

Core Content

Cluster Title: Experiment with transformations in the plane.
Standard: G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Concepts and Skills to Master
<ul style="list-style-type: none"> • Define angle, circle, perpendicular line, parallel line, and line segment. • Use precise definitions to identify and model an angle, circle, perpendicular line, parallel line, and line segment. • Demonstrate mathematical notation for each term.

Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> • Understanding the undefined terms point, line, and plane. • Understand distance is a non-negative quantity. 	
Academic Vocabulary	
angle, circle, perpendicular line, parallel line, line segment, distance, arc	
Suggested Instructional Strategies	Resources
<p>Have students write their own understanding of a given term.</p> <p>Give students formal and informal definitions of each term and compare them.</p> <p>Develop precise definitions through use of examples and non-examples.</p> <p>Discuss the importance of having precise definitions.</p>	
Sample Formative Assessment Tasks	
Skill-based Task State the definition of a circle.	Problem Task Identify real-life examples of each term in the student's environment, using definitions.

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Cluster Title: Experiment with transformations in the plane.
Standard: G.CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; 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 to those that do not (e.g., translation versus horizontal stretch).
Concepts and Skills to Master
<ul style="list-style-type: none"> • Represent reflections, rotations and translations using a variety of media. • Compare and contrast rigid and non-rigid transformations. • Understand transformations as functions that take points in the plane as inputs and give other points as outputs.

Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> • Identify different types of transformations. 	
Academic Vocabulary	
plane, transformation, reflection, rotation, translation, preserve, function in terms of input and output	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> • Understand that a function has one output for every input whether the input is a number or a point in the plane. • Use M.C. Escher pictures to compare and contrast rigid and non-rigid transformations. 	
Sample Formative Assessment Tasks	
Skill-based Task Which of the following preserves distance and which does not? $(x, y) \rightarrow (x+1, y+2)$ $(x, y) \rightarrow (x^2, y+1)$	Problem Task If a transformation preserves distances, what other information would you need to know to determine an output for the point (1,0)?

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Cluster Title: Experiment with transformations in the plane.
Standard: G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
Concepts and Skills to Master
<ul style="list-style-type: none"> Describe and identify lines and points of symmetry. Describe rotations and reflections which take a rectangle, parallelogram, trapezoid, or regular polygon onto itself.

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Critical Background Knowledge	
<ul style="list-style-type: none"> Understand lines of symmetry. Understand properties of rectangle, parallelogram, trapezoid, and regular polygons such as angle measures and side lengths. 	
Academic Vocabulary	
rectangle, parallelogram, trapezoid, regular polygon, rotation, reflection, symmetry	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> Provide sets of polygons for students to manipulate. Use mirrors or a reflective device to help students see lines of symmetry. 	http://illuminations.nctm.org Frieze http://illuminations.nctm.org Symmetries II
Sample Formative Assessment Tasks	
Skill-based Task Draw the lines of reflection symmetry that would carry the polygon onto itself. <div style="text-align: center;">  </div>	Problem Task Given any number between 0 and 180, can you find a polygon that has that rotational symmetry? Explain.

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Cluster Title: Experiment with transformations in the plane.
Standard: G.CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
Concepts and Skills to Master
<ul style="list-style-type: none"> • Through observations and conjectures develop definitions of rotations, reflections, and translations. • Define rotations, reflections, and translations using angles, circles, perpendicular lines, parallel lines, and line segments.

Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> • Use inductive reasoning to make conjectures. • Know definitions and properties of angles, circles, perpendicular lines, parallel lines, and line segments. 	
Academic Vocabulary	
angle, circle, perpendicular lines, parallel lines, line segment, rotation, reflection, translation, conjecture, inductive reasoning	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> • Draw rotations, reflections, and translations. • Use geometry software to model rotations, reflections, and translations. 	http://illuminations.nctm.org Symmetries II
Sample Formative Assessment Tasks	
Skill-based Task Perform a rotation, reflection, and translation with a given polygon and give a written explanation of how each step meets the definitions of each transformation using correct mathematical terms.	Problem Task Given a polygon and its transformation, identify the angle of rotation or the distance of translation.

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Cluster Title: Experiment with transformations in the plane.
Standard: G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
Concepts and Skills to Master
<ul style="list-style-type: none"> • Perform rotations, reflections and translations using a variety of methods. • Identify the sequence of transformations that will carry a given figure to another. • Understand that the composition of transformations is not commutative.

Supports for Teachers

Critical Background Knowledge	
<ul style="list-style-type: none"> • Understand the significance of the order in mathematics 	
Academic Vocabulary	
rotation, reflection, translation	
Suggested Instructional Strategies	Resources
<ul style="list-style-type: none"> • Have students use a variety of tools to explore and perform simple, multi-step, and composite rotations, reflections, and translations. • Given a transformation, work backwards to discover the sequence that led to that transformation. 	
Sample Formative Assessment Tasks	
Skill-based Task Given $\triangle ABC$, reflect it about intersecting lines l & m . Identify the angle of rotation.	Problem Task Prove that every rotation is a composition of two reflections.