Sept. 30, 2015

8th Grade Module 2
The Concept of Congruence

Topic A: Definitions and Properties of the Basic Rigid Motions

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.

Materials provided: 3 boxes of Patty Paper (1000 sheets per box) provided to each Middle School.

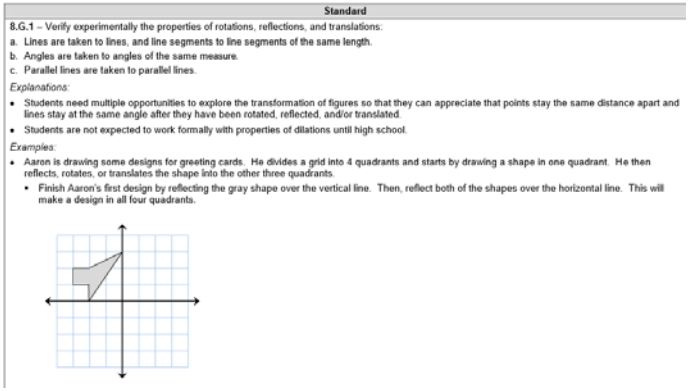
Lesson 1: Why Move Things Around?

Lesson Hints	Additional Supports/ Materials	I can…
• Use Patty Paper to help kids move objects on either a coordinate plane or sheet of paper. • Reinforce terminology (picture reference is also recommended)	• Patty Paper • Overhead projector transparencies • Fine point dry-erase markers • Felt cloth or other eraser (one per student, or per pair)	• Use appropriate vocabulary to describe and create a rigid transformation (rotations, reflection, and translation). • Understand image and pre-image are congruent in rigid transformations.

Lesson 2: Definition of Translations and Three Basic Properties

Lesson Helps	Additional Supports/ Materials	I can…
• Consider showing several examples of vectors that can be used instead of just one. • Post new vocabulary words, definitions, and related symbolic notation in a prominent location in the room. • Video presentation in teacher's edition (GeoGebra)	• http://www.geogebra.org/cms/en/ (free download to use on your smart board)	• Draw a translation along a vector and use appropriate labels. • Understand that translations preserve segment lengths, type, and degrees of angles.

SBAC Connection



Standard

8.G.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.

Explanations:

- Students need multiple opportunities to explore the transformation of figures so that they can appreciate that points stay the same distance apart and lines stay at the same angle after they have been rotated, reflected, and/or translated.
- Students are not expected to work formally with properties of dilations until high school.

Examples:

- Aaron is drawing some designs for greeting cards. He divides a grid into 4 quadrants and starts by drawing a shape in one quadrant. He then reflects, rotates, or translates the shape into the other three quadrants.
  - Finish Aaron's first design by reflecting the gray shape over the vertical line. Then, reflect both of the shapes over the horizontal line. This will make a design in all four quadrants.

To view or use these examples, copy and paste into a word document.

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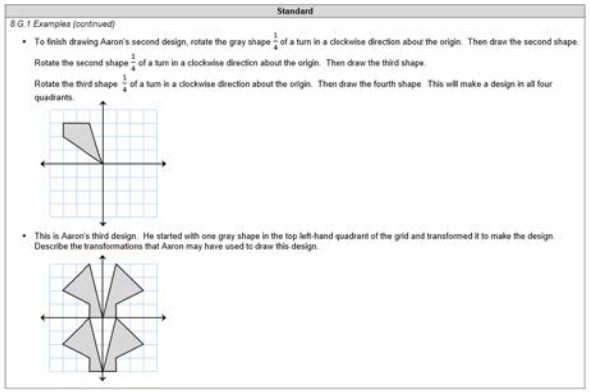
Lesson 3: Translating Lines (Socratic Discussion)

Lesson Helps	Additional Supports/ Materials	I can…
• Students complete Exercise 1 independently in preparation for the **Socratic discussion** that follows. • We use the notation $Translatio(L)$. We want to make clear the basic rigid motion that is being performed, so the notation: $Translatio(L)$ is written to mean "the translation of L along the specified vector."		• Understand that translated lines are parallel. • Write statements that explain the process of transformation as well as the conclusion.

Lesson 4: Definition of Reflection and Basic Properties

Lesson Helps	Additional Supports/ Materials	I can…
• Show that reflections share some of the same fundamental properties with translations (e.g., lines map to lines, angle and distance)	• Patty Paper	• Understand and can create a reflection across a line • Understand and can model the similarity between reflections and translations using parallel lines


Standard

8.G.1 Examples (continued)

- To finish drawing Aaron's second design, rotate the gray shape $\frac{1}{4}$ of a turn in a clockwise direction about the origin. Then draw the second shape.

