Richmond Public Schools
Curriculum Framework
Geometry

Strand: Reasoning, Lines, and Transformations	
G.3c	The student will investigate symmetry and determining whether a figure is symmetric with respect to a line or a point.
G.3d	The student will determine whether figures have been translated, reflected, rotated, or dilated, using coordinate methods.

Suggested Pacing	Cognitive Demand
First Nine Weeks	G.3c-d
2 instructional days (including assessment)	Apply

Spiraling Down Standards	Spiraling Up Standards
8.7 The student will a) given a polygon, apply transformations, to include translations, reflections, and dilations, in the coordinate plane; and b) identify practical applications of transformations. **7.7** The student will apply translations and reflections of right triangles in the coordinate plane.	**AII.6** For absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic functions, the student will b) use knowledge of transformations to convert between equations and the corresponding graphs of functions.

Essential Questions	Common Misconceptions
How does the concept of distance, midpoint and slope relate to symmetry and transformation? When we translate an image, every point and line in that image is moved in the same direction and the same distance. In order for a line to be a line of reflection, the line must pass through the midpoint of each segment, and it must be perpendicular to each segment.	• In reflections, students tend to get confused with y = # and x = #. Taking time to go over different types of lines of reflection will be helpful (y = x, y = -x, y = 0, x = 0, x = #, y = #) • Students may have problem remembering rotation rules. Having student graph the figure and rotate paper will help discover the rules.

What is line symmetry? A figure has line symmetry if the figure can be reflected across a line so that the image coincides with the preimage. **What is point symmetry?** Point Symmetry is when every part has a matching part: the same distance from the central point. but in the opposite direction. **How is a figure translated, reflected, rotated, or dilated?** - Translation: The shape or object will move left, right, up, or down. Also, you could have a combination for example up and right. - Rotation: The shape or object will turn. This is usually turning some degree clockwise or counterclockwise. - Reflection: The shape or object flips across a line or point - Dilation: The shape or object gets smaller or bigger by a scale factor.	• Some students may draw an image and then incorrectly label the corresponding vertices of the image. Suggest that students label each vertex as they plot the point for the transformation. • Students sometimes confuse translation with transformation. Have them draw a Venn diagram to make clear that translation, or slide, is one kind of transformation. • Some students may confuse the direction of a rotation (clockwise or counterclockwise). Remind students that the direction is assumed to be counterclockwise unless otherwise stated. Associate this default direction with the way the quadrants are numbered. • Some students may think that any diagonal of a figure is a line of symmetry. Have them draw a rectangle that is not a square and one of the diagonals. Folding along this diagonal demonstrates that it is not a line of symmetry. • In evaluating rectangular shapes for symmetries, students sometimes identify the diagonals as lines of symmetry. Unless a rectangle is a square, its diagonals are not lines of symmetry. • Some students will follow the rule for reflecting over the x- or y-axis when trying to reflect over the line $y = x$. Remind students that they can graph the points and the line $y = x$ on graph paper, and then fold the paper along the line of symmetry to see where the points will land. • Some students may perform a combination of transformations in the wrong order. Emphasize the importance of doing the transformations in the correct order by asking them to rotate a

	triangle 90° in the plane and then reflect it in the *x*-axis. They will get a different result if the order is reversed.
Understanding the Standard	**Essential Knowledge and Skills**
• Symmetry and transformations can be explored with computer software, paper folding, and coordinate methods. • A transformation of a figure, called a preimage, changes the size, shape, and/or position of the figure to a new figure called the image. • Transformations and combinations of transformations can be used to describe movement of objects in a plane. • The image of an object or function graph after an isomorphic transformation is congruent to the preimage of the object. o A rotation is an isometric transformation in which an image is formed by rotating the preimage about a point called the center of rotation. The center of rotation may or may not be on the preimage. Rotations may be more than 180^0. o A reflection is an isometric transformation in which an image is formed by reflecting the preimage over a line called the line of reflection. All corresponding points in the image are equidistant from the line of reflection. o A translation is an isometric transformation in which an image is formed by moving every point on the preimage the same distance in the same direction. • A dilation is a transformation in which an image is formed by enlarging or reducing the preimage proportionally by a scale	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine whether a figure has point symmetry, line symmetry, both, or neither.(c) • Given an image and preimage, identify the transformation or combination of transformations that has/have occurred. Transformations include: o a translation; o a reflection over any horizontal or vertical line or the lines $y = x$ or $y = -x$; o a clockwise or counter clockwise rotation of 90°, 180°, 270°, or 360° on a coordinate grid where the center of rotation is limited to the origin; and o a dilation from a fixed point on a coordinate grid. (d)

factor from the center of dilation. The center of dilation may or may not be on the preimage. The image is similar to the preimage.

