UbD: Geometry - Constructions and Rigid Transformations

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<tr><td>Time Frame: 22 Lessons</td><td>Unit 1: Constructions and Rigid Transformations</td><td>Course Name: Geometry</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td>Established Goal(s)</td><td colspan="2">Transferable Skills</td></tr>
<tr><td rowspan="3">Standards Addressed:

HSG-CO.A.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.
HSG-CO.A.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).
HSG-CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
HSG-CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
HSG-CO.A.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.
HSG-CO.C.9: Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines,</td><td colspan="2">Students will be able to independently use their learning to...

● experiment with transformations in the plane
● understand congruence in terms of rigid motions
● make geometric constructions
● apply mathematical knowledge, skill, and reasoning to solve real-world problems.
● develop clear and effective communication.
● increase self-direction.
● develop creative and practical problem-solving.
● develop informed and integrative thinking.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td><u>Understandings</u>
Students will understand that...
● math is a continuum, Algebra is needed for Geometry, and math concepts will build on themselves as we develop our mathematical understandings.
● geometric constructions are created using only a straight edge and compass.
● making constructions can lead to tangible definitions of geometric concepts.
● transformations appear frequently in both our natural and industrial world.
● describing transformations with precision is important for transferring information
● there is both beauty and practicality in making patterns using transformations
● to develop the understanding they will need to experiment with transformations in the plane</td><td><u>Essential Questions</u>
● How are patterns, algebra, and geometry related?
● How can we construct geometric concepts and use that construction to define (then later prove) those concepts?
● Why is it important that we agree on concise definitions of fundamental words like points, lines, and planes?</td></tr>
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	Acquisition	
alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints. **HSG-CO.C.10:** Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180 degrees; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point. **HSG-CO.D.12:** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line. **HSG-CO.D.13:** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. HSG-MG.A.3: Apply geometric methods to solve design problems **HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. **HSN-Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	*Students will know...* ● that compasses create circles and can be used to transfer distances across a construction. ● how to create diagrams using a straightedge to produce a line or segment through two points. ● how to create a construction from instructions (in written language). ● how to describe (in writing) construction steps precisely. ● that a perpendicular bisector is the set of points equidistant from two given points. ● how to construct a perpendicular bisector. ● how to construct an equilateral triangle. ● how to use circles in a construction to reason (using words and other representations) about lengths in figures. ● how to construct a line that's perpendicular to a given line through a given point on the line. ● how to construct an angle bisector. ● how to construct a square. ● how to describe (orally and in writing) the diagonals of a square and use these conjectures to construct a square inscribed in a circle. ● how to coordinate (orally) technology tools with paper and pencil tools to construct a diagram. ● how to use technology to construct a diagram. ● how to choose geometric methods to solve design problems. ● how to construct perpendicular bisectors and explain (in writing) how they are used to solve problems. ● that rigid transformations produce congruent figures by preserving distance and angles. ● how to draw the result of a transformation (in written language) of a given figure. ● how to explain (orally and in writing) a sequence of transformations to take a given figure onto another. ● that the term "reflection" (in written and spoken language) requires specifying a line of reflection. ● how to determine whether a figure is a reflection of another. ● how to draw reflections of figures.	*Students will be able to...* ● create shapes precisely. ● use compass and straightedge constructions to make patterns. ● explore equal distances. ● identify what shapes are possible within the construction of a regular hexagon. ● use tools to solve some construction challenges. ● construct a line parallel to a given line that goes through a point not on the given line. ● construct a line perpendicular to a given line that goes through a point not on the given line. ● use straightedge and compass moves to construct squares. ● use technology to help them construct specific diagrams. ● use perpendicular bisectors. ● draw some transformations. ● reflect some figures. ● translate some figures. ● draw some transformations. ● rotate shapes precisely. ● describe some symmetries of shapes. ● describe more symmetries of shapes. ● compare transformed figures. ● figure out some transformations. ● make convincing explanations. ● prove statements about parallel lines. ● prove the Triangle Angle Sum Theorem. ● construct some creative shapes. ● define and use geometry-specific vocabulary words that were introduced in this unit. Mathematical Practices:

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	• that the term "translation" (in written and spoken language) requires specifying a directed line segment. • whether a figure is a translation of another. • how to draw translations of figures. • that rigid transformations produce congruent figures by preserving distance and angles. • how to draw the result of a transformation (in written language) of a given figure. • how to explain (orally and in writing) a sequence of transformations to take a given figure onto another. • that the term "rotation" (in written and spoken language) requires several descriptors including angle, center, and direction. Determine whether a figure is a rotation of another. Draw rotations of figures • how to describe (orally and in writing) the reflections that take a figure onto itself. • how to describe (orally and in writing) the rotations that take a figure onto itself. • how to compare and contrast (orally) diagrams of transformations. • that the notation represents the image of point . • how to explain (orally and in writing) a sequence of transformations that take given points to another set of points. • how to draw the result of a transformation (in written language) of a given figure. • how to explain (orally and in writing) a sequence of transformations to take a given figure onto another • how to label diagrams and explain conjectures (orally and in writing). • how to prove (in writing) that vertical angles are congruent. • how to prove (in writing) that when a transversal crosses parallel lines, alternate interior angles are congruent. • how to prove that when a transversal crosses parallel lines, corresponding angles are congruent. • how to prove (in writing) that the sum of the measures of the angles in a triangle is 180 degrees. • how to create a new geometric pattern using construction techniques. • how to create a pattern from instructions (in written language). • describe (in writing) how to recreate a pattern.	• make sense of problems and persevere in solving them. • reason abstractly and quantitatively. • construct viable arguments and critique the reasoning of others. • model with mathematics. • use appropriate tools strategically. • attend to precision. • look for and make use of structure. • look for and express regularity in repeated reasoning.

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	• how to define and correctly use the glossary terms: circle, line segment, parallel, conjecture, perpendicular bisector, inscribed, angle bisector, regular polygon, tesselation, assertion, congruent, image, rigid transformation, theorem, reflection, directed line segment, translation, rotation, line of symmetry, reflection symmetry, symmetry, and rotation symmetry.	