Mathematics Curriculum Guide

Plane Geometry ~ Senior Campus

2017-18

Topic 3: Transformations

Transfer Goals
1) Demonstrate perseverance by making sense of a never-before-seen problem, developing a plan, and evaluating a strategy and solution. 2) Effectively communicate orally, in writing, and using models (e.g., concrete, representational, abstract) for a given purpose and audience. 3) Construct viable arguments and critique the reasoning of others using precise mathematical language.

Essential Questions:

- How does a dilation transform a figure?
- How can figures in a plane be transformed, and what are various ways to represent that transformation?
- What are the ways that a regular polygon can be mapped onto itself?
- How can rigid motion transformations be used to show that two figures are congruent?
- How can all rigid transformations be expressed as compositions of reflections?
- How can a composition of isometries be represented in a single transformation?
- What are the properties of a dilation?
- How are the image and pre-image related in a dilation?
- What is the difference between a reduction and an enlargement?

Standards: G-CO 2, G-CO 3, G-CO 4, G-CO 5, G-CO 6, G-CO 7, G-SRT 1, G-SRT 1a, G-SRT 1b

Timeframe: 4 weeks/20 days
Start Date: October 9, 2017
Assessment Dates: November 2-3, 2017

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Resources
2 Days	**Topic Opener – Name Reflection** SMP: 2 G-CO 2, G-CO 4, G-CO 6 **"Kaleidoscope Project"** (see attached)	**Building up to …** How can figures in a plane be transformed and what are various ways to represent that transformation?	• Congruent images can be created by reflecting an image over a line.	**Vocabulary:** congruent images, reflection, image, transformation	• Reflect an image over a line	Graph paper cut into 8 inch by 8 inch squares (one per student plus extra for demonstration and mistakes), color pencils, crayons, etc.

Common Core Practices

- ☐ Instruction in the Standards for Mathematical Practices
- ☐ Use of Talk Moves
- ☐ Note-taking
- ☐ Use of Manipulatives
- ☐ Use of Technology
- ☐ Use of Real-world Scenarios
- ☐ Project-based Learning
- ☐ Thinking Maps

Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 Days	**Lesson 9-1 thru 9-3: Translations, Reflections, Rotations** SMP: 1,3,4,7 (pp. 545-567) **G-CO 2, G-CO 4, G-CO 5, G-CO 6**	**Focus Questions:** • How can figures in a plane be transformed? • What are various ways to represent that transformation? **Inquiry Question:** 9-1 p. 545 Solve It!	• Transformations are functions that take points as inputs and give other points as outputs. • Transformations can be rigid or non-rigid. • The distance between points and the angles in a geometric figure stay the same when it is transformed using rigid motion.	**Vocabulary:** transformation, mapping, rigid motion, non-rigid motion, function notation, input, output, preimage, image, prime notation, corresponding parts, translation, reflection, line of reflection, rotation, center of rotation, angle of rotation	• Represent transformations in the plane using tracing paper. • Describe transformations as functions that take points in the plane as inputs and give other points as outputs. • Compare transformations that preserve distance and angle measure to those that do not (e.g., translation versus horizontal stretch). • Given a geometric figure and a rotation, reflection, or translation (in words, ordered-pair rules, or function notation), draw the transformed figure using graph paper, tracing paper, etc. • Identify a transformation given the coordinates of a preimage and its image or the graph of a preimage and its image • Describe a sequence of transformations that will carry a given figure onto another.	• Tracing Paper **Common Core Problems:** **9.1:** #4, 5, 6, 22, 27, 28, 35 **9.2:** 4, 5, 23, 26, 31, 35 **9.3: #**5, 6, 7, 8, 24, 25, 31, 32, 33, 36, 37, 49 **Thinking Map:** Create a Tree Map with Branches that show examples of translations, reflections, and rotations.
1 day	**Review Lesson 9.1 thru 9.3 Concepts & Skills** Use Textbook Resources and/or Teacher Created Items					
1 day	**Concept Byte: Symmetry** SMP: 7 (pp. 568-569) **G-CO 3**	**Focus Questions:** • What rotations and reflections will carry a polygon onto itself?	• A regular polygon can be carried onto itself using rotational and/or reflectional symmetry	**Vocabulary:** Symmetry, line symmetry, reflectional symmetry, line of symmetry, rotational symmetry, point symmetry	• Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself	

