WGSD Curriculum – Honors Geometry
Mathematical Practices

High Priority Standards
CCSS.Math.Practice.MP1

Learning Goal	**Proficiency Scale**
Students will be able to make sense of problems and persevere in solving them.	4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Discussing, explaining, and solving a problem with multiple representations and in multiple ways. ● Struggling with various attempts over time. ● Learning from previous solution attempts. ● Checking answers using a different method or strategy. 2: Student demonstrates they are nearing proficiency by: ● Explaining his/her thought processes when solving a problem and representing it in several ways. ● Trying several approaches in find a solution and seeking hints only if stuck. 1: Student demonstrates a limited understanding or skill with the learning goal by: ● Explaining his/her thought processes when solving a problem one way. ● Staying with a challenging problem for more than one attempt.

Learning Targets

- Explain the meaning of a problem and look for efficient ways to solve it
- Use concrete objects or pictures to help conceptualize and solve problems
- Checks their thinking by asking themselves, “Does this make sense?”
- Listens to the strategies of others and tries different approaches
- Uses a different strategies to check answers
- Takes time to thoughtfully consider problems

Learning Design

- Provides time and facilitates discussion in problem solutions
- Facilitates discourse in the classroom so that students UNDERSTAND the approaches of others
- Provides opportunities for students to explain themselves, the meaning of a problem, etc.
- Provides opportunities for students to connect concepts to “their” world
- Provides students TIME to think and become “patient” problem solvers
- Facilitates and encourages students to check their answers using different methods (not calculators)
- Provides problems that focus on relationships and are “generalizable”

WGSD Curriculum – Honors Geometry
Mathematical Practices

High Priority Standards
CCSS.Math.Practice.MP2

Learning Goal	**Proficiency Scale**
Students will be able to reason abstractly and quantitatively.	4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by ● Converting situations into symbols to solve problems. ● Converting mathematical equations into meaningful situations. 2: Student demonstrates they are nearing proficiency by translating situations into symbols to solve problems. 1: Student demonstrates a limited understanding or skill with the learning goal by reasoning with models or pictorial representations to solve problems.

Learning Targets

- Recognize that a number represents a specific quantity
- Connect the quantity to written symbols and create a logical representation of the problem at hand
- Consider both the appropriate units involved and the meaning of quantities
- Write simple expressions that record calculations with numbers and symbols
- Represent or round numbers using place value concepts

Learning Design

- Provides a range of representations of math problem situations and encourages various solutions
- Provides opportunities for students to make sense of quantities and their relationships in problem situations
- Provides problems that require flexible use of properties of operations and objects
- Emphasizes quantitative reasoning which entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them and/or rules; and knowing and flexibly using different properties of operations and objects

WGSD Curriculum – Honors Geometry
Mathematical Practices

High Priority Standards
CCSS.Math.Practice.MP3

Learning Goal	**Proficiency Scale**
Students will be able to construct viable arguments and critique the reasoning of others.	4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Justifying and explaining, with accurate language and vocabulary, why his/her solution is correct. ● Comparing his/her strategy to other students' strategies, asking questions, and making connections with his/her own thinking. ● Explaining the reasoning of others. 2: Student demonstrates they are nearing proficiency by: ● Explaining his/her thinking and the thinking of others with accurate vocabulary. ● Explaining other students' solutions and identifying strengths and weaknesses of the strategy. 1: Student demonstrates a limited understanding or skill with the learning goal by: ● Explaining his/her solution. ● Discussing other ideas, approaches, and strategies.

Learning Targets

- Construct arguments using concrete referents, such as objects, pictures, and drawings
- Refine their mathematical communication skills by answering questions like "How do you know?" and "Can you show me another way?"
- Refine their mathematical communication skills by asking others questions like "How do you know?" and "How did you get that?"
- Explain their thinking to others and respond to others' thinking

Learning Design

- Provides ALL students opportunities to understand and use stated assumptions, definitions, and previously established results in constructing arguments
- Provides ample time for students to make conjectures and build a logical progression of statements to explore the truth of their conjectures
- Provides opportunities for students to construct arguments and critique arguments of peers
- Facilitates and guides students in recognizing and using counterexamples
- Encourages and facilitates students justifying their conclusions, communicating, and responding to the arguments of others
- Asks useful questions to clarify and/or improve students' arguments