Rotate the second shape $\frac{1}{4}$ of a turn in a clockwise direction about the origin. Then draw the third shape.

Rotate the third shape $\frac{1}{4}$ of a turn in a clockwise direction about the origin. Then draw the fourth shape. This will make a design in all four quadrants.

- This is Aaron's third design. He started with one gray shape in the top left-hand quadrant of the grid and transformed it to make the design. Describe the transformations that Aaron may have used to draw this design.

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Lesson 5: Definition of Rotation and Basic Properties			
Lesson Helps	Additional Supports/ Materials	I can…	
• Show how to read a protractor (may be a new learning or just a review.) • Show that rotations preserve lengths of segments and degrees of measures angles. • **Positive** degree of rotation moves the figure **counterclockwise** and a **negative** degree of rotation moves the figure **clockwise.** • Two weblinks (Geogebra) included.	• Patty Paper • Protractors (class set)	• Rotate a figure around a given center. • Understand that rotation preserves lengths and angle measures.	
Lesson 6: Rotations of 180 Degrees			
Lesson Helps	Additional Supports/ Materials	I can…	
• Rotations of 180 degrees	• Patty Paper • Protractors (class set)	• Understand that rotating a point 180 degrees on a coordinate plane changes the point from (a, b) to (-a,-b). • Understand that rotations of 180 degrees about a point creates a parallel line.	

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Topic B: Sequencing the Basic Rigid Motions

8.G.A.2 Understand that 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.

Lesson 7: Sequencing Translations

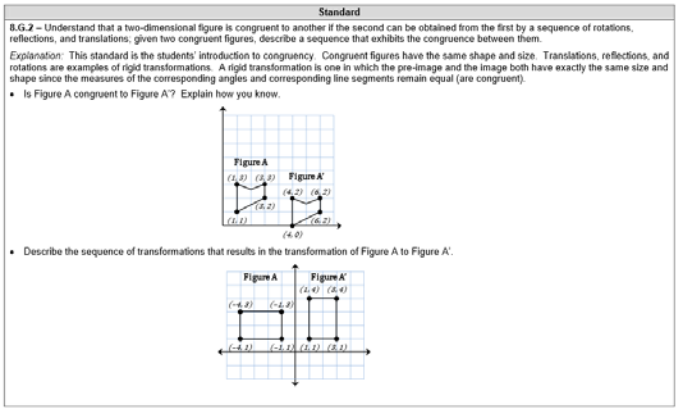
Lesson Helps	Additional Supports/ Materials	I can…
• Students learn about sequence of transformations	• Patty Paper • Protractors (class set)	• Describe the sequence of transformation from one figure to another. • Describe the sequence of transformations along a vector of one figure back to the original position.

Lesson 8: Sequencing Reflections and Translations

Lesson Helps	Additional Supports/ Materials	I can…
• Video link provided about general idea of sequencing.	• Patty Paper • Protractors (class set)	• Understand the relationship between reflection and inverse transformations. • Model and explain that the sequence is important in rigid transformations.

Lesson 9: Sequencing Rotations (Exploratory Challenge)

Lesson Helps	Additional Supports/ Materials	I can…



To view or use these examples, copy and paste into a word document.

• May need teacher modeling to support the sequence of rigid motions.	• Patty Paper • Protractors (class set)	• Describe the sequence of rotations that will map a triangle to its original position. • Describe the sequence of rotations that will map a triangle to its original position.	
Lesson 10: Sequences of Rigid Motions			
Lesson Helps	Additional Supports/ Materials	I can…	
• Modeling using Geogebra is an option.	• Patty Paper • Grid Paper • Protractors (class set)	• Describe the sequence of transformations used to map one figure onto another.	