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Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
1 day	**Performance Task: Revisit "Kaleidoscope"** Refer to Notes and Additional Resources **CCSS: G-CO 5** **SMP 7**				• Given a pre-image and its image, write the transformation in function notation. • Identify reflectional and rotational symmetry in a design.	Provide copies of pre-made design or have students work on their own design. Use worksheet at end of this document or similar questions.
3 Days	**Lesson 9-4: Compositions of Isometries** SMP: 1,3,6 (pp. 570-576) **G-CO 5, G-CO 6**	**Focus Question:** • How can a composition of isometries be represented in a single transformation? **Inquiry Question:** 9-4 p. 570 Solve It!	• A translation is a composition of reflections across parallel lines. • A rotation is a composition of reflections across intersecting lines.	**Vocabulary:** isometry, composition of isometries, reflections across parallel lines, reflections across intersecting lines	• Graph a composition of isometries given a composition in function notation • Specify when one transformation could give the same image as a composition • Use composite function notation to describe a sequence of transformations that will carry a given figure onto another.	**Common Core Problems:** **9.4:** #4,5,22.26, 27, 28,40 **Thinking Map:** Create a Flow Map showing the steps for composing reflections across intersecting lines.
3 Days	**Lesson 9-5: Congruence Transformations** SMP: 1,3,4 (pp. 578-585) **G-CO 6, G-CO 7**	**Focus Question:** • Suppose two figures are congruent. What do you know about how the figures are related in the plane? **Inquiry Question:** 9-5 p. 578 Solve It!	• If two figures can be mapped to each other by a sequence of rigid motions, then the figures are congruent.	**Vocabulary:** congruent, congruence transformation	• Identify congruence transformations. • Prove triangle congruence using isometries.	**Common Core Problems:** **9.5:** #3,4,5, 12, 13, 17-1921, 22, 23, 24, 25, 26, 27, 28

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Time	Lesson/ Activity	Focus Questions for Lessons	Understandings	Knowledge	Skills	Additional Resources
2 Days	**Lesson 9-6: Dilations** SMP: 1,3,4,7 (pp. 587-593) **G-CO 2, G-SRT 1a, G-SRT 1b**	**Focus Question:** • What are the properties of a dilation? • How are the image and pre-image related in a dilation? • What is the difference between a reduction and an enlargement? **Inquiry Question:** 9-6 p. 587 Solve It!	• Properties of dilations • A dilation maps a line segment to a parallel line segment • The distance from center of dilation to the image is equal to the distance from the center of dilation to the pre-image times the scale factor • The length of the image is equal to the length of the pre-image times the scale factor • The center of dilation is on the same line with the pre-image and image points (collinear).	**Vocabulary: s**cale factor, dilation, center of dilation, enlargement, reduction	• Determine the scale factor given a preimage and its image. • Graph an image given a figure and a dilation. • Use composite function notation to describe a sequence of transformations that will carry a given figure onto another when one of the transformations is a dilation.	**Common Core Problems:** **9.6:** #5,6, 34, 35, 36, 39, 44, 45-48
2 Days	**Review Topic 3 Concepts & Skills** Use Textbook Resources and/or Teacher Created Items					
2 Days	**Topic 3 Assessment** (Created and provided by PUSD)					

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PROJECT

Kaleidoscope

An actual kaleidoscope creates its unique design by reflecting a fundamental image (e.g. a group of colorful pebbles) through a series of mirrors. The kaleidoscope design in this activity is created in the same way. However, the fundamental image is an artistic rendering of the student's name, and reflecting lines are substituted for the mirrors.