WGSD Curriculum – Honors Geometry
Mathematical Practices

High Priority Standards
CCSS.Math.Practice.MP4

Learning Goal	**Proficiency Scale**
Students will be able to model with mathematics.	4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Recognizing math in everyday situations. ● Using a variety of models, symbolic representations, and technology tools to represent the solution to a problem and accurately explain the solution representation. 2: Student demonstrates they are nearing proficiency by: ● Recognize math in everyday situations, when prompted. ● Using models and symbols to represent and solve a problem. 1: Student demonstrates a limited understanding or skill with the learning goal by using models to represent and solve a problem with teacher support.

Learning Targets

- Represents problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, acting out, making a chart, list, or graph, creating equations, etc. and use all of these representations as needed
- Connect different representations and explain the connections
- Evaluate results in the context of the situation and reflect on whether the results make sense
- Evaluate the utility of models to determine which models are most useful and efficient to solve problems

Learning Design

- Provides problem situations that apply to everyday life
- Provides rich tasks that focus on conceptual understanding, relationships, etc.

WGSD Curriculum – Honors Geometry
Mathematical Practices

High Priority Standards
CCSS.Math.Practice.MP5

Learning Goal	**Proficiency Scale**
Students will be able to use appropriate tools strategically.	4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by combining various tools to explore and solve a problem as well as justifying his/her tool selection and problem solution. 2: Student demonstrates they are nearing proficiency by selecting from a variety of provided tools the ones that can be used to solve a problem and explaining his/her reasoning for the selection. 1: Student demonstrates a limited understanding or skill with the learning goal by using the appropriate tool, when provided, to find a solution.

Learning Targets

- Consider the available tools (including, but not limited to estimation, graph paper, manipulatives, table, list, etc.) when solving a mathematical problem and decide when certain tools might be helpful
- For example, they may use unit cubes to fill a rectangular prism and a ruler to measure the dimensions
- Use graph paper to accurately create graphs and solve problems or make predictions from real world data

Learning Design

- Provides a variety of tools and technology for students to explore to deepen their understanding of math concepts
- Provides problem solving tasks that require students to consider a variety of tools for solving (Tools might include pencil/paper, concrete models, manipulatives, ruler, protractor, calculator, spreadsheet, computer algebra system, statistical package, or dynamic geometry software, etc.)

WGSD Curriculum – Honors Geometry
Mathematical Practices

<table>
<tr><td colspan="2"><u>High Priority Standards</u>
CCSS.Math.Practice.MP6</td></tr>
<tr><td><u>Learning Goal</u>

Students will be able to attend to precision.</td><td><u>Proficiency Scale</u>
4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by using appropriate symbols, vocabulary, and labeling to communicate effectively and exchange ideas.

2: Student demonstrates they are nearing proficiency by incorporating appropriate vocabulary and symbols in most mathematical communications.

1: Student demonstrates a limited understanding or skill with the learning goal by communicating his/her reasoning and solution to others, with support.</td></tr>
<tr><td colspan="2"><u>Learning Targets</u>
● Use clear and precise language in their discussions with others and in their own reasoning
● Specify units of measure and state the meaning of the symbols used
● Report answers that appropriately address the context of a problem</td></tr>
<tr><td colspan="2"><u>Learning Design</u>
● Facilitates, encourages and expects precision in communication
● Provides opportunities for students to explain and/or write their reasoning to others</td></tr>
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Mathematical Practices

<table>
<tr><td colspan="2"><u>High Priority Standards</u>
CCSS.Math.Practice.MP7</td></tr>
<tr><td><u>Learning Goal</u>

Students will be able to look for and make use of structure.</td><td><u>Proficiency Scale</u>
4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:
● Noticing mathematical expressions as component parts.
● Using mathematical generalizations to identify the most efficient solution to mathematical tasks.

2: Student demonstrates they are nearing proficiency by composing and decomposing number situations and relationships in order to simplify solutions.

