VALWOOD

GO BEYOND

Geometry Honors Curriculum

Honors Geometry Course Overview

Course Description

Advanced Geometry presents a thorough study of the structure of the postulate system and development of formal two-column proof. It considers the topics of congruence, parallelism, perpendicularity, properties of polygons, similarity, and the relationships of circles, spheres, lines, and planes with respect to space as well as the plane. Basic principles of probability will be introduced. Use of algebraic skills is expected. As an advanced course, this course goes beyond the curriculum expectations of a standard course offering by increasing the depth and complexity. Students are engaged in dynamic, high-level learning via the Standards for Mathematical Practice. The pace of an advanced course may be faster than that of the CP Geometry course.

Topics at a Glance

- Transformation in a plane
- Congruence
- Properties of Triangles
- Polygons and Quadrilaterals
- Similarity
- Right Triangles and Pythagorean Identities
  - Special right triangles
  - Trig Ratios
  - Solving Right Triangles
  - Triangle Applications
  - Angles of depression/elevation
  - Area Formulas
  - Solving general Triangles
  - Law of Sine/Cosine
- Vectors
- Two Column proof
- Geometric Properties with equations
- Probability
- Geometric Modeling
- Circles

Assessments

- Summative assessments adopted from course materials
- Classroom assessments

Grade Level Expectations

Standard	Big Ideas for Geometry
1. Number Sense, properties, and operations	
2. Patterns, Functions, & Algebraic Structures	
3. Data Analysis, Statistics, & Probability	1. Probability models outcomes for situations in which there is inherent randomness
4. Shape, Dimension, & Geometric Relationships	1. Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically 2. Concepts of similarity are foundational to geometry and its applications 3. Objects in the plane can be described and analyzed algebraically 4. Attributes of two and three-dimensional objects are measurable and can be quantified 5. Objects in the real world can be modeled using geometric concepts

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.

1. Number Sense, Properties, and Operations

Number sense provides students with a firm foundation in mathematics. Students build a deep understanding of quantity, ways of representing numbers, relationships among numbers, and number systems. Students learn that numbers are governed by properties, and understanding these properties leads to fluency with operations.

Valwood Graduate Competencies
The Valwood graduate competencies are the preschool through twelfth-grade concepts and skills that all graduates will be able to demonstrate.

Valwood Graduate Competencies in the Number Sense, Properties, and Operations Standard are:

- Understand the structure and properties of our number system. At their most basic level numbers are abstract symbols that represent real-world quantities
- Understand quantity through estimation, precision, order of magnitude, and comparison. The reasonableness of answers relies on the ability to judge appropriateness, compare, estimate, and analyze error
- Are fluent with basic numerical and symbolic facts and algorithms, and are able to select and use appropriate (mental math, paper and pencil, and technology) methods based on an understanding of their efficiency, precision, and transparency
- Make both relative (multiplicative) and absolute (arithmetic) comparisons between quantities. Multiplicative thinking underlies proportional reasoning
- Understand that equivalence is a foundation of mathematics represented in numbers, shapes, measures, expressions, and equations
- Apply transformation to numbers, shapes, functional representations, and data

*Standard 1 is not represented in the Geometry course.

2. Patterns, Functions, and Algebraic Structures

Pattern sense gives students a lens with which to understand trends and commonalities. Being a student of mathematics involves recognizing and representing mathematical relationships and analyzing change. Students learn that the structures of algebra allow complex ideas to be expressed succinctly.

Valwood Graduate Competencies
The Valwood graduate competencies are the preschool through twelfth-grade concepts and skills that all graduates will be able to demonstrate.

