Davison Community Schools
ADVISORY CURRICULUM COUNCIL
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Lauren Draper, Corey Miller, Darcey Kondel, Shawn Lewis, Matt Lobban

Geometry (DHS/DAE)

Course Essential Questions:
How do we use Geometry to analyze, describe and communicate mathematical relationships and patterns?

Phase II Curriculum
Unit 1: Foundations of Geometry

Essential Questions:	Essential Understanding:
• What are some of the fundamentals of geometry?	• The fundamentals of geometry are finding the measures and properties of line segments and angles. Also, examining the nature of basic reasoning in both inductive and deductive forms, exploring if-then statements, and writing proofs.

Curriculum Standards- DOK noted where applicable with Standards

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. **(DOK 1)**
CED.A.1 Create equations and inequalities in one variable and use them to solve problems. **(DOK 1,2)**
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.**(DOK 2)**
GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. **(DOK 1,2)**
CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **(DOK 1,2)**
SSE.A.1a Interpret parts of an expression, such as terms, factors, and coefficients. **(DOK 1,2)**
CO.C.9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, 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.
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. **(DOK 3)**
CO.C.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. **(DOK 3)**
A.REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. **(DOK 1,2,3)**

LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
• The sum of the lengths of all sections of a segment is the length of the segment. • The sum of the measure of two small angles that form a larger angle is the measure of the larger angle. • A construction is a geometric figure produced using only a straightedge and a compass. • Constructions are useful tools in Geometry. • The Midpoint Formula is used to find the midpoint of a segment in the coordinate plane and the Distance Formula is used to find the length. • The Midpoint Formula can be adapted to partition a segment into two segments with any ratio of lengths. • Inductive reasoning can be used to identify patterns, provide evidence for or disprove conjectures, and make predictions. • In mathematics, conditional statements are expressed as if-then statements consisting of a hypothesis and a conclusion. Conditional statements can be evaluated using truth tables. • Deductive reasoning is the process of using given statements or facts to logically reach a valid conclusion. • Justify statements of a proof with definitions, postulates, theorems, and properties. • In indirect reasoning, you assume that the desired conclusion is false, which leads to a contradiction, allowing you to assume that what you want to prove must be true.	• Communicate precise definitions of angle and segment • Use absolute value and the segment addition postulate. • Use the protractor postulate and the angle addition postulate. • Identify congruent segments and congruent angles. • Construct copies of segments and angles. • Construct segments, perpendicular bisectors of segments, and bisectors of angles. • Apply construction to problems involving portions of segments and angles. • Use the midpoint formula to find the midpoint of a segment drawn on a coordinate plane. • Use the distance formula to find the length of a segment drawn on the coordinate plane. • Use inductive reasoning to identify patterns and make predictions based on data. • Use inductive reasoning to provide evidence that conjectures are true or provide counterexamples to disprove them. • Write conditional and biconditional statements. • Find the contrapositive, converse, and inverse of a conditional statement. • Find truth values for conditional statements and complete truth tables. • Use deductive reasoning to draw a valid conclusion based on a set of given facts. • Use deductive reasoning to prove geometric theorems about lines and angles. • Use indirect reasoning to prove theorems about lines and angles. • Use proof by contradiction and proof by contrapositive to prove conditional statements.

Phase II Curriculum Unit: 2 Parallel and Perpendicular Lines	
Essential Question: ● What properties are specific to parallel lines and perpendicular lines?	**Essential Understanding:** ● Students will focus on the properties of parallel lines and angle relationships formed when parallel lines are cut by a transversal. Students also will example how these angle relationships can help prove whether or not lines are parallel, the relationships between parallel lines and triangle angles, and the relationships between the slopes of parallel and perpendicular lines.
Curriculum Standards- DOK noted where applicable with Standards	
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. **(DOK 1)** **CO.C.9** Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, 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*. **(DOK 3)** **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*. **(DOK 3)** **MG.A.3** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). **(DOK 2,3,4)** **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). **(DOK 1,2,3)**	
LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
● When parallel lines are cut by a transversal, the special angle pairs that are formed are congruent, supplementary, or both. ● Congruent or supplementary angles formed by two lines and a transversal can be used to prove the lines are parallel. ● The sum of the measures of the interior angles of a triangle is 180 degrees, and the measure of an exterior angle of a triangle is equal to the sum of the measures of the remote interior angles. ● Two parallel lines have equal slopes. ● The slope of perpendicular lines are negative reciprocals of each other.	● Define parallel lines using the undefined terms point and line. ● Prove theorems about lines and angles. ● Use theorems to find the measures of angles formed by parallel lines and a transversal. ● Prove that two lines cut by a transversal are parallel using the converses of parallel line angle relationships theorems. ● Use properties of parallel lines and transversals to solve real-world and mathematical problems. ● Write and use flow proofs. ● Use lines constructed parallel to another line to solve problems and prove theorems. ● Use the sum of the angle measures in a triangle to solve problems.