1: Student demonstrates a limited understanding or skill with the learning goal by looking for structure or patterns within mathematics to help him/her solve problems efficiently.</td></tr>
<tr><td colspan="2"><u>Learning Targets</u>
● Look closely to discover a pattern or structure
o For instance, students use properties of operations as strategies to add, subtract, multiply and divide with whole numbers, fractions, and decimals.
● Examine numerical patterns and relate them to a rule or a graphical representation</td></tr>
<tr><td colspan="2"><u>Learning Design</u>
● Provides opportunities and time for students to explore patterns and relationships to solve problems
● Provides rich tasks and facilitates pattern seeking and understanding of relationships in numbers rather than following a set of steps and/or procedures</td></tr>
</table>

WGSD Curriculum – Honors Geometry
Mathematical Practices

<table>
<tr><td colspan="2"><u>High Priority Standards</u>
CCSS.Math.Practice.MP8</td></tr>
<tr><td><u>Learning Goal</u>

Students will be able to look for and express regularity in repeated reasoning.</td><td><u>Proficiency Scale</u>
4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:
● Connecting prior knowledge to an unfamiliar mathematical situation.
● Creating a model or equation that unifies the various aspects of a problem.
● Noticing patterns, making generalizations, and predicting patterns.

2: Student demonstrates they are nearing proficiency by finding and explaining patterns.

1: Student demonstrates a limited understanding or skill with the learning goal by connecting prior knowledge to new situations and noticing patterns with prompting from a teacher or peer.</td></tr>
<tr><td colspan="2"><u>Learning Targets</u>
● Notice repetitive actions in computation and look for more shortcut methods
● Use repeated reasoning to understand algorithms and make generalizations about patterns</td></tr>
<tr><td colspan="2"><u>Learning Design</u>
● Provides problem situations that allow students to explore regularity and repeated reasoning
● Provides rich tasks that encourage students to use repeated reasoning to form generalizations and provides opportunities for students to communicate these generalizations</td></tr>
</table>

High Priority Standards

G.CO.A.2 Represent transformations in the plane, and describe them as functions that take points in the plane as inputs and give other points as outputs.
G.CO.A.3 Describe the rotational symmetry and lines of symmetry of two-dimensional figures.
G.CO.A.4 Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.
G.CO.A.5 Demonstrate the ability to rotate, reflect or translate a figure, and determine a possible sequence of transformations between two congruent figures.
G.CO.B.6 Develop the definition of congruence in terms of rigid motions.

Learning Goal

Students will be able to identify and apply transformations of figures in the coordinate plane.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- drawing a reflection, translation, or rotation of figures on and off the coordinate plane.
- analyzing figures in terms of their symmetries using concepts of reflection, rotation, translation, dilations and combinations of these.
- developing definitions of rotations, reflections and translations
- representing transformations using descriptions of functions that take points in the plane as inputs and give other points as outputs.
- comparing transformations that preserve distance and angle to those that do not.
- developing the definition of congruence in terms of rigid motions.
- identifying the lines of symmetry of two-dimensional figures.
- determining a possible sequence of transformations between two congruent figures.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: angle, angle of rotation, circle, dilation, line of symmetry, line segment, perpendicular line, parallel line, ray, reflection, rotation, translation, isometry.
- performing specific processes such as:
    - describing the rotations and reflections of a two-dimensional figure that carry it onto itself.

1: Student demonstrates a limited understanding or skill with the learning goal by:

- identifying the transformation applied to an object.

Learning Targets

- Use the descriptions of rigid motions (translations, rotations, reflections) to transform figures.
- 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 (preserving size and shape) to decide if they are congruent. (e.g., Is there a combination of rigid motions that transforms the first figure onto the second?).
- Compare transformations and describe the horizontal and vertical shifts of functions.
- Describe the rotational symmetry of two- dimensional figures. For example, given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- Describe the lines of symmetry of two- dimensional figures.
- Calculate the number of lines of reflection symmetry and the degree of rotational symmetry of any regular polygon.
- When determining a sequence of transformations that carry a geometric figure onto itself, there should be no more than two transformations in the sequence.
- Given a geometric figure and a rotation, reflection or translation, draw the transformed figure using graph paper, tracing paper or geometry software.
- Observe patterns and develop definitions of rotations, reflections, and translations by using manipulatives, constructions, Geoboards or geometry software.

High Priority Standards

G.CO.B.6 Develop the definition of congruence in terms of rigid motions.
G.CO.B.7 Develop the criteria for triangle congruence from the definition of congruence in terms of rigid motions.
G.CO.B.9 Prove theorems about triangles.

