High School - Geometry

North Boone CUSD 200

UNITS (8/8 SELECTED)	SUGGESTED DURATION
Unit 1: Transformations and Congruence	*29 lessons*
Unit 2: Lines, Angles, & Triangles	*27 lessons*
Unit 3: Using Similar Triangles	*5 lessons*
Unit 4: Quadrilaterals & Coordinate Proof	*27 lessons*
Unit 5: Right Triangles and Trigonometry	*18 lessons*
Unit 6: Measurement & Modeling in 2 & 3 Dimensions	*24 lessons*
Unit 7: Probability and Graph Analysis	*5 lessons*
Unit 8: Properties of Circles	*25 lessons*

Unit 1: Transformations and Congruence

High School - Geometry - *Last Updated on March 21, 2019*

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.

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).

CO.C.9: Prove theorems about lines and angles.

CO.A.4: Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

CO.A.3: Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

PRIORITY 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.
CO.C.9	Prove theorems about lines and angles.

Unit 1: Transformations and Congruence

High School - Geometry - *Last Updated on March 21, 2019*

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Just about any real-world situation involving shapes or the location of objects in space can be represented using the tools of geometry. A logical deductive system of reasoning is used to unify all mathematical knowledge. Precise definitions of mathematical terms are an essential component in this logical deductive system of reasoning. When a certain set of fundamental ideas or understandings are assumed to be true, all other mathematical results can be logically derived and proved from these foundations. While there are many forms for proofs (such as two-column, flowcharts, and narrative paragraphs), the main purpose of any proof is to present a logically sound argument. Finding a proof and communicating a proof are two different things. Completed proofs are models for how to present a finished logical argument. Finding a proof is rarely linear and is most often a process of sorting through information looking for logical connections that can be organized and communicated in any format. Rigid transformations can represent situations in which objects slide, turn, or flip.	How can you use the tools of geometry to solve real-world problems? How can you use transformations to solve real-world problems?

Unit 1: Transformations and Congruence

High School - Geometry - *Last Updated on March 21, 2019*

Students will know (Knowledge):	Students will be able to (Skills):
• That undefined notions of point, line, and distance exist • Key concepts and vocabulary associated with transformations and congruence including: line segment, endpoints, ray, coplanar, parallel, collinear, postulate, midpoint, segment bisector, angle, vertex, side, degrees, angle bisector, transformation, preimage, image, rigid motion, theorem, linear pair, vector, initial point, terminal point, translation, perpendicular lines, perpendicular bisector, reflection, rotation, center of rotation, angle of rotation, center of dilation, dilation, scale factor, symmetry, line symmetry, line of symmetry, rotational symmetry, angle of rotational symmetry • How measuring an angle is similar to and different from measuring a line segment • How to go about proving a statement • Various forms for communicating proofs • How dilation transforms a figure	• Use the undefined terms *point, line, and plane* to write definitions for geometric terms such as *line segment and ray* • Correctly use key concepts and vocabulary associated with transformations and congruence in explanations of problem solving, proofs, and/or discussion • Draw a segment and measure its length • Describe transformations in the coordinate plane using algebraic representations and words • Draw the image of a figure under a translation, a reflection, a rotation, and a dilation • Determine whether a figure has line symmetry or rotational symmetry • Apply more than one transformation to a figure • Draw and label visual representation of key concepts and vocabulary • Match key concepts and vocabulary with written definitions or descriptions and/or visual representations

Unit 2: Lines, Angles, & Triangles

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STANDARDS

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.

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.

CO.C.9: Prove theorems about lines and angles.

CO.C.10: Prove theorems about triangles.

SRT.B.5: Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

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).

SRT.A.3: Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

PRIORITY STANDARDS

CO.C.9	Prove theorems about lines and angles.
CO.C.10	Prove theorems about triangles.
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)

Unit 2: Lines, Angles, & Triangles

High School - Geometry - *Last Updated on March 21, 2019*

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
The characteristics of parallel and perpendicular lines help us analyze real-world objects. Through a point P not on line ℓ, there is exactly one line parallel to ℓ. The distance from a point P to a line ℓ is defined as the length of the perpendicular segment from P to ℓ. Principles and applications of triangle congruence can be used to analyze and construct many real-world architectural and engineering features such as trusses and geodesic domes. Two geometric figures are congruent if they are the same size and shape. Triangle congruence criteria are based on analyses of rigid motions; and provide shortcuts for proving triangles congruent. Triangle congruence serves as a foundation for the development of formal proof. The properties of triangles are used to solve problems wherever triangles appear in the real world, such as in the shape of a building or a park. Special segments can be used to find many characteristics of real-world triangles such as their areas or centers of mass	How can you use parallel and perpendicular lines to solve real-world problems? How can you use triangle congruence to solve real-world problems? How can you use properties of triangles to solve real-world problems? How can you use special segments in triangles to solve real-world problems?

