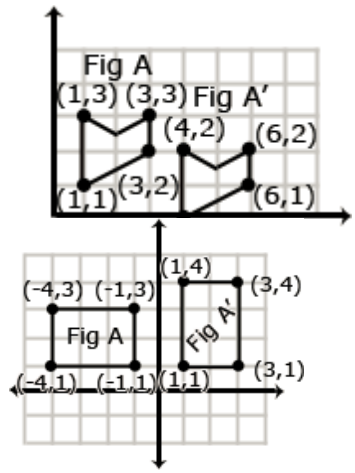
Unit 11: Transformations and Congruence

Cluster: Understand congruence and similarity using physical models, transparencies, or geometry software.

Nevada Academic Content Standard	What does this standard mean that a student will know and be able to do? (adapted from North Carolina *8th Grade Standards, Unpacked Content*)
8.G.A.1 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.	**8.G.1** Students use compasses, protractors and rulers or technology to explore figures created from translations, reflections and rotations. Characteristics of figures, such as lengths of line segments, angle measures and parallel lines, are explored before the transformation (pre-image) and after the transformation (image). Students understand that these transformations produce images of exactly the same size and shape as the pre-image and are known as rigid transformations.
8.G.A.2 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.	**8.G.2** This standard is the students' introduction to congruency. Congruent figures have the same shape and size. Translations, reflections and rotations are examples of rigid transformations. A rigid transformation is one in which the pre-image and the image both have exactly the same size and shape since the measures of the corresponding angles and corresponding line segments remain equal (are congruent). Students examine two figures to determine congruency by identifying the rigid transformation(s) that produced the figures. Students recognize the symbol for congruency (≅) and write statements of congruency. *Example 1:* Is Figure *A* congruent to Figure *A*′? Explain how you know. *Solution:* These figures are congruent since *A*′ was produced by translating each vertex of Figure *A* 3 to the right and 1 down. *Example 2:* Describe the sequence of transformations that results in the transformation of Figure *A* to Figure *A*′. *Solution:* Figure *A*′ was produced by a 90º clockwise rotation around the origin.



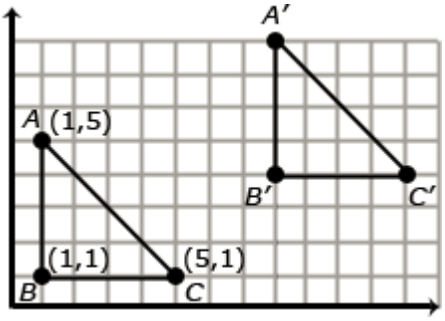
8.G.A.3
Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8.G.3 Students identify resulting coordinates from translations, reflections, and rotations (90º, 180º and 270º both clockwise and counterclockwise), recognizing the relationship between the coordinates and the transformation.

Translations

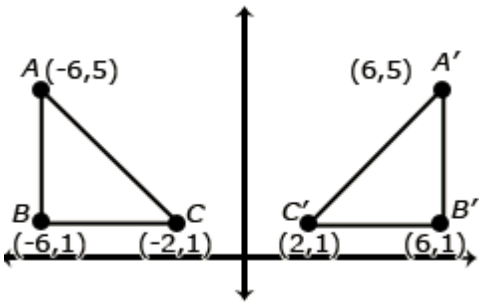
Translations move the object so that every point of the object moves in the same direction as well as the same distance. In a translation, the translated object is *congruent* to its pre-image.

Triangle *ABC* has been translated 7 units to the right and 3 units up. To get from *A* (1,5) to *A′* (8,8), move *A* 7 units to the right (from $x = 1$ to $x = 8$) and 3 units up (from $y = 5$ to $y = 8$). Points *B* and *C* also move in the same direction (7 units to the right and 3 units up), resulting in the same changes to each coordinate.



Reflections

A reflection is the "flipping" of an object over a line, known as the "line of reflection". In the 8th grade, the line of reflection will be the *x*-axis and the *y*-axis. Students recognize that when an object is reflected across the *y*-axis, the reflected *x*-coordinate is the opposite of the pre-image *x*-coordinate (see figure).

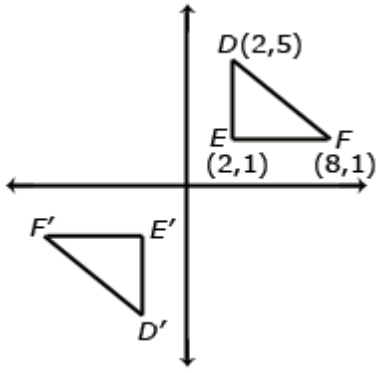


Likewise, a reflection across the *x*-axis would change a pre-image coordinate (3, -8) to the image coordinate of (3, 8) -- note that the reflected *y*-coordinate is opposite of the pre-image *y*-coordinate.