Learning Goal

Students will understand congruence and use triangle congruence as a foundation for formal proof.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- using theorems and postulates to prove triangle congruence.
- proving theorems using triangle sum, exterior angle, properties of special triangles, midpoints, medians, angle bisectors, mid-segment, ASA, AAS, SAS, SSS, and HL.
- explaining what criteria are needed to prove two or more figures are congruent.
- applying the properties of congruence to solve problems.
- determining if two figures are congruent by determining if rigid motions will turn one figure into the other.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: corresponding sides, corresponding angles, midpoint, congruent, SAS, ASA, SSS, AAS, HL, vertical angle, exterior angle, interior angle, median, angle bisector, and mid-segment.
- performing specific processes such as:
    - identifying congruent sides and angles given congruent figures.
    - identifying corresponding sides and angles of congruent figures.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Theorems should include, but are not limited to, the following: 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.
- Develop the criteria for triangle congruence, if and only if corresponding sides and corresponding angles are maintaining their angle measure and side lengths from rigid transformations (that when distance is preserved, corresponding sides are congruent, and angle measure is preserved, corresponding angles are congruent, the triangles must also be congruent).
- Develop the triangle congruence criteria by using the appropriate rigid motions definitions to minimize requirements for congruence of triangles.
- Prove theorems and interpret geometric diagrams by identifying what can and cannot be assumed about triangles.

High Priority Standards

G.SRT.A.1 Construct and analyze scale changes of geometric figures.
G.SRT.A.2 Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures.
G.SRT.A.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
G.SRT.B.4 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Learning Goal

Students will be able to identify similar figures and use similarity to solve problems.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- examining polygons and determining if they are similar.
- solving problems involving similar figures.
- constructing and analyzing scale changes of geometric figures by verifying with experimentation the properties of dilations when given a center and a scale factor.
- understanding when dilating a line segment:
  - if the center of dilation is not on the line segment, the dilation results in a parallel segment and does not contain the center of dilation.
  - if the center of dilation is on the line segment, the dilation results in a segment containing the center of dilation.
- determining the dilation of a line segment is longer or shorter in the same ratio as the scale factor and verifying that a side length of the image is equal to the scale factor multiplied by the corresponding side length of the preimage.
- using the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
- proving theorems about triangle similarity including AA~, SSS~, SAS~, HL~, and Triangle Proportionality Theorem.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: dilation, parallel, proportion, ratio, scale factor, similar polygons, SAS~, SSS~, AA~.
- performing specific processes such as:
  - identifying criteria for similar polygons.
  - setting up proportions needed to solve problems.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Use the definition of similarity by examining corresponding side length to see they are in the same ratio of similar figures and the corresponding angle measures are congruent.
- Use the idea of dilation transformations to develop the definition of similarity. Understand that a similarity transformation is a combination of a rigid motion and a dilation.
- Identify and explain that AA similarity is a sufficient condition for two triangles to be similar.
- Prove theorems about triangles, including a line parallel to one side of a triangle divides the other two sides proportionally and the Pythagorean Theorem using triangle similarity.
- Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Learning Design

- using dilation by taking a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

High Priority Standards

G.SRT.C.5 Understand that side ratios in right triangles define the trigonometric ratios for acute angles.
G.SRT.C.6 Explain and use the relationship between the sine and cosine of complementary angles.
G.SRT.C.7 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles.
G.SRT.C.8 Derive the formula A = 1/2 ab sin(C) for the area of a triangle.

Learning Goal

Students will be able to define trigonometric ratios and solve problems involving right triangles.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- understanding that side ratios in right triangles define the trigonometric ratios for acute angles.
- explaining and using the relationship between the sine and cosine of complementary angles.
- using trigonometric ratios and the Pythagorean Theorem to solve right triangles.
- using the formula A = 1/2 ab sin(C) to find the area of a triangle.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: cosine, sine, tangent, secant, cosecant, cotangent, Pythagorean Theorem, trigonometric ratio.
- performing specific processes such as:
  - identifying all six trigonometric ratios for a given figure.
  - using the Pythagorean Theorem to find missing sides of a right triangle.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Understand, using similarity, that side ratios in right triangles define the trigonometric ratios (sine, cosine, tangent, secant, cosecant, cotangent) for acute angles.
- Explain and use the relationship between the sine and cosine ratios for acute angles in a right triangle when given two side lengths.
- Use a diagram of a right triangle to explain that for a pair of complementary angles A and B, the sine of angle A is equal to the cosine of angle B and the cosine of angle A is equal to the sine of angle B.
- Use Pythagorean Theorem to find missing sides of right triangles.
- Use trigonometric ratios of right triangles to solve for missing sides or angles.
- Use calculators, graphing calculators or programs, tables, spreadsheets, or computer algebra systems to solve right triangle problems.
- Use the area formula of triangles and trigonometric functions to derive the formula for $A = \frac{1}{2} ab \sin C$.