Valwood Graduate Competencies in the 2. Patterns, Functions, and Algebraic Structures Standard are:

- Are fluent with basic numerical and symbolic facts and algorithms, and are able to select and use appropriate (mental math, paper and pencil, and technology) methods based on an understanding of their efficiency, precision, and transparency
- Understand that equivalence is a foundation of mathematics represented in numbers, shapes, measures, expressions, and equations
- Make sound predictions and generalizations based on patterns and relationships that arise from numbers, shapes, symbols, and data
- Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics
- Use critical thinking to recognize problematic aspects of situations, create mathematical models, and present and defend solutions

*Standard 2 is not represented in the Geometry course.

3. Data Analysis, Statistics, and Probability

Data and probability sense provides students with tools to understand information and uncertainty. Students ask questions and gather and use data to answer them. Students use a variety of data analysis and statistics strategies to analyze, develop and evaluate inferences based on data. Probability provides the foundation for collecting, describing, and interpreting data.

Valwood Graduate Competencies
The Valwood graduate competencies are the preschool through twelfth-grade concepts and skills that all graduates will be able to demonstrate.

Valwood Graduate Competencies in the 3. Data Analysis, Statistics, and Probability Standard are:

- Recognize and make sense of the many ways that variability, chance, and randomness appear in a variety of contexts
- Solve problems and make decisions that depend on understanding, explaining, and quantifying the variability in data
- Communicate effective logical arguments using mathematical justification and proof. Mathematical argumentation involves making and testing conjectures, drawing valid conclusions, and justifying thinking
- Use critical thinking to recognize problematic aspects of situations, create mathematical models, and present and defend solutions

Content Area: Mathematics – Honors Geometry

Standard: 3. Data Analysis, Statistics, and Probability

Valwood Graduates:

Recognize and make sense of the many ways that variability, chance, and randomness appear in a variety of contexts.

GRADE LEVEL EXPECTATION

Concepts and skills students master:

3. Probability models outcomes for situations in which there is inherent randomness.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Understand independence and conditional probability and use them to interpret data. i. Describe events as subsets of a sample space using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events. ii. Explain 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. iii. Using the conditional probability of A given B as P(A and B)/P(B), interpret the 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. iv. 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. v. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. b. Use the rules of probability to compute probabilities of compound events in a uniform probability model. i. 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. ii. 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.	**Inquiry Questions:** 1. Can probability be used to model all types of uncertain situations? For example, can the probability that the 50th president of the United States will be female be determined? 2. How and why are simulations used to determine probability when the theoretical probability is unknown? 3. How does probability relate to obtaining insurance? **Relevance and Application:** 1. Comprehension of probability allows informed decision-making, such as whether the cost of insurance is less than the expected cost of illness, when the deductible on car insurance is optimal, whether gambling pays in the long run, or whether an extended warranty justifies the cost. 2. Probability is used in a wide variety of disciplines including physics, biology, engineering, finance, and law. For example, employment discrimination cases often present probability calculations to support a claim. **Nature of Discipline:** 1. Some work in mathematics is much like a game. Mathematicians choose an interesting set of rules and then play according to those rules to see what can happen. 2. Mathematicians explore randomness and chance through probability. 3. Mathematicians construct viable arguments and critique the reasoning of others. 4. Mathematicians model with mathematics.

4. Shape, Dimension, and Geometric Relationships

Geometric sense allows students to comprehend space and shape. Students analyze the characteristics and relationships of shapes and structures, engage in logical reasoning, and use tools and techniques to determine measurement. Students learn that geometry and measurement are useful in representing and solving problems in the real world as well as in mathematics.

Valwood Graduate Competencies
The Valwood graduate competencies are the preschool through twelfth-grade concepts and skills that all graduates will be able to demonstrate.

Valwood Graduate Competencies in the 4. Shape, Dimension, and Geometric Relationships standard are:

- Understand quantity through estimation, precision, order of magnitude, and comparison. The reasonableness of answers relies on the ability to judge appropriateness, compare, estimate, and analyze error
- Make sound predictions and generalizations based on patterns and relationships that arise from numbers, shapes, symbols, and data
- Apply transformation to numbers, shapes, functional representations, and data
- Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics
- Use critical thinking to recognize problematic aspects of situations, create mathematical models, and present and defend solutions

Content Area: Mathematics – Honors Geometry

Standard: 4. Shape, Dimension, and Geometric Relationships

Valwood Graduates:

Apply transformation to numbers, shapes, functional representations, and data.