	• Show that two lines in the coordinate plane are parallel by comparing their slopes, and solve problems. • Show that two line in the coordinate plane are perpendicular by comparing their slopes, and use that information to solve problems.

<table>
<tr><td colspan="2">Phase II Curriculum
Unit: 3 Transformations</td></tr>
<tr><td>Essential Questions:
What are properties of the four types of rigid motion?</td><td>Essential Understanding:
The four types of rigid motions are a translation, reflection, rotation, and glide reflection.</td></tr>
<tr><td colspan="2">Curriculum Standards- DOK noted where applicable with Standards</td></tr>
<tr><td colspan="2">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). (DOK 1,2)
CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. (DOK 2)
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. (DOK 1,2,3)
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. (DOK 1,2)
CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. (DOK 1,2)</td></tr>
<tr><td colspan="2">LEARNING TARGETS</td></tr>
<tr><td>Knowledge/Content
I Know …</td><td>Skills/Processes
I Can …</td></tr>
<tr><td>Reflections are rigid motions across a line of reflection
Students will create an image, given a preimage and the line of reflection, both with and without a coordinate plane.
A translation is a rigid motion that moves all points of the preimage the same distance in the same direction.
A translation is the composition of two reflections.
Rotation is a rigid motion described by its center of rotation and angle of rotation.
Any rotation can be described by two reflections whose lines of reflection meet at the center of rotation at half the angle of rotation.
Any composition of rigid motions can be represented by a combination of at least two of</td><td>Find a reflected image and write a rule for a reflection.
Define reflection as a transformation across a line of reflection with given properties nd perform reflections on and off a coordinate grid.
Translate a figure and write a rule for a translation.
Find the image of a figure after a composition of rigid motions.
Prove that a translation is a composition of two reflections.
Rotate a figure and write a rule for a rotation.
Prove that a rotation can be written as the composition of two reflections.
Specify a sequence of transformations that will carry a given figure onto another.
Use geometric descriptions of rigid motions to transform figures.</td></tr>
</table>

the following : a translation, reflection, rotation, or glide reflection. ● A figure that can be mapped onto itself using a rigid motion is symmetric. ● Both rotations and reflections can map a figure onto itself.	● Describe the rotations and/or reflections that carry a polygon onto itself. ● Predict the effect of a given rigid motion on a figure. ● Identify types of symmetry in a figure.

Phase II Curriculum **Unit: 4 Triangle Congruence**	
Essential Questions: • What relationships between sides and angles of triangles can be used to prove triangles congruent?	**Essential Understanding:** • Because corresponding parts of congruent triangles are congruent (CPCTC), triangles can be proven to be congruent if the SAS, SSS, ASA or AAS criteria the the triangles holds true.
Curriculum Standards- DOK noted where applicable with Standards	
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. **(DOK 1,2,3)** **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. **(DOK 1,2)** **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. **(DOK 3)** **SRT.B.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **(DOK 1,2,3)** **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. **(DOK 2,3)** **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. **(DOK 2,3)**	
LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
• Figures that have the same size and shape are congruent. • If a rigid motion or composition of rigid motions can map one figure onto another, then the figures are congruent. • An isosceles triangle has congruent base angles and legs. • The angle bisector of the vertex angle of an isosceles triangle is also the perpendicular bisector of the base. • An equilateral triangle is also equiangular. • Two triangles are congruent if two corresponding sides and the corresponding	• Relate congruence to rigid motions. • Demonstrate that two figures are congruent by using one or more rigid motions to map one onto the other. • Use properties and theorems about isosceles and equilateral triangles to solve problems. • Identify congruent triangles using properties of isosceles and equilateral triangles. • Prove triangle congruence by SAS and SSS congruence criteria and use triangle congruence to solve problems. • Understand that corresponding part of congruent triangles are congruent and use CPCTC.