High Priority Standards

G.CO.A.1 Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc.
G.C.A.1 Prove that all circles are similar using similarity transformations.
G.C.A.2 Identify and describe relationships among inscribed angles, radii and chords of circles.
G.C.A.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
G.C.B.4 Derive the formula for the length of an arc of a circle.
G.C.B.5 Derive the formula for the area of a sector of a circle.

Learning Goal

Students will understand and apply properties of circles.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- proving that all circles are similar using similarity transformations (dilations).
- identifying and describing relationships among inscribed angles, radii and chords.
- proving properties of angles for a quadrilateral inscribed in a circle.
- deriving the formula for the length of an arc of a circle.
- deriving the formula for the area of a sector of a circle.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: circle, minor arc, major arc, arc length, center, chord, secant, circumference, diameter, pi, radius, sector, tangent, central angle, circumscribed angle, inscribed angle, degrees, inscribed and circumscribed polygons.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Identify and describe relationships among inscribed angles, radii and chords. (Include, but not limited to, 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.)
- Derive the formula for length of an arc of a circle by using similarity of circles.
- Derive the formula for the area of a circle by using the ratio of the arc length.
- Prove that all circles are similar by showing that for a dilation centered at the center of a circle, the preimage and the image have equal central angle measures.
- Use the fact that the ratio of circumference to diameter is the same for circles; prove that all circles are similar.
- Identify all parts of the circle and the relationships among the inscribed angles and the intercepted arc.
- Identify the relationships between but not limited to the radii, diameter, tangent lines, secant lines and the chords of a circle.
- Describe the relationship between a circumscribed angle and the arcs it intercepts.
- Recognize that an inscribed angle whose sides intersect the endpoints of the diameter of a circle is a right angle.
- Recognize that the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
- Prove the properties of angles for a quadrilateral inscribed in a circle by using relationships of inscribed and their intercepted arcs (opposite angles are supplementary).

High Priority Standards

G.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.
G.GMD.A.2 Use volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems.
G.GMD.B.3 Identify the shapes of two-dimensional cross-sections of three-dimensional objects.
G.GMD.B.4 Identify three-dimensional objects generated by transformations of two-dimensional objects.
G.GPE.B.6 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
G.MG.A.1 Use geometric shapes, their measures and their properties to describe objects.
G.MG.A.2 Apply concepts of density based on area and volume in modeling situations.
G.MG.A.3 Apply geometric methods to solve design mathematical modeling problems.