Vocabulary

Transformation	Symmetry	Rotation
Reflection	Translation	Image
Pre-image	Point symmetry	Line symmetry
Isometry	Isomorphism	Dilation
Scale Factor	Center of Dilation	Clockwise
Counter Clockwise		

Assessment

1. Powerschool Assessments
   G.3c (E:1KL16W)
   G.3d (E:14LZWM)

2. Mulligan Checkpoint G.3
   Checkpoint G.3

3. Formative Assessments (Paper)
   G.3c,d FA

4. Cumulative Assessment #1 (SOLs G.3a-d, G.4a-d)
   Cumulative Assessment #1

Instructional Activities Organized by Learning Objective

Virginia Department of Education

- Transformations
- Symmetry

Textbook

- Geometry, ©2012, Price, et al, McGraw-Hill School Education Group page(s) 613-667**(in part)**

Notes and Homework

G.3c,d Notes and Keys
G.3c,d Homework and Keys

Resources

- **Print**
  - Coach book, Virginia edition Lessons 12-13 page(s) 89-105
- **Technology**
  - Gizmo
    - Rotations, Reflections and Translations
    - Holiday Snowflake Design
  - Youtube Videos
    - Translations
    - Reflections
    - Rotations
    - Dilations
    - Line Symmetry

	■ Point Symmetry ○ Quizizz Practice ■ G.3c Symmetry Quizizz Practice ■ G.3d Transformations Quizizz Practice **Instructional Activities** G.3c,d Symmetry and Transformation Practice Symmetry Activity Give students pictures of figures or objects that have line symmetry, rotational symmetry, both, or neither. Students get two sets of each figure. One set of pictures is placed face up between the pair of students and one set is face down. The first student draws a card, such as the picture of a square, and gives oral clues such as, "This figure has both rotational symmetry and line symmetry. Its angle of rotation is 90 degrees; it has 4 sides and 4 angles; and has 4 lines of symmetry." The second student picks the picture that matches the clues. They switch roles and repeat the process.
Cross-Curricular Connections	**Tiered Interventions**
Have students discuss and explain familiar events involving angles of reflection, such as playing golf, basketball, and soccer, or using light and mirrors. The branch of physics called *optics* is the study of the properties and behavior of light. One of the fundamental principles of the field is that when a beam of light strikes a reflective surface, the angle of incidence (the angle of the incoming beam) is congruent to the angle of reflection. The flags of many nations have rotational symmetry or line symmetry. The flags of a few nations, such as Jamaica, have both.	**Tier 3: Recall and Reproduction** Vocabulary 1. Have students study flashcards, create their own flashcards, play a matching game or test themselves on Quizlet. Quizlet Flashcards Coordinates 2. Some students have difficulty visualizing rotations. Have students copy the image on graph paper and then rotate the paper a given number of degrees. Tell them that the location and orientation of the figure on the graph after rotating the paper shows how the final image looks when the rotation rule is applied to the preimage.

Research the flags of the nations of the world to find examples of symmetry. If you wish, disregard color and concentrate only on the designs of the flags. Draw or print out examples of designs you find especially interesting or attractive.	3. For each of the transformations, ask students to summarize all the possible ways to represent the transformation: graphically, using a rule, and using words. When students use words, encourage them to be as specific as possible, using the appropriate vocabulary from this lesson. Discuss the different advantages of each representation. 4. Encourage students to try to identify the transformation from its rule before drawing the image. Then have them draw the image to verify their predictions and highlight any misconceptions. A reflection in the coordinate plane can be across either axis, any vertical or horizontal line, or any other line, such as $y = x$ or $y = -x$. Discuss with students how to identify the line of reflection for a reflection. Use HOY and VUX to help with identifying horizontal and vertical lines of reflection. **Horizontal** slope of **0** **Y** = # line of symmetry **Vertical** **U**ndefined slope **X** = # line of symmetry 5. To reinforce the meaning of *rotation*, show some examples of rotations that might be familiar to students—for example, the turn of a steering wheel or Earth's orbit around the sun. Ask students to give other examples of turns or rotations in the real world, such as the motion of a DVD in a player, or of a doorknob. Discuss what all of the motions have in common. Help students see that all involve moving points around a fixed point.

	6. Ask students to write, say, or show sequences of rotations, reflections, and translations, using their hands. For example: Reflection — both hands facing outward, thumbs nearly together. Translation — one hand facing forward and one backward in the same orientation. Rotation — one hand pointing left (thumb up) and one hand right (thumb down), fingers facing each other. **Tier 2: Basic Skills and Concepts** Practice and Drill 1. Transformations and Symmetry Drills 2. Give each student three sheets of graph paper. Have each student draw a preimage and an image showing a translation on one sheet, a reflection on another, and a rotation on the third. Have them write the rule for each transformation on the back. Then, working in groups of three or four, have students analyze each other's graphs and determine the rule used to create each transformation. 3. Have students make a graphic organizer or table to compare properties of reflections, rotations, translations, and dilations. **Tier 1: Strategic Thinking and Reasoning** Application Have students sort the block letters of the alphabet according to Vertical/Line symmetry using a Venn diagram. Alphabet Venn diagram template