WAKE COUNTY PUBLIC SCHOOL SYSTEM

High School Programs

Math 2 UNIT 1 OVERVIEW: Transformations Parent Guide

Unit Outcomes At the end of this unit, your student should be able to:	**Key Vocabulary** Terms to deepen students' understanding
Transformations ✓ Use prime notation to distinguish an image from its pre-image. ✓ Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. ✓ Verify experimentally the properties of transformations. ✓ Compare transformations that preserve distance and angle between the corresponding parts of the pre-image and image (rigid motions) to those that do not (non-rigid motions like a dilation and a horizontal or vertical stretch). ✓ Determine whether a single transformation is a translation, reflection, rotation, or dilation based on the relationships between the pre-image and image. ✓ Determine the translation vector given a pre-image and its translated image. ✓ Determine the line of reflection given a pre-image and its reflected image. ✓ Determine the center and angle of rotation given a pre-image and its rotated image. ✓ Determine the scale factor given a pre-image and its dilated image. ✓ Establish a function rule for the horizontal and vertical change given a pre-image and its translated image graphed on the coordinate plane. ✓ Establish a function rule and determine the equation of the line of reflection given a pre-image and its reflected image graphed on the coordinate plane. ✓ Establish a function rule given a pre-image and its rotated image of 90° clockwise, 90° counterclockwise, or 180° in the coordinate plane. ✓ Establish a function rule given a pre-image and its dilated image on the coordinate plane with center at (0, 0), ✓ Verbally describe a translation, reflection, rotation or dilation given a pre-image and its image on the coordinate plane. ✓ Draw on plain paper the translation of a figure given a translation vector.	✓ *Transformation* ✓ *Rigid motion* ✓ *Non-rigid motion* ✓ *Prime notation* ✓ *Congruent* ✓ *Pre-Image* ✓ *Image* ✓ *Rotation* ✓ *Reflection* ✓ *Translation* ✓ *Corresponding parts* ✓ *Dilation* ✓ *Translation Vector* ✓ *Line of Reflection* ✓ *Center of rotation* ✓ *Angle of rotation* ✓ *Scale Factor* ✓ *Center of Dilation* ✓ *Congruent Figures* ✓ *Similar Figures* ✓ *Composition (of transformations)* ✓ *Isometry* ✓ *Domain* ✓ *Range*

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✓ Draw on plain paper the reflection of a figure given the line of reflection. ✓ Draw on plain paper the rotation of a figure given the center of rotation and angle of rotation. ✓ Draw on plain paper the dilation of a figure given a scale factor and center of dilation. ✓ Draw on the coordinate plane the translation of a figure given the verbal or algebraic description of the horizontal and vertical change. ✓ Draw on the coordinate plane the reflection of a figure given the equation of the horizontal or vertical line of reflection ✓ Draw on the coordinate plane the rotation of a figure 90° clockwise, 90° counterclockwise, or 180° of a figure given a verbal description. ✓ Draw on the coordinate plane the dilation of a figure with center of dilation at (0, 0) given a scale factor. ✓ Draw on the coordinate plane the image of a transformation (translation, reflection, rotation or dilation) given the function rule for the transformation. ✓ Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. ✓ Perform multiple transformations on a given figure. ✓ Specify the sequence of transformations that will carry a given figure onto another. ✓ Use dynamic geometry software to perform transformations.	

Key Standards Addressed Connections to Common Core/NC Essential Standards	**Where This Unit Fits** Connections to prior and future learning
NC.M2.F-IF.1 Extend the concept of a function to include geometric transformations in the plane by recognizing that: • The domain and the range of a transformation function *f* are sets of points in the plane • The image of a transformation is a function of its pre-image	**Coming into this unit, students should have a strong foundation in:** ✓ Identifying whether a single transformation is a translation, reflection, rotation, or dilation. ✓ Determining the translation vector or, if graphed on the coordinate plane, give a verbal description of the horizontal

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NC.M2.F-IF.2 Extend the use of function notation to express the image of a geometric figure in the plane resulting from a translation, rotation by multiples of 90 degrees about the origin, reflection across an axis, or dilation as a function of it pre-image

NC.M2.G-CO.2 Experiment with transformations in the plane

- Represent transformations in the plane
- Compare rigid motions that preserve distance and angle measure (translations, reflections, rotations) to transformations that do not preserve both distance and angle measure (e.g. stretches, dilations).
- Understand that rigid motions produce congruent figures while dilations produce similar figures.

NC.M2.G-CO.3 Given a triangle, quadrilateral, or regular polygon, describe any reflection or rotation symmetry i.e., actions that carry the figure onto itself. Identify center and angle(s) of rotation symmetry. Identify line(s) of reflection symmetry.