Learning Goal

Students will be able to justify two and three dimensional measurement formulas and apply the formulas to solve problems.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- giving an informal argument for the formulas for the volume of a cylinder, pyramid and cone.
- using volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems.
- determining the area and volume of similar figures in relation to the scale factor.
- identifying the shapes of two-dimensional cross-sections of three-dimensional objects
- identifying three-dimensional objects generated by rotations of two-dimensional objects.
- using coordinates and the distance formula/Pythagorean theorem to compute perimeters of all polygons.
- using coordinates and the distance formula/Pythagorean theorem to compute the areas of triangles and rectangles.
- applying concepts of density based on volume in modeling situations.
- applying geometric methods to solve design mathematical modeling problems.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: altitude, area, base, composite figure, cone, cross-section, cylinder, distance formula, height, parallelogram, rectangle, sphere, surface area, trapezoid, triangle, pyramid, oblique, slant height.
- performing specific processes such as:
    - finding the volume of three dimensional solids.
    - Use geometric shapes, their measures and their properties to describe objects.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Give an informal argument for the formulas of volume for a cylinder, pyramid and cone.
- Demonstrate informal arguments by using Cavalieri's Principle, if two solids have the same height and the same cross-sectional area at every level, then they have the same volume, for finding volumes of oblique cylinders, cones and pyramids.
- Use volume formulas for cylinders, pyramids, cones and spheres to solve problems. Missing measures can include but are not limited to slant height, altitude, height, edge length, and radius.
- Use volume formulas of composite figures using combinations of cylinders, pyramids, cones and spheres.
- Understand when a figure in the plane results from another by applying a similarity transformation with scale factor k; its area is k^2 times the area of the first.
- Understand volumes of solid figure scale k^3 under a similarity transformation with scale factor k.
- Determine the shape of a plane section parallel or perpendicular to the base of three-dimensional objects.
- Determine the shape of a plane section not parallel to, but not intersecting the base of three-dimensional objects.
- Identify three-dimensional objects generated by transformations of two-dimensional objects (One side of the two-dimensional shape needs to be set on the axis or axes).
- Use geometric shapes, their measures and their properties to describe objects. (e.g., Modeling a tree trunk or a human torso as a cylinder. Estimate the volume of a water tower using a sphere or cylinder.)
- Apply concepts of density based on area and volume in modeling situations. (e.g., persons per square mile, BTUs per cubic foot), the formula for density should be provided.
- Apply geometric methods to solve design mathematical modeling problems. (e.g., Design an object or structure to satisfy physical constraints or minimize cost. Calculate how many boxes a truck can hold.)

High Priority Standards

G.GPE.A.1 Derive the equation of a circle.
G.GPE.A.2 Derive the equation of a parabola given a focus and directrix.
G.GPE.B.3 Use coordinates to prove geometric theorems algebraically.
G.GPE.B.4 Prove the slope criteria for parallel and perpendicular lines and use them to solve problems.
G.GPE.B.5 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
G.GPE.B.6 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.

Learning Goal

Students will be able to express geometric properties with equations.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- deriving the equation of a circle, given the center and radius using the Pythagorean Theorem.
- completing the square to find the center and radius of a circle given an equation.
- using coordinates to prove geometric theorems algebraically.
- proving the slope criteria for parallel and perpendicular lines and using them to solve problems.
- finding the point on a directed line segment between two given points that partitions the segment in a given ratio.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: center, radius, Pythagorean Theorem, slope, parallel, and perpendicular
- performing specific processes such as:
    - identifying the center and radius of a circle, given the equation in standard form.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Derive the equation of a parabola (in standard form) given a focus and directrix, using the fact that the distances to the focus and to the directrix are equal from any point on the parabola.
- Use coordinates to prove simple geometric theorems algebraically. (e.g., prove or disprove that a figure defined by four given points in the Cartesian 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).)
- Prove geometric theorems algebraically in triangles.
- Prove geometric theorems algebraically in circles.
- Use slope to determine if sides are parallel, intersecting, or perpendicular.
- Use the distance formula or Pythagorean theorem to determine if lengths are equal.
- Use the midpoint formula or the distance formula to decide if a side has been bisected.
- When proving theorems on the coordinate plane, vertices are on intersecting grid lines and coordinates are integers.

- Determine whether two given lines are parallel, perpendicular or oblique. Lines can be horizontal, vertical or neither. Equations associated with these lines may have no solution, one solution or infinitely many solutions.

High Priority Standards

G.CO.A.1 Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc.
G.CO.C.8 Prove theorems about lines and angles.
G.CO.C.10 Prove theorems about polygons.

Learning Goal

Students will be able to prove theorems about lines, angles, and polygons.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- proving theorems about polygons.
- using theorems to solve problems involving polygons.
- proving theorems about lines and angles.
- proving theorems using perpendicular bisector, parallel lines, angle bisector, linear pairs, supplementary angles, complementary angles, vertical angles, corresponding angles, consecutive interior angles, alternate interior angles and alternate exterior angles.
- defining angle, plane, circle, perpendicular line, line segment, and ray based on undefined notions of point, line, distance along a line and distance around a circular arc.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: angle, plane, parallel, perpendicular, slope, distance, quadrilateral, parallelogram, rectangle, square, trapezoid, kite, rhombus, diagonals, line segment, ray, perpendicular bisector, parallel lines, angle bisector, linear pairs, supplementary angles, complementary angles, vertical angles, corresponding angles, consecutive interior angles, alternate interior angles and alternate exterior angles.
- performing specific processes such as:
    - viewing geometric simulations to explore theorems about polygons.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Prove theorems about polygons, which include, but not limited to parallelograms, kites, trapezoids, and hexagons.
- Theorems related to polygons should include, but are not limited to, the following: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

- Theorems related to lines and angles should include, but are not limited to, the following: 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.
- Prove theorems using the following, but not limited to: perpendicular bisector, parallel lines, angle bisector, linear pairs, supplementary angles, complementary angles, vertical angles, corresponding angles, alternate interior angles and alternate exterior angles.