included angles are congruent, or the three pairs of corresponding sides are congruent. • If two triangles are congruent, then all corresponding angles and sides are congruent. • Two triangles are congruent if two pairs of corresponding angles and the included sides are congruent. • Two polygons are congruent if they can be divided into corresponding congruent triangles. • Two triangles can be proven congruent without showing that all corresponding parts are congruent. • Right triangles can be proven congruent when the hypotenuse and leg of one are congruent to the corresponding sides of the other. • Triangle congruence theorems apply to all triangles, whether or not any parts of the triangles overlap other triangles.	• Prove that two triangles are congruent using ASA and AAS criteria and apply ASA to solve problems. • Prove that two polygons, all of whose corresponding sides and angles are congruent, are congruent. • Prove the Hypotenuse-Leg Theorem • Use congruence criteria for triangles to solve problems and to prove relationships in geometric figures. • Apply congruence criteria to increasingly intricate problems involving overlapping triangles and multiple triangles.

Phase II Curriculum **Unit: 5 Relationships in Triangles**	
Essential Questions: ● How are the sides, segments, and angles of triangles related?	**Essential Understanding:** ● The perpendicular bisector of a segment is the line containing all points that are equidistant from the endpoints of the segment. Similarly, the angle bisector of an angle is the line containing all points that are equidistant from the sides of the angle. ● Key points of concurrency can be defined for a triangle. Perpendicular bisectors intersect at the circumcenter. Angle bisectors intersect at the incenter. Medians intersect at the centroid. Altitudes intersect at the orthocenter. ● The lengths of any two sides of a triangle determine the range of possible values for the length of the third side. The longest side of a triangle is opposite the largest angle, and the shortest side is opposite the smallest angle. ● If two sides of one triangle are congruent to two sides of another triangle, the comparison of the measures of their included angles depends on the comparison of the lengths of the non-congruent sides.
Curriculum Standards- DOK noted where applicable with Standards	
CO.C.9 Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, 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*. **(DOK 3)** **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*. **(DOK 2)** **REI.B.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. **(DOK 1)** **C.A.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. **(DOK 2,3)** **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*. **(DOK 3)** **SRT.B.5** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **(DOK 1,2,3)**	

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). **(DOK 1,2,3)** **REI.C.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. **(DOK 1,2)** **REI.D.10** *Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).* **(DOK 1)**

LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
• The perpendicular bisector of a segment contains all the points that are equidistant from the endpoints of the segment, and an angle bisector contains all the points that are equidistant from the sides of the angle. • The perpendicular bisectors of the sides of a triangle are concurrent at its circumcenter. • The angle bisectors of a triangle are concurrent at its incenter. • The medians of a triangle are concurrent at its centroid. • The lines containing the altitudes of a triangle are concurrent at its orthocenter. • The lengths of the sides of a triangle are related to the measures of the angles in the triangle. • The sum of the lengths of two sides of a triangle is greater than the length of the third side. • When two triangles have two pairs of congruent sides, the longer third side is opposite the larger included angle, and the shorter third side is opposite the smaller included angle.	• Prove the Perpendicular Bisector Theorem, the Angle Bisector Theorem, and their converses. • Use the Perpendicular Bisector Theorem to solve problems. • Use the Angle Bisector Theorem to solve problems. • Prove that the point of concurrency of the perpendicular bisectors of a triangle, called the circumcenter, is equidistant from the vertices. • Prove that the point of concurrency of the angle bisectors of a triangle, called the incenter, is equidistant from the sides. • Identify special segments in triangles and understand theorems about them. • Find an duse the point of concurrency of the medians of a triangle to solve problems and prove relationships in triangles. • Find the point of concurrency of the altitudes of a triangle. • Prove that the side lengths of a triangle are related to the angle measures of the triangle. • Use the angle measures of a triangle to compare the side lengths of the triangle. • Use the Triangle Inequality Theorem to determine if three given side lengths will form a triangle and to find a range of possible side lengths for a third side given two side lengths. • Prove the Hinge Theorem and use the Hinge Theorem to compare side lengths. • Prove the Converse of the Hinge Theorem and use the Converse of the Hinge Theorem to compare angle measures.

