UbD: Geometry - Coordinate Geometry

Time Frame: 17 Lessons	Unit 6: Coordinate Geometry	Course Name: Geometry

Stage 1: Desired Results

Established Goal(s)

Standards Addressed:

HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.
HSA-REI.C.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle x2 + y2 = 3.
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients.
HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
HSG-C.A.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are

Transferable Skills

Students will be able to independently use their learning to...

- **translate between the geometric description and the equation for a conic section.**
- **use coordinates to prove simple geometric theorems algebraically.**
- 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.

Meaning

Understandings

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.
- they can translate between the geometric description and the equation for a conic section.
- they can use coordinates to prove simple geometric theorems algebraically.

Essential Questions

- How do the properties of geometric shapes relate to the properties of numbers and algebraic expressions?
- How does our knowledge of geometry support what we have already learned in algebra?

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	Acquisition	
right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. **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.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.B.6** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. **HSG-CO.B.7** Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. **HSG-CO.B.8** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. **HSG-CO.C.10** Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; 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.	*Students will know...* ● how to prove triangles are congruent using coordinates. ● how to reflect, rotate, and translate figures in the coordinate plane. ● how to use coordinate transformation notation to take points in the plane as inputs and give other points as outputs. ● how to determine whether a transformation produces congruent or similar images (or neither). ● how to derive an equation for a circle in the coordinate plane. ● how to describe how squared binomials relate to the equation of a circle. ● how to complete the square to find the center and radius of a circle. ● that a parabola is the set of points equidistant from a given point and line. ● how to derive an equation for a parabola in the coordinate plane given a focus and a directrix. ● how to use the definition of slope to write the equation for a line in point-slope form. ● how to prove that the slopes of parallel lines are equal. ● how to use slopes of parallel lines to solve problems. ● how to prove that the slopes of perpendicular lines are opposite reciprocals. ● how to use slopes of perpendicular lines to solve problems. ● how to gather information about a line and write its equation.	*Students will be able to...* ● construct rigid transformations in a coordinate plane and recognize patterns for each type of transformation. ● write transformations as functions. ● describe in words and in writing the types of transformations. ● relate distances and circles. ● use squares and circles in the coordinate plane. ● completing the square in a quadratic equation. ● find distances and write equations for parabolas. ● write equations and draw graphs. ● write equations of lines. ● describe parallel lines in the coordinate plane. ● describe perpendicular lines in the coordinate plane. ● show intersection points represent solutions to equations. ● write a coordinate proof. ● use weighted averages. ● use weighted averages in a triangle. ● recognize and use specific lines in triangles.

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HSG-GPE.A.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. **HSG-GPE.A.2** Derive the equation of a parabola given a focus and directrix. **HSG-GPE.B.4** Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point (0, 2). **HSG-GPE.B.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point). **HSG-GPE.B.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio. **HSG-GPE.B.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. **HSG-SRT.B.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **HSN-Q.A.1** Use units as a way to understand problems and to guide the solution of multi step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	• how to use a graph to find the intersection points of a line and a circle. • how to use coordinates of figures to prove geometric theorems. • how to calculate the coordinates of a point on a line segment that partitions the segment in a given ratio. • how to determine the point where the medians of a triangle intersect. • how to determine the point where the altitudes of a triangle intersect. • how to define and correctly use the glossary terms: directrix, focus, parabola, point-slope form, opposite, reciprocal, and median (line in a triangle).	• define and use geometry-specific vocabulary words that were introduced in this unit. Mathematical Practices: • 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