Unit 2: Lines, Angles, & Triangles

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Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with lines, angles, and triangles including: vertical angles, complementary angles, supplementary angles, transversal, hypotenuse, legs, interior angle, auxiliary line, exterior angle, remote interior angle, isosceles triangle, vertex angle, base, base angles, equilateral triangle, equiangular triangle, median or a triangle, midsegment of a triangle, orthocenter of a triangle, point of concurrency • The ways to show that two triangles are congruent • What the SSS, SAS, ASA, AAS, and HL Triangle Congruence Theorems tell about triangles • What can be concluded about two figures that are congruent (CPCTC) • What can be said about the interior and exterior angles of a triangle and other polygons • The special relationships among angles and sides in isosceles and equilateral triangles	• Correctly use key concepts and vocabulary associated with lines, angles, and triangles in explanations of problem solving, proofs, and/or discussion • Draw and label visual representation of key concepts and vocabulary • Match key concepts and vocabulary with written definitions or descriptions and/or visual representations • Find the measures of angles formed by intersecting lines • Prove and use theorems about angles formed by transversals that intersect parallel lines • Prove that two lines are parallel • Find the equation of a line that is parallel or perpendicular to a given line • Show how two triangles are similar (AA) • How the segments that join the midpoints of a triangle's sides related to the triangle's sides • How to find the balance point or center of gravity of a triangle

Unit 3: Using Similar Triangles

High School - Geometry - *Last Updated on March 21, 2019*

STANDARDS

SRT.B.4: Prove theorems about triangles.

SRT.B.5: Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

PRIORITY STANDARDS

SRT.B.4	Prove theorems about triangles.

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Similarity is a useful tool in real-world problems involving things that have the same shape but different sizes such as finding the height of a tall object by measuring its shadow.	How can you use similarity to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with using similar triangles, such as: indirect measurement, • How a line parallel to one side of a triangle that intersects the other two sides divides those sides	• Correctly use key concepts and vocabulary associated with using similar triangles in explanations of problem solving, proofs, and/or discussion • Use similar triangles to solve problems

Unit 4: Quadrilaterals & Coordinate Proof

High School - Geometry - *Last Updated on March 21, 2019*

STANDARDS

CO.C.11: Prove theorems about parallelograms.

SRT.B.5: Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

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).

GPE.B.7: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

PRIORITY STANDARDS

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).
GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Unit 4: Quadrilaterals & Coordinate Proof

High School - Geometry - *Last Updated on March 21, 2019*

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Wherever quadrilaterals are found in the real world, such as in buildings, billboards, or paving stones, their properties can be used to answer questions about them. A parallelogram is a quadrilateral whose opposite sides are parallel. The rectangle, rhombus, and square are parallelograms with additional properties beyond those of parallelograms. Kites and trapezoids are quadrilaterals with properties and conditions that distinguish them from rectangles, rhombuses, and squares. The use of coordinates can make it easier to represent the orientations, locations, and dimensions of objects in space, helping to solve many real-world problems. Coordinate (or analytic) Geometry is a branch of geometry that merges geometry and algebra using the coordinate plane.	How can you use properties of quadrilaterals to solve real-world problems? How can you use coordinate proofs using slope and distance to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with quadrilaterals and coordinate proof, including: diagonal, isosceles trapezoid, kite, midsegment of a trapezoid, parallelogram, quadrilateral, rectangle, rhombus, square, trapezoid, coordinate proof, composite figure • The criteria that can be used to prove that a quadrilateral is a parallelogram • The properties of rectangles, rhombuses, and squares	• Correctly use key concepts and vocabulary associated with quadrilaterals and coordinate proof in explanations of problem solving, proofs, and/or discussion • Draw and label visual representation of key concepts and vocabulary • Match key concepts and vocabulary with written definitions or descriptions and/or visual representations

Unit 4: Quadrilaterals & Coordinate Proof

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Students will know (Knowledge):	Students will be able to (Skills):
• The properties of kites and trapezoids	• Draw conclusions about the sides, angles, and diagonals of a parallelogram • Use given conditions to show that a quadrilateral is a rectangle, a rhombus, or a square • Use slope to solve problems involving parallel lines • Use slope to solve problems involving perpendicular lines • Use slope and the distance formula in coordinate proofs • Find the perimeter and area of polygons in the coordinate plane

Unit 5: Right Triangles and Trigonometry

High School - Geometry - *Last Updated on March 21, 2019*

STANDARDS

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.