Phase II Curriculum **Unit: 6 Quadrilaterals and Other Polygons**	
Essential Questions: ● How are the properties of parallelograms used to solve problems and to classify quadrilaterals?	**Essential Understanding:** ● If a quadrilateral has two pairs of congruent adjacent sides and no pair of congruent opposite sides, then it is a kite. ● If a quadrilateral has exactly one pair of parallel opposite sides, then it is a trapezoid. ● Opposite sides of parallelograms are congruent, Conversely, a quadrilateral can be classified as a parallelogram if both pairs of opposite sides are congruent. ● Diagonals of parallelograms bisect each other. Conversely, a quadrilateral can be classified as a parallelogram if the diagonals bisect each other. ● Opposite angles of parallelograms are congruent. Conversely, a quadrilateral can be classified as a parallelogram if both pairs of opposite angles are congruent. ● Consecutive angles of parallelograms are supplementary. Conversely, a quadrilateral can be classified as a parallelogram if an angle is supplementary with both consecutive angles. ● If one pair of opposite sides of a quadrilateral is parallel and congruent, then the quadrilateral is a parallelogram. ● A parallelogram is a rectangle if the diagonals are congruent. ● A parallelogram is a rhombus if the diagonals are perpendicular or if a diagonal bisects both opposite angles. ● A parallelogram is a square if the diagonals are perpendicular and congruent.
Curriculum Standards- DOK noted where applicable with Standards	
SRT.B.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **(DOK 1,2,3)** **C.A.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. **(DOK 2,3)** **CO.C.11** Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals*. **(DOK 3)**	
LEARNING TARGETS	
Knowledge/Content	**Skills/Processes**

I Know …	I Can …
• The sum of the exterior angles of a polygon is 360°, regardless of the number of sides. • The sum of the interior angles of a polygon is 180°(n - 2), where n is the number of sides. • Diagonals of a kite are perpendicular, and one diagonal bisects the other. • In isosceles trapezoids, diagonals are congruent. • The length of the midsegment of a trapezoid is half the sum of the lengths of the bases. • In a parallelogram, consecutive angles are supplementary, opposite angles are congruent, opposite sides are congruent, and the diagonals bisect each other. • A quadrilateral with two pairs of congruent opposite sides, or one pair of congruent parallel sides, or diagonals bisecting each other is a parallelogram. • A quadrilateral with an angle supplementary to both of its consecutive angles, or two pairs of opposite congruent angles is a parallelogram. • The diagonals of a rhombus are perpendicular, bisect each other, and bisect opposite angles. • They form four congruent triangles. • In a rectangle, the diagonals are congruent. • Squares have properties of rhombuses and rectangles. • A parallelogram with perpendicular diagonals or diagonals that bisect angles is a rhombus. • A parallelogram with congruent diagonals is a rectangle. • A parallelogram with perpendicular congruent diagonals or with congruent diagonals and a diagonal that bisects angles is a square.	• Show that the sum of the exterior angles of a polygon is 360° and use that to solve problems. • Show that the sum of the interior angles of a polygon is the product of 180° and two less than the number of sides, and use that to solve problems. • Use properties of the diagonals of a kite to solve problems and prove relationships. • Use properties of isosceles trapezoids to solve problems and prove relationships. • Use the relationship between the lengths of the bases and midsegment of a trapezoid to solve problems. • Show that the consecutive angles of a parallelogram are supplementary and opposite angles are congruent. • Show that opposite sides of a parallelogram are congruent. • Show that diagonals of a parallelogram bisect each other. • Demonstrate that a quadrilateral is a parallelogram based on its sides and diagonals. • Demonstrate that a quadrilateral is a parallelogram based on its angles. • Prove that the diagonals of rhombuses are perpendicular bisectors of each other and angle bisectors of the angles of the rhombus. • Prove that the diagonals of a rectangle are congruent. • Use properties of rhombuses, rectangles, and squares to solve problems. • Identify rhombuses, rectangles, and squares by the characteristics of diagonals of parallelograms.