Rotations

A rotation is a transformation performed by "spinning" the figure around a fixed point known as the center of rotation. The figure may be rotated clockwise or counterclockwise up to 360º (at 8th grade, rotations will be around the origin and a multiple of 90º). In a rotation, the rotated object is *congruent* to its pre-image.

Consider when triangle *DEF* is 180° clockwise about the origin. The coordinate of triangle *DEF* are *D*(2,5), E(2,1), and *F*(8,1). When rotated 180° about the origin, the new coordinates are *D′*(-2,-5), *E′*(-2,-1) and *F′*(-8,-1). In this case, each coordinate is the opposite of its pre-image (see figure).



Approximate Time Frame: *2 - 3 weeks*

Terms:

- ✓ transformation
- ✓ pre-image
- ✓ image
- ✓ prime notation
- ✓ translation
- ✓ rotation
- ✓ center of rotation
- ✓ angle of rotation
- ✓ reflection
- ✓ line of reflection
- ✓ congruence

Resources

MGH – McGraw Hill, Glencoe Math (2015)
ML – McDougal Littell, Pre-Algebra Book; Larson, 2005
EX – Explorations in Core Math (Holt McDougal)
LZ – Learn Zillion Website
NY – *Engage* New York
IL – Illinois *Model Math Curriculum*
MAP – Math Assessment Project (MARS)

	Suggested Topics for Lessons	***Suggested Resources***
8.G.A.1 **8.G.A.3**	**Introduce Transformations: Translations, Reflections, Rotations** SBAC Evidence: ➢ The student verifies that rigid transformations preserve distance and angle measures. ➢ The student constructs a new figure after the original figure is dilated, rotated, reflected, or translated. ➢ The student describes the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	➢ MGH 6-1 Inquiry Lab*: Transformations* (page 449) ➢ MGH 6-1 *Translations* (page 453) ➢ MGH 6-2 *Reflections* (page 461) ➢ MGH 6-3 *Rotations* (page 475) ➢ ML 13.4 *Translations* (page 729) ➢ ML 13.5 *Reflections and Symmetry* (page 734) ➢ ML 13.6 *Rotations and Symmetry* (page 741) ➢ EX 5-6 *Transformations* (page 199) ➢ EX 5-7 *Similarity and Congruence Transformations* (page 205) ➢ EX 5-8 *Identifying Combined Transformations* (page 209) ➢ Khan Academy Skills Practice: *8G1 Properties of rotations, reflections, translations* ➢ Khan Academy Skills Practice: *8G3 Effect of transformations using coordinates* ➢ IL Unit *3 Congruence and Similarity: Lesson 1of 3* ➢ NY Module 2, Topic A, Lessons 1-6: *Definitions & Properties of Basic Rigid Motions* ➢ NY Module 2, Topic B, Lessons 7-10: *Sequencing the Basic Rigid Motions* ➢ NY Module 2, Topic C, Lessons 11: *Definition of Congruence & Some Basic Prop* ➢ PBS Learning Media: *Math Shorts Video—Translation* ➢ PBS Learning Media: *Math Shorts Video—Rotation* ➢ PBS Learning Media: *Math Shorts Video—Reflection* ➢ PBS Learning Media: *Translations and Reflections* ➢ YouTube: *Gangnam Style Math (Transformation Style) Fun Learning Math!* ➢ MAP Assessment Lesson: *Representing and Combining Transformations* ➢ MAP Assessment Task: *Aaron's Design* ➢ Kaplinsky: *Ms. Pac-Man and Transformations* ➢ Louisiana Extended Response: *Transformations, page 165* ➢ Louisiana Instructional Task: *Game Design, page 188* ➢ VA Lesson: *Transformations*

		➢ LZ Lesson Set: *Verify properties of rotations, reflections and translations (Knab)* ➢ LZ Lesson Set: *Verify properties of rotations, reflections and translations (Ogean)* ➢ LZ Lesson Set: *Describe the effect of translations, ….using coordinates (Knab)* ➢ LZ Lesson Set: *Describe the effect of translations, ….using coordinates (Ogean)*
8.G.A.2	**Congruence** SBAC Evidence: ➢ The student describes sequences of rotations, reflections, translations, and dilations that can verify whether two dimensional figures are similar or congruent to each other.	➢ MGH 7-1 Inquiry Lab*: Composition of Transformations* (page 505) ➢ MGH 7-1 *Congruence and Transformations* (page 509) ➢ MGH 7-2 Inquiry Lab*: Investigate Congruent Triangles* (page 517) ➢ MGH 7-2 *Congruence* (page 521) ➢ EX 5-7 *Similarity and Congruence Transformations* (page 205) ➢ EX 5-8 *Identifying Combined Transformations* (page 209) ➢ PBS Learning Media: *Defining Congruence/School Yourself Geometry* ➢ LZ Lesson Set: *Understand congruency in two-dimensional figures (Knab)* ➢ LZ Lesson Set: *Assess congruence using rotations, reflections and translations (Ogean)* ➢ Khan Academy Skills Practice: *8G2 Exploring rigid transformations and congruence*