SRT.C.8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

SRT.D.10: (+) Prove the Laws of Sines and Cosines and use them to solve problems.

C.A.1: Prove that all circles are similar.

PRIORITY STANDARDS

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.
SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Unit 5: Right Triangles and Trigonometry

High School - Geometry - *Last Updated on March 21, 2019*

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Trigonometric ratios that allow you to find the side length of a right triangle given an angle measure (or vice versa) are useful in solving real-world problems that involve triangular shapes. Because all right triangles with a given acute angle are similar, the ratios of: • the length of the leg opposite the angle to the length of the hypotenuse; • the length of the leg adjacent to the angle to the length of the hypotenuse; and • the length of the leg opposite the angle to the length of the leg adjacent to the angle do not depend upon the size of the triangle Solving a right triangle is the process of using given measures in the triangle to find unknown side lengths or angle measures. Understanding triangle trigonometry is helpful in solving real-world problems (such as those connected with real estate) when direct measurement is impossible. The Law of Sines may be used to solve any triangle given either of the following. • Two angle measures and any side length • Two side lengths and a non-included angle measure. The Law of Cosines may be used to solve a triangle given either of the following. • Two side lengths and the included angle measure • Three side lengths	How can you use trigonometry with right triangles to solve real-world problems? How can you use triangle trigonometry to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with trigonometry, including: Side-Side-Side Similarity, similar, similarity transformation, adjacent, opposite, tangent, $\tan^{-1}A$, inverse tangent of < A, trigonometric ratio, sine, cosine, inverse trigonometric ratios, Pythagorean triple, radians • The side lengths and the trigonometric ratios in special right triangles	• Correctly use key concepts and vocabulary associated with trigonometry in explanations of problem solving, proofs, and/or discussion • Find the tangent ratio for an acute angle • Use the sine and cosine ratios, and their inverses, in calculations involving right triangles • Solve a right triangle • Use trigonometric ratios to find side lengths and angle measures of non-right triangles • Use the Law of Cosines to find measures of any triangle

Unit 6: Measurement & Modeling in 2 & 3 Dimensions

High School - Geometry - *Last Updated on March 21, 2019*

STANDARDS

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.

GMD.A.2: (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

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.

GMD.A.3: Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

C.A.1: Prove that all circles are similar.

C.B.5: Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

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).

PRIORITY STANDARDS

GMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Unit 6: Measurement & Modeling in 2 & 3 Dimensions

High School - Geometry - *Last Updated on March 21, 2019*

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Arc length and sector area are useful when analyzing circular shapes. Volume formulas are useful when needing to find how much liquid something can hold, such as a cup or a swimming pool. The volume of a rectangular prism is the product of the area of its base and its height. This is the starting point for developing the volume formulas for other three-dimensional figures. The volume formulas for cylinders, pyramids, cones, and spheres all rely on application of principle that if two three-dimensional figures have the same height and the same cross-sectional area at every level, then they have the same volume. Visualizing a solid is useful in solving problems involving surface area, such as determining how much paint is needed to cover an object. Two and three dimensional figures are commonly encountered in real world contexts and problem solving. The ability to visualize: • three-dimensional figures, • the generation of solid figures by rotating two-dimensional figures, • and cross-sections of figures is an essential skill for solving real-world and mathematical problems Modeling is useful for solving any real-world problem involving objects that are too large or unwieldy to manipulate or measure directly.	How can the arc length and sector area of a circle beused to solve real-world problems? How can you use volume formulas to solve real-world problems? How can visualizing solids help you to solve real-world problems? How can you use modeling to solve real-world problems?

Unit 6: Measurement & Modeling in 2 & 3 Dimensions

High School - Geometry - *Last Updated on March 21, 2019*

Enduring Understandings	Essential Question(s)
When all dimensions of a two dimensional figure are multiplied by a nonzero constant k, the perimeter or circumference changes by a factor of k and the area changes by a factor of k^2 When all the dimensions of a three-dimensional figure are multiplied by a nonzero constant k, the surface area changes by a factor of k^2 and the volume changes by a factor of k^3	