Phase II Curriculum **Unit: 7 Similarity**	
Essential Questions: ● How are properties of similar figures used to solve problems?	**Essential Understanding:** ● Unknown angle measures and side lengths can be found by using the property that corresponding angles of similar figures are congruent and corresponding sides lengths are proportions. Triangle similarity can be determined by applying the AA~ , SSS~, and SAS~ Theorems. Triangle similarity is used to establish proportional relationships.

Curriculum Standards- DOK noted where applicable with Standards

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). **(DOK 1,2)**
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. **(DOK 1,2,3)**
SRT.A.1.A A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. **(DOK 2)**
SRT.A.1.B The dilation of a line segment is longer or shorter in the ratio given by the scale factor. **(DOK 2)**
SRT.A.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. **(DOK 1,2)**
C.A.1 Prove that all circles are similar. **(DOK 3)**
SRT.A.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. **(DOK 2,3)**
SRT.B.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **(DOK 1,2,3)**
SRT.B.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. **(DOK 3)**
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. **(DOK 3)**

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
• A dilation is a transformation that preserves angle measure but not length. • The dilation of a figure is determined by the scale factor and center of dilation. • Every distance from the center of dilation and every side length in a preimage are multiplied by the scale factor to find the corresponding distance and side length in the image. • A similarity transformation is a dilation combined with one or more rigid motions. • In order for two figures to be similar, there must be a similarity transformation that maps one figure to the other. • All circles are similar. • Two triangles are similar if a composition of rigid motions and a dilation will map one triangle onto another. • Two pairs of congruent angles, or three pairs of sides with lengths that are in the same proportion, or two pairs of sides having congruent included angles with lengths that are in the same proportion, are sufficient to show that two triangles are similar. • The length of the altitude to the hypotenuse of a right triangle is the geometric mean of the lengths of the two segments of the hypotenuse. • The length of a leg of a right triangle is the geometric mean of the length of the hypotenuse and the segment of the hypotenuse adjacent to the leg. • A segment parallel to one side of a triangle divides the triangle into two similar! triangles • If the segment parallel to the one side of the triangle connects the midpoints of the two sides, the smaller triangle is in proportion 1:2 with the larger triangle. • A segment that bisects an angle of a triangle divides the opposite side of the triangle into segments that are proportional to the adjacent sides.	• Dilate figures on and off the coordinate plane. • Understand how distances and lengths in a dilation are related to the scale factor and center of dilation. • Understand that two figures are similar if there is a similarity transformation that maps one figure onto another. • Identify a combination of rigid motions and dilation that maps one figure to a similar figure. • Identify the coordinates of an image under a similarity transformation. • Use dilations and rigid motions to prove triangles similar. • Use AA~, SSS~, and SAS~ to prove triangles are similar. • Use similarity of right triangles to solve problems. • Use length relationships of the sides of right triangles and an altitude drawn to the hypotenuse to solve problems. • Use the Side-Splitter Theorem and the Triangle MIdsegment Theorem to find lengths of sides and segments of triangles. • Use the Triangle-Angle-Bisector Theorem to find lengths of sides and segments of triangles.

Phase II Curriculum

Unit: 8 Right Triangles and Trigonometry

Essential Questions:	**Essential Understanding:**
• How are the Pythagorean Theorem and trigonometry useful?	• The Pythagorean Theorem and trigonometry are useful to apply properties of similar figures to solve for unknown side lengths and angles of right triangles.