NC.M2.G-CO.4 Verify experimentally properties of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments

NC.M2.G-CO.5 Given a geometric figure and a rigid motion, find the image of a figure. Given a geometric figure and its image, specify a rigid motion or sequence of rigid motions that will transform the pre-image to its image.

NC.M2.G-SRT.1 Verify experimentally the properties of dilations with given center and scale factor:

and vertical change, given a pre-image and its translated image,.

- ✓ Determining the line of reflection given a pre-image and its reflected image
- ✓ Determining the center of rotation and angle of rotation given a pre-image and its rotated image
- ✓ Determining the scale factor given a pre-image and its dilated image
- ✓ Given a pre-image and its dilated image on the coordinate plane, determine an algebraic rule** to describe the dilation.
- ✓ Using geometric descriptions of rigid motions to transform figures.
- ✓ Draw on plain paper a translation given a translation vector; a reflection given a line of reflection; a rotation given a center and angle of rotation;, and a dilation given a scale factor and center of dilation.

This unit builds to the following future skills and concepts:

- ✓ Continued experimentation with transformations in the coordinate plane.
- ✓ Making connections between geometric and algebraic transformations.
- ✓ Writing a logical argument with a “given” and a “prove” statement.
- ✓ Using deductive reasoning to construct formal geometric proofs.
- ✓ Constructing geometric shapes using various tools, including dynamic geometry software.

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a. when a line segment passes through the center of dilation, the line segment and its image lie on the same line. When a line segment does not pass through the center of dilation, the line segment and its image are parallel. b. The length of the image of a line segment is equal to the length of the line segment multiplied by the scale factor c. The distance between the center of a dilation and any point on the image is equal to the scale factor multiplied by the distance between the dilation center and the corresponding point on the pre-image. d. Dilations preserve angle measure	✓ Applying geometric concepts to solve more complex modeling and design problems.

Additional Resources

Materials to support understanding and enrichment

- ✓ **Teaching videos made by Wake County teachers**
  - Success Series: Transformations - Part 1 – (Video) Reflections and Translations
  - Success Series: Transformations - Part 2 – (Video) Rotations and Dilations
- ✓ **Transformations**
  - Properties of Rigid Transformation – (Tutorial) Apply the properties of translation, reflection, and rotation to perform the motion
  - Motion Geometry: Rotations, Reflections and Translations – (Video) Explanation and real world application of rigid transformations
  - Performing Transformations on the Coordinate Plane – (Tutorial) – Apply the properties of translation, reflection, rotation, and dilation on the coordinate system
- ✓ **Composition of Transformations**
  - Defining Transformations to Match Polygons – (Video) Explores composition of transformations to map a pre-image to its image
  - Apply Composition of Transformation – (Video) Explores composition of transformations and multiple transformations over parallel and intersecting lines.
  - Transforming Polygons – (Tutorial) Perform a sequence of rigid transformations to map a pre-image to its image
  - Graph the Image – (Tutorial) Use algebraic rules to graph an image after a sequence of transformations
- ✓ **Translations**
  - Translations of Polygons – (Video) Translation of polygons on the coordinate system

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- Determining a Translation for a Shape – (Video) Finding the algebraic rule for a translation
- Translations: Writing the Algebraic Rule – (Tutorial) Write the algebraic rule given a pre-image and image
- Translation of Polygons – (Tutorial) Apply the properties of translation to polygons in the coordinate system
- Translations and Vectors – (Reference Notes) – Explanations of translations with vectors
- Translations Using Vectors – (Video) Explore translations and vectors using dynamic geometry software

✓ **Rotations**

- Rotating a Segment about the Origin – (Video) Rotation of a segment about the origin
- Rotation of Polygons – (Video) Rotation of polygons on the coordinate system
- Performing a Rotation to Match Figures – (Video) Finds the angle of rotation given a pre-image and image
- Rotation of Polygons – (Tutorial) Apply the properties of rotation to polygons in the coordinate system
- Rotation: Graphing the Image and Finding the Coordinates of the Image – (Tutorial) Apply the properties of rotation to graph an image around a center of rotation and find the coordinates of an image.

✓ **Reflections**

- Reflecting a Line across Another Line – (Video) Reflection of a line across another line given its equation
- Reflection and Mapping Points – (Video) Explores reflection over a line and the algebraic relationship between corresponding points
- Determining the Line of Reflection – (Video) Explores finding a line of reflection given the coordinates of the pre-image and image using midpoint
- Reflections: Graphing the Image and Finding the Coordinates of the Image – (Tutorial) Apply the properties of reflection to graph an image over a line of reflection and find the coordinates of an image.