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with measurement and modeling in 2 and 3 dimensions, including: right prism, right cylinder, oblique prism, oblique cylinder, cross section, net, surface area, regular pyramid, right cone, density, scale factor • How the formulas for the volume of a prism and cylinder relate to area formulas students already know • Tools that can be used to visualize solid figures accurately • How the formula for the lateral area of a regular pyramid is similar to the formula for the lateral area of a right cone • How multiplying one or more of the dimensions of a figure affects its attributes	• Correctly use key concepts and vocabulary associated with measurement and modeling in 2 and 3 dimensions in explanations of problem solving, proofs, and/or discussion • Justify and use the formulas for the circumference and area of a circle • Find the length of an arc of a circle • Find the area of a sector of a circle • Find the volume of a pyramid • Calculate the volumes of composite figures that include cones • Use the formula for the volume of a sphere to calculate the volumes of composite figures • Find the surface area of a prism or cylinder • Use the formula for the surface area of a sphere to calculate the surface areas of composite figures • Model real-world situations involving density • Model situations to meet real-world constraints

Unit 7: Probability and Graph Analysis

High School - Geometry - *Last Updated on March 21, 2019*

STANDARDS

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.

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.

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.

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.

MD.B.6: (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

PRIORITY STANDARDS

Unit 7: Probability and Graph Analysis

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DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Probability is useful for analyzing the likelihood that a particular event sill happen such as a die will show 6 on a throw or that it will rain. Probability measures the likelihood of an event. The theoretical probability of an event is the ratio of the number of outcomes in the event to the total number of possible outcomes. Conditional probability and independence of events are useful for analyzing how the occurrence of one event affects the probability of another. Two events are independent if the occurrence of one does not affect the probability of the other. Probability along with the connections among random samples, convenience samples, and fair decision-making helps represent real-world problems with mathematics.	How can you use probability to solve real-world problems? How can you use conditional probability and independence of events to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with probability and graph analysis, including: measures of central tendency, measures of variability, normal distribution, standard deviation, conditional probability, independent events, dependent events, • What it means for two events to be independent	• Correctly use key concepts and vocabulary associated with probability and graph analysis in explanations of problem solving, proofs, and/or discussion • Calculate a conditional probability • Find the probability of dependent events • Use probability to help make fair decisions • Use conditional probability help make real-world decisions

Unit 8: Properties of Circles

High School - Geometry - *Last Updated on March 21, 2019*

STANDARDS

C.A.2: Identify and describe relationships among inscribed angles, radii, and chords.

C.A.3: Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

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.

PRIORITY STANDARDS

C.A.2	Identify and describe relationships among inscribed angles, radii, and chords.
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.

Unit 8: Properties of Circles

High School - Geometry - *Last Updated on March 21, 2019*

DESIRED RESULTS

Enduring Understandings	Essential Question(s)
Angles and segments in circles can be used to solve real-world problems when they involve linear and circular shapes such as in clockwork or machinery. Facts and relationships among angles and rectangles inscribed in circles, arc lengths, tangent lines, the radius, angles circumscribed around circles, and segments help represent real world and mathematical problems involving circular shapes. The ratio of the circumference to the diameter of any circle is a constant. Proportional reasoning is used to find areas of sectors, arc lengths in circles, and to derive relevant formulas. Circle equations are helpful in measuring things like how loud a sound is from the point of sound emission. Parabolic equations are helpful in solving problems involving the need to accurately synchronize events. The equation for a circle is derived from the distance formula.	How can you use angles and segments in circles to solve real-world problems? How can you use equations of circles to solve real-world problems?

Students will know (Knowledge):	Students will be able to (Skills):
• Key concepts and vocabulary associated with circles, including: chord, central angel, inscribed angle, arc, minor arc, major arc, semicircle, adjacent arcs, Inscribed Angel Theorem, Inscribed Quadrilateral Theorem, tangent, point of tangency, Tangent-Radius Theorem, Chord-Chord Product Theorem, secant, secant segment, external secant segment, Secant-	• Correctly use key concepts and vocabulary associated with circles in explanations of problem solving, proofs, and/or discussion • Determine the measures of central angles and inscribed angles of a circle • Write the equation of a circle given its radius and the coordinates of its center

Unit 8: Properties of Circles

High School - Geometry - *Last Updated on March 21, 2019*

Students will know (Knowledge):	Students will be able to (Skills):
Secant Theorem, tangent segment, Intersecting Chords Angle Measure Theorem, Tangent-Secant Interior Angle Measure Theorem, Tangent-Secant Exterior Angle Measure Theorem, circle • Conclusions that can be drawn about the angles of a quadrilateral inscribed in a circle • The key theorems about tangents to a circle • The relationships between the segments in circles • The relationships between angles formed by lines that intersect a circle	