Curriculum Standards- DOK noted where applicable with Standards

SRT.B.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. **(DOK 3)**
SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **(DOK 1,2)**
SRT.C.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. **(DOK 1)**
SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles. **(DOK 1,2)**
SRT.D.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems. **(DOK 1,2,3)**
SRT.D.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces). **(DOK 1,2,3)**
SRT.D.9 (+) Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. **(DOK 2,3)**

LEARNING TARGETS

Knowledge/Content
I Know …

- The Pythagorean Theorem can be understood through the relationships between the similar triangles formed by the altitude to the hypotenuse.
- The length of the hypotenuse of a 45-45-90 triangle is $\sqrt{2}$ times the leg length.
- The length of the hypotenuse of a 30-60-90 triangle is twice the length of the shorter leg, and the length of the longer leg is $\sqrt{3}$ times the length of the shorter leg.
- For any two right triangles with a given acute angle, the ratios of any two corresponding side lengths are equal.
- The ratio of the opposite side to the hypotenuse is the sine ratio, the ratio of the adjacent side to the hypotenuse is the cosine ratio, and the ratio of the opposite side to the adjacent side is the tangent ratio.

Skills/Processes
I Can …

- Prove the Pythagorean Theorem using similar right triangles.
- Understand and apply the relationships between side lengths in 45-45-90 and 30-60-90 triangles.
- Define and calculate sine, cosine, and tangent ratios.
- Use trigonometric ratios to solve problems .
- Understand why the Law of Sines applies to any triangle.
- Use the Law of Sines to solve problems.
- Develop an understanding of the Law of Cosines.
- Use the Law of Cosines to solve problems.
- Distinguish between angles of elevation and depression.
- Use trigonometric ratios and the Law of Sines and Cosines to solve problems.

• For any triangle, the ratio of the sine of an angle to the length of the opposite side is constant for all three pairs of angles and opposite sides. • If two side lengths and the measure of a non-included angle, or two angle measures and a side length are known, all of the angle measures and side lengths of a triangle can be found. • For any triangle, the square of the length of a side is the sum of the squares of the lengths of the other two sides minus the product of the two, the lengths of the other two sides, and the cosine of the angle between them. • The relationship allows missing sides and angle to be found in the cases not covered by the Law of Sines. • The ratios of the corresponding sides of right triangles are constant for right triangles with given base angles and are related to the base angles. • The relationships can be used to solve problems where side lengths, angle measures or areas of triangles are desired.	

Phase II Curriculum **Unit: 9 Coordinate Geometry**	
• **Essential Questions:** How can geometric relationships be proven by applying algebraic properties to geometric figures represented in the coordinate plane?	**Essential Understanding:** • Students will analyze figures on the coordinate plane using slope, midpoint, and distance. Students will examine coordinate proofs, using coordinate geometry to prove properties of figures.

Curriculum Standards- DOK noted where applicable with Standards

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,√3) lies on the circle centered at the origin and containing the point (0, 2). **(DOK 3)**
GPE.B.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. **(DOK 1,2)**
GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. **(DOK 1,2)**
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*. **(DOK 3)**
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. **(DOK 1)**
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. **(DOK 1,2)**

LEARNING TARGETS

Knowledge/Content I Know …	Skills/Processes I Can …
• Algebra is used to determine properties of geometric figures drawn on the coordinate plane • Slopes can be used to determine whether segments are parallel or perpendicular. • The Distance Formula can be used to find lengths of segments. • The Midpoint Formula can be used to bisect segments. • Proofs using coordinate geometry require planning by determining the properties to be shown with algebra, drawing a labeled diagram on the coordinate plane and calculating the	• Use coordinate geometry to classify triangles and quadrilaterals on the coordinate plane. • Solve problems involving triangles and polygons on the coordinate plane. • Plan a method of proof using coordinate geometry. • Prove theorems using algebra and the coordinate plane. • Write the equation for a circle given the graph of the circle or given the center and radius of the circle. • Graph a circle from its equation. • Explain the relationship between a focus and directrix and the corresponding parabola.

values needed to show the desired relationships. • Use the equations of a circles in the coordinate plane is given by $(x - h)^2 + (y - k)^2 = r^2$ where (h, k) is the center of the circle and r is the radius. • An equation of a parabola in the coordinate plane with the vertex at the origin is given by y= $\frac{1}{4p} x^2$, where p is the distance between the focus and vertex. • If the vertex is the point (h, k), an equation of the parabola is given by $y\text{-}k = \frac{1}{4p} (x - h)^2$.	• Write equations for parabolas given the focus and the directrix.