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Topic C: Congruence and Angle Relationships

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.A.5

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.*

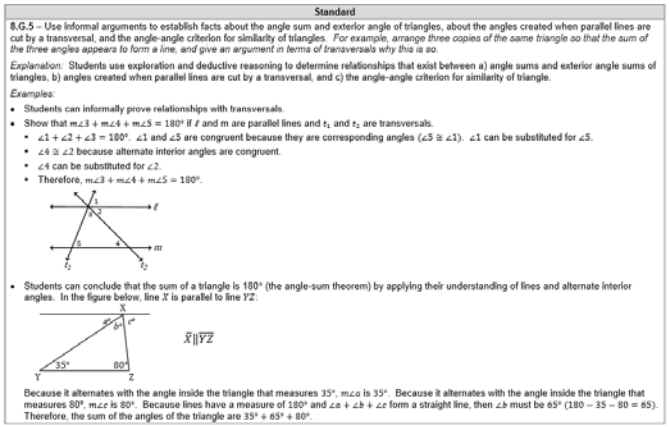
Lessons 11: Definition of Congruence and Some Basic Properties

Lesson Helps	Additional Supports/ Materials	I can…
• Use the properties and notation of congruency (≅). • **Congruence is now realized** as "a sequence of basic rigid motions that maps one figure onto another". • Great lessons for students to manipulate using the Smartboard.	• Patty Paper • Grid Paper • Protractors (class set)	• Explain the definition of congruence and represent congruence corrections using symbols. • Determine if two figures are congruent by identifying the transformation used to produce one figure onto the other.

Lessons 12: Angles Associated with Parallel Lines (Exploratory Challenge)

Lesson Helps	Additional Supports/ Materials	I can…
• Several new vocabulary terms about angle relationships, a visual display of these is a great tool for learning. • Kuta is a great resource for reinforcement.	• Protractors (class set) • Grid paper	• Understand the relationship between corresponding angles, alternate interior angles, and alternate exterior angles and parallel

SBAC Connections



Standard

8.G.5 – 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.*

Explanation: Students use exploration and deductive reasoning to determine relationships that exist between a) angle sums and exterior angle sums of triangles, b) angles created when parallel lines are cut by a transversal, and c) the angle-angle criterion for similarity of triangle.

Examples:

- Students can informally prove relationships with transversals.
- Show that $m\angle 3 + m\angle 4 + m\angle 5 = 180°$ if ℓ and m are parallel lines and t_1 and t_2 are transversals.
  - $\angle 1 + \angle 2 + \angle 3 = 180°$. $\angle 1$ and $\angle 5$ are congruent because they are corresponding angles ($\angle 5 \cong \angle 1$). $\angle 1$ can be substituted for $\angle 5$.
  - $\angle 4 \cong \angle 2$ because alternate interior angles are congruent.
  - $\angle 4$ can be substituted for $\angle 2$.
  - Therefore, $m\angle 3 + m\angle 4 + m\angle 5 = 180°$.

- Students can conclude that the sum of a triangle is 180° (the angle-sum theorem) by applying their understanding of lines and alternate interior angles. In the figure below, line X is parallel to line YZ.

$\overleftrightarrow{X} \| \overline{YZ}$

Because it alternates with the angle inside the triangle that measures 35°, $m\angle a$ is 35°. Because it alternates with the angle inside the triangle that measures 80°, $m\angle c$ is 80°. Because lines have a measure of 180° and $\angle a + \angle b + \angle c$ form a straight line, then $\angle b$ must be 65° (180 – 35 – 80 = 65). Therefore, the sum of the angles of the triangle are 35° + 65° + 80°.

To view or use these examples, copy and paste into a word document.

• Introduce the term "Theorem" and "converse of a theorem."		lines. • Explore and justify relationships that exist between angles created when parallel lines are cut by a transversal. • Create informal proofs about angles formed by parallel lines and transversals.	
Lessons 13: Angle sum of a Triangle			
Lesson Helps	Additional Supports/ Materials	I can…	
• Term straight angle is used. • This is a manipulation to use with the Smartboard. • http://www.mathopenref.com/triangleinternalangles.html • Great video using the concept of parallel lines and angles. https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-geometry/cc-8th-triangle-angles/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180 • Paper manipulation of any triangle. http://www.cutoutfoldup.com/406-illustrate-that-	• Grid Paper • Protractors (class set) • There are several options for students to determine the interior sum of a triangle is 180 degrees. ---Depending upon time, student can create the various triangles to share their findings in small group. ---Teachers can create the various (acute, right, obtuse, etc.) triangles and have students measure.	• Draw conclusions about the angle sum of a triangle. • Understand that the sum of the interior angles of a triangle is always 180 degrees (The Angle Sum Theorem).	

interior-angles-of-a-triangle-sum-to-180-.php			
Lessons 14: More on the Angles of a Triangle			
Lesson Helps	Additional Supports/ Materials	I can…	
• Example 1 will be used throughout the lesson. • Term of straight angle is reinforced.	• Protractors (class set)	• Find the missing angle measures of a triangle. • Prove angle sum theorem in multiple ways.	
End of Module Assessment			