✓ **Dilations**

- Comparing Side Lengths after Dilation – (Video) Dilation of a triangle and the lengths of corresponding sides of the pre-image and image
- Properties and Characteristics of Dilations – (Reference Notes) Explanations of dilation properties, drawing dilations, and algebraic rules of dilations.

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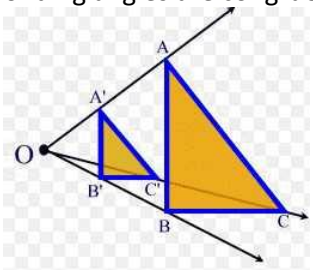
Glossary		
Angle of rotation	The measure of degrees that a figure is rotated about a fixed point.	Click to return to Key Vocabulary List
Center of Dilation	The point around which a figure grows or shrinks by a given proportion (scale factor).	
Center of rotation	The fixed point around which a figure turns in a rotation.	
Composition (of transformations)	A series of transformations produced one after the other such that the image of the first transformation becomes the preimage of the second.	
Congruent	Having the same size and shape.	
Congruent figures	Figures having the same size and shape; for polygons the corresponding angles and sides are congruent.	
Corresponding parts	When figures are in the same orientation, the parts on one figure that map onto the parts of another figure.	
Dilation	A non-ridge transformation that preserves the shape of a geometric figure, but not necessarily the size. It enlarges or reduces a figure proportionally (scale factor) from a given point (center of dilation). The preimage and image are similar meaning the corresponding angles are congruent and the sides are proportional. 	
Domain	The set of all inputs of a function. Typically associated with the x-values of an ordered pair.	
Horizontal stretch	A horizontal stretch is the expansion or compression of a figure horizontally or along the x-axis. 	Click to return to Key Vocabulary List
Image	The figure that is a result of a transformation of a previous geometric figure	
Isometry	A transformation where the preimage and the image are congruent.	
Line of Reflection	The location where a preimage flips over to create the image. The corresponding parts of the pre-image and image are equidistant to the line of reflection.	
Non-rigid motion	A motion in which the preimage and image are not congruent.	

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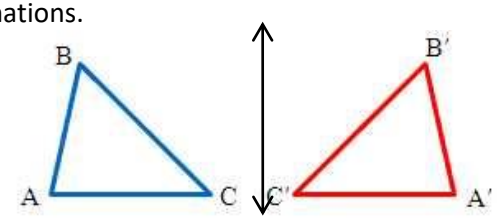
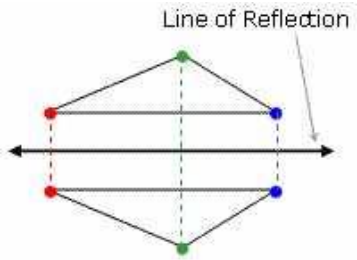
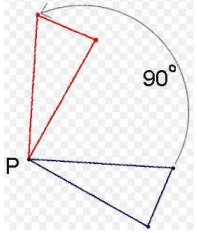
Preimage	Original figure in a transformation
Prime notation	Symbolic representation given to images as a result of a transformation. If P is the original figure, then P' (read P prime) is the original figure after one transformation; P'' (read P double-prime) is the result of the original figure after two transformations. 
Range	The set of all outputs of a function. Typically associated with the y-values of an ordered pair.
Reflection	It is a rigid motion that flips a figure over a line of reflection. The corresponding parts of the preimage and image are equidistant to the line of reflection or the reflection line is the perpendicular bisector of the segment joining the preimage and image. 
Rigid motion	Transformation in which the preimage and image are congruent (the same size and shape).
Rotation	It is a rigid motion that turns a figure in a given direction a given number of degrees (angle of rotation) about a fixed point (the center of rotation). The corresponding parts of the preimage and image are equidistant to the center of rotation and have all turned angle of rotation amount. 

Click to return to Key Vocabulary List

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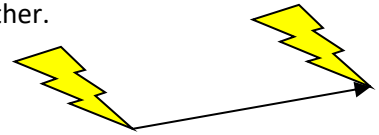
Scale factor	The ratio of a side of a preimage to the corresponding side of its image in two similar figures	
Similar figures	Geometric figures whose corresponding angles are congruent and whose corresponding sides are proportional	
Transformation of a geometric figure	Motion which causes the change of a figures the position, shape, or size.	
Translation	A rigid transformation that is a sliding motion of a preimage. All the corresponding points of the preimage and image are equidistant from each other. 	**Click to return to Key Vocabulary List**
Translation vector (honors only)	an arrow that indicates the distance and direction to translate a figure in a plane	

*** Please note**, the unit guides are a work in progress. If you have feedback or suggestions on improvement, please feel free to contact sdupree@wcpss.net.