High Priority Standards

G.CO.D.11 Construct geometric figures using various tools and methods.

Learning Goal

Students will be able to make geometric constructions.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- constructing geometric figures and geometric components using various tools and methods (compass and straightedge, string, reflective devices, paper folding, tracing paper, or online tool).
- articulating the steps of construction in a sequence.
- explaining how constructions result in the desired object.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: regular polygon, inscribed circles, bisector, perpendicular bisector.
- performing specific processes such as:
  - constructing basic geometric components.
  - constructing specific geometric shapes.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
  - Construct basic geometric components. (e.g., 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).
  - Construct specific geometric shapes. (e.g., regular hexagons inscribed in circles, equilateral triangles, squares, etc.)
  - Explain how constructions result in the desired object such as copying a segment, copying an angle, bisecting an angle, constructing perpendicular lines, constructing perpendicular bisectors, constructing parallel lines, constructing a parallel line through a point not on a line.
  - Construct specific geometric shapes such as regular hexagons inscribed in circles, equilateral triangles, squares.

High Priority Standards

G.CP.A.1 Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections or complements of other events.
G.CP.A.2 Understand the definition of independent events and use it to solve problems.
G.CP.A.3 Calculate conditional probabilities of events.
G.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.
G.CP.A.5 Recognize and explain the concepts of conditional probability and independence in a context.
G.CP.A.6 Apply and interpret the Addition Rule for calculating probabilities.
G.CP.A.7 Apply and Interpret the general Multiplication Rule in a uniform probability model.
G.CP.A.8 Use permutations and combinations to solve problems.

Learning Goal

Students will understand independence and conditional probability and use them to interpret data.

Proficiency Scale

4: In addition to score 3.0 performance, the student demonstrates an in-depth inference or advanced application, or innovates with the learning goal.

3: Student demonstrates mastery with the learning goal as evidenced by:

- calculating conditional probabilities of events.
- constructing and interpreting two-way frequency tables of data when two categories are associated with each object being classified.
- Using the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
- recognizing and explaining the concepts of conditional probability and independence in a context.
- applying and interpreting the Addition Rule for calculating probabilities.
- applying and interpreting the general Multiplication Rule in a uniform probability model.
- using permutations and combinations to solve problems.

2: Student demonstrates they are nearing proficiency by:

- recognizing and recalling specific vocabulary, such as: subset, union, intersection, complement, conditional probability, permutation, combination, independent, mutually exclusive.
- performing specific processes such as:
    - describing events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections or complements of other events.
    - understanding the definition of independent events and using it to solve problems.

1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

- Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions (U; or), intersections (∩; and) or complements ((A U B)'; not)of other events.
- Use correct set notation, with appropriate symbols, to identify sets and subsets.
- Understand 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 P(A ∩ B) = P(A) • P(B).
- Calculate probabilities for events, including joint probabilities.
- Example for Two-way Frequency Table: 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.
- Example of conditional probability and independence: Compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.
- Identify two events as mutually exclusive. P(A or B) = P(A) + P(B).
- 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.
- Apply and interpret the general Multiplication Rule Apply, P(A and B)=P(A)P(B|A)=P(B)P(A|B),in a uniform probability model and interpret the answer in terms of the model.
- Use permutations to solve problems, by using P(n, r) = $\frac{n!}{(n-r)!}$
- Use combinations to solve problems by using C(n, r) = $\frac{n!}{(n-r)!r!}$

Learning Design

- two-way frequency table: https://www.onlinemathlearning.com/table-sample-space-cp4.html

Sources:
https://dese.mo.gov/media/pdf/curr-math-mls%20expanded-expectaions-geometry