Phase II Curriculum **Unit: 10 Circles**	
Essential Questions: ● How are the figures formed related to the radius, circumference, and area of a circle when a line or lines intersect a circle?	**Essential Understanding:** ● Students will examine arc length, sector area, and segment area and an introduction to radians as a unit of angle measure. Students will examine properties of tangents, chords, and inscribed angles.
Curriculum Standards- DOK noted where applicable with Standards	
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. **(DOK 1)** **C.B.5** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. **(DOK 1,2,3)** **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 right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. **(DOK 1,2)** **C.A.4+** Construct a tangent line from a point outside a given circle to the circle. **(DOK 2)** **CO.D.13** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. **(DOK 2)**	
LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
● Arcs are classified as minor arcs or major arcs depending on whether they are smaller or larger than a semicircle. ● The length of tan arc is a portion of the circumference proportional to the corresponding central angle. ● The area of a sector of a circle is the portion of the area of the circle proportional to the central angle. ● The area of a segment of a circle is the area of the corresponding sector minus the area of the corresponding triangle. ● A line that is tangent to a circle intersects the circle at exactly one point and is perpendicular to the radius to that point. ● If two segments are tangent to the same circle and have a common endpoint exterior to the circle, the segments are congruent.	● Calculate the length of an arc when the central angle is given in degrees or radians. ● Calculate the area of sectors and segments of circles. ● Identify lines that are tangent to a circle using angle measure and segment lengths. ● Solve problems involving tangent lines. ● Prove and apply relationships between chords, arcs, and central angles. ● Find lengths of chords given the distance from the center of the circle, and use this information to solve problems. ● Identify and apply relationships between the measures of inscribed angles, arcs, and central angles. ● Identify and apply the relationships between an angle formed by a chord and a tangent to its intercepted arc.

• In a circle or congruent circles, two chords are congruent if the corresponding central angles are congruent or if the chords intercept congruent arcs. • The perpendicular bisector of a chord is a diameter of the circle. • In a circle, the measure of an inscribed angle is one-half of the measure of its intercepted arc. • In a circle, the measure of an angle formed by a chord and a tangent to the circle is one-half of the measure of its intercepted arc. • When two secants intersect inside a circle, the measure of the angle formed is half the sum of the intercepted arcs. • When secants or tangents intersect outside a circle, the measure of the angle formed is half the difference of the intercepted arcs. • When secants or tangents intersect inside or outside a circle, the product of the distances from point of intersection to the points on the circle is the same for both lines.	• Recognize and apply the angle relationships formed by secants and tangents intersecting inside and outside a circle. • Recognize and apply segment length relationships formed by secants and tangents intersecting inside and outside a circle.

Phase II Curriculum **Unit: 11 Two- and Three-Dimensional Models**	
Essential Questions: ● How is Cavalieri's Principle helpful in understanding the volume formulas for solids?	**Essential Understanding:** ● Students will compare the relationship between the numbers of faces, vertices, and edges in polyhedrons, examining cross sections, and determining the three-dimensional figure formed by rotating a two-dimensional figure. Students will compare the volume of oblique solids to cross sections of oblique solids to corresponding right solids.
Curriculum Standards- DOK noted where applicable with Standards	
GMD.B.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. **(DOK 1,2)** **GMD.A.1** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments*. **(DOK 2,3)** **GMD.A.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.* **(DOK 1,2)** **MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).* **(DOK 1,2)** **MG.A.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).* **(DOK 1,2)** **GMD.A.2+** Give an informal argument using Cavalieri's principle for the formula for the volume of a sphere and other solid figures. **(DOK 1,2)**	
LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
● The sum of the number of faces and vertices of a polyhedron equals two more than the number of edges. ● The cross section of a plane and a convex polyhedron is a polygon. ● A polygon rotated about an axis yields a three-dimensional figure with circular cross sections. ● Cavalieri's Principle states that two figures with the same height and same cross sectional area at every level have the same volume. ● Cavalieri's Principle can be used to calculate the area of oblique prisms and cylinders.	● Use Euler's formula to calculate the number of vertices, faces, and edges in polyhedrons. ● Describe cross sections of polyhedrons. ● Describe rotations of polygons about an axis. ● Understand how the volume formulas for prisms and cylinders apply to oblique prisms and cylinders. ● Model three dimensional figures as cylinders and prisms to solve problems. ● Understand how the volume formulas for pyramids and cones apply to oblique pyramids and cones. ● Model three-dimensional figures as pyramids and cones to solve problems.