The fundamental image (the student's name) is reflected over the nearest line, and then the reflected image is subsequently reflected over each successive line until all eight cells of the paper are filled. The next step is to label each type of transformation as a reflection or rotation (the cells alternate between the two options). Stress to the students that the goal is to create a complex pattern in which the original name is no longer recognizable. A unique design should be the final result (see figure on the left). This is best accomplished by making sure that the name reaches from one side of the cell to the other.

Concepts
Transformations, reflections, rotations, composite reflections.

Time: 1 hour

Materials
Student Handout, rulers, paper and colored pencils.

Preparation
Students should be familiar with basic transformations, reflections and rotations in particular.

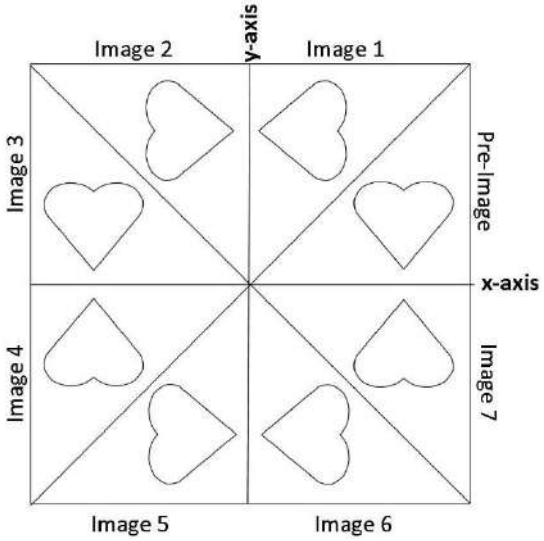
NAME REFLECTION FOLLOW-UP

Objectives

Apply the vocabulary and ideas learned in Topic 2 to a name reflection design.

What To Do …

1. Identify your pre-image.
2. Choose a horizontal and vertical fold to be the x-axis and y-axis.
3. Starting from your pre-image, label each triangle as Image 1, Image 2, etc. (see example below)
4. Answer the questions below using your design. When comparing your pre-image to each image, think of the folds in the paper that you identified as the x- and y-axis.



Name Reflection Questions

Question 1 – How would we name the lines formed by the diagonal (corner-to-corner) folds?

Question 2 – Compare each image to the pre-image & describe the transformation that resulted in the image. (For example: Image 4 is a 180° rotation of the pre-image about the origin)

Image 1 is a _____

Image 2 is a _____

Image 3 is a _____

Image 4 is a _____

Image 5 is a _____

Image 6 is a _____

Image 7 is a _____

Question 2 – Does your design have reflectional symmetry? If so, how many lines of reflection are there?
_____

Question 3 – Does your design have rotational symmetry? If so, what is the angle of rotational symmetry? _____

Josh is animating a scene where a troupe of frogs is auditioning for the Animal Channel reality show, "The Bayou's Got Talent.: In this scene the frogs are demonstrating their "leap frog" acrobatics act. Josh has completed a few key images in this segment, and now needs to describe the transformations that connect various images in the scene.

For each pre-image/image combination listed below, describe the transformation that moves the pre-image to the final image.

- If you decide the transformation is a **rotation**, you will need to give the **center of rotation**, the **direction** of the rotation (clockwise or counterclockwise), and the **measure of the angle** of rotations.
- If you decide the transformation is a **reflection**, you will need to give the **equation of the line** of reflection.
- If you decide the transformation is a **translation**, you will need to describe the **"rise" and "run"** between pre-image points and their corresponding image points.
- If you decide it takes a **combination of transformations** to get from the pre-image to the final image, **describe each transformation in the order** they would be completed.

Pre-image	Final Image	Description
Image 1	Image 2	
Image 2	Image 3	
Image 3	Image 4	
Image 1	Image 5	
Image 2	Image 4