• Cones and pyramids with the same height and same area at every cross section have equal volume. • The volume of a cone or pyramid can be found using the formula V= $\frac{1}{3}Bh$, where B is the area of the base and h is the height. • Apply Cavalieri's Principle to show that the volume of a hemisphere is equal to the volume of a cylinder of equal diameter and height minus the volume of a cone of equal diameter and height. • Find the volumes of objects composed of two or more solids by decomposing the solid into its component parts.	• Use Cavalieri's Principle to show how the volume of a hemisphere is related to the volume of a cone and a cylinder. • Calculate volumes and surface areas of spheres and composite figures.

Phase II Curriculum **Unit: 12 Probability**	
Essential Questions: ● How can you find the probability of events and combinations of events?	**Essential Understanding:** ● Students will understand and graph probability distributions and learn methods for using probability models and expected value to make decisions.

Curriculum Standards- DOK noted where applicable with Standards

CP.A.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). **(DOK 1,2)**
CP.A.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. **(DOK 1)**
CP.A.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer. **(DOK 1,2,3)**
CP.B.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) - P(A and B), and interpret the answer in terms of the model. **(DOK 1,2)**
CP.A.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B. **(DOK 1,2)**
CP.A.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results. **(DOK 1,2)**
CP.B.6 Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. **(DOK 1,2)**
CP.B.8 (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. **(DOK 1,2)**
CP.B.9 Use permutations and combinations to compute probabilities of compound events and solve problems. **(DOK 1,2)**
MD.A.1(+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. **(DOK 2,3)**
MD.A.3(+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes. **(DOK 1,2)**
MD.A.4(+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data

distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households? **(DOK 1,2)**
CP.B.9(+) Use permutations and combinations to compute probabilities of compound events and solve problems. **(DOK 1,2)**
MD.A.2 (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. **(DOK 1,2)**
MD.B.5(+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. **(DOK 1,2,3)**
MD.B.5.A(+) Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant. **(DOK 1,2)**
MD.B.5.B (+) Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident. **(DOK 2,3)**
MD.B.6(+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). **(DOK 1,2)**
MD.B.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). **(DOK 2,3)**

LEARNING TARGETS	
Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
• Two events that cannot both occur are mutually exclusive. • Two events are independent if the occurence of one does not affect the probability of the other. • The probability that two independent events both occur is the product of their possibilities. • The conditional probability that event A will occur, given that another event B has occurred, is written as P(A|B) and can be calculated by dividing P(A and B) by P(B). • Two events are independent if and only if P(A|B) = P(A) and P(A|B) = P(B). • A permutation is an arrangement of items in which the order of the items matters. • A combination is an arrangement in which order does not matter. • You can define a theoretical probability distribution by calculating the probability of each outcome in an experiment or an experimental probability distribution by using the real-world relative frequency of each outcome. • Expected value is the probability-weighted average of all possible values of a variable.	• Explain independence of events in everyday language and everyday situations • Determine the probability of the union of two events (A or B) and the intersection of two independent events (A and B). • Understand the conditional probability of A given B as the fraction of outcome sin B that also belong to A. • Interpret independence of events in terms of conditional probability. • Use a two-way frequency table to decide if events are independent and to approximate conditional probabilities. • Calculate the number of permutations and combinations in mathematical and real-world contexts. • Use permutations and combinations to compute probabilities of compound events and solve problems. • Calculate the expected value in situations involving change. • Weigh the possible outcomes of a decision by comparing expected values and finding expected payoffs.

• Expected value can be interpreted as the average outcome for many trials of an experiment. • Use expected value to find expected payoffs in a situation involving change or to compare options with differing costs and benefits. • To determine whether a procedure is fair, compare the probabilities to the possible outcomes. • To choose among options, compare expected values. • In situations with two possible outcomes for each trial, use binomial probabilities.	• Analyze decisions and evaluate fairness using probability concepts.