GRADE LEVEL EXPECTATION

Concepts and skills students master:

1. Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Experiment with transformations in the plane. i. State 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. ii. Represent transformations in the plane using appropriate tools. iii. Describe transformations as functions that take points in the plane as inputs and give other points as outputs. iv. Compare transformations that preserve distance and angle to those that do not. v. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. vi. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. vii. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using appropriate tools. viii. Specify a sequence of transformations that will carry a given figure onto another. b. Understand congruence in terms of rigid motions. i. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure. ii. Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. iii. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if	**Inquiry Questions:** 1. What happens to the coordinates of the vertices of shapes when different transformations are applied in the plane? 2. How would the idea of congruency be used outside of mathematics? 3. What does it mean for two things to be the same? Are there different degrees of "sameness?" 4. What makes a good definition of a shape? **Relevance and Application:** 1. Comprehension of transformations aids with innovation and creation in the areas of computer graphics and animation. **Nature of Discipline:** 1. Geometry involves the investigation of invariants. Geometers examine how some things stay the same while other parts change to analyze situations and solve problems. 2. Mathematicians construct viable arguments and critique the reasoning of others. 3. Mathematicians attend to precision. 4. Mathematicians look for and make use of structure.

corresponding pairs of sides and corresponding pairs of angles are congruent. iv. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. c. Prove geometric theorems. i. Prove theorems about lines and angles. ii. Prove theorems about triangles. iii. Prove theorems about parallelograms. d. Make geometric constructions. i. Make formal geometric constructions with a variety of tools and methods. ii. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.	

Content Area: Mathematics – Honors Geometry

Standard: 4. Shape, Dimension, and Geometric Relationships

Valwood Graduates:

Use critical thinking to recognize problematic aspects of situations, create mathematical models, and present and defend solutions.

GRADE LEVEL EXPECTATION

Concepts and skills students master:

2. Concepts of similarity are foundational to geometry and its applications.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Understand similarity in terms of similarity transformations. i. Verify experimentally the properties of dilations given by a center and a scale factor. 1. Show that 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. 2. Show that the dilation of a line segment is longer or shorter in the ratio given by the scale factor. ii. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar. iii. 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. iv. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. b. Prove theorems involving similarity. i. Prove theorems about triangles. ii. Prove that all circles are similar. iii. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. c. Define trigonometric ratios and solve problems involving right triangles. i. Explain 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.	**Inquiry Questions:** 1. What happens to the coordinates of the vertices of shapes when different transformations are applied in the plane? 2. How would the idea of congruency be used outside of mathematics? 3. What does it mean for two things to be the same? Are there different degrees of "sameness?" 4. What makes a good definition of a shape? **Relevance and Application:** 1. Comprehension of transformations aids with innovation and creation in the areas of computer graphics and animation. **Nature of Discipline:** 1. Geometry involves the investigation of invariants. Geometers examine how some things stay the same while other parts change to analyze situations and solve problems. 2. Mathematicians construct viable arguments and critique the reasoning of others. 3. Mathematicians attend to precision. 4. Mathematicians look for and make use of structure.

ii. Explain and use the relationship between the sine and cosine of complementary angles. iii. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. d. Prove and apply trigonometric identities. i. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$. ii. Use the Pythagorean identity to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle. e. Understand and apply theorems about circles. i. Identify and describe relationships among inscribed angles, radii, and chords. ii. Construct the inscribed and circumscribed circles of a triangle. iii. Prove properties of angles for a quadrilateral inscribed in a circle. f. Find arc lengths and areas of sectors of circles. i. 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. ii. Derive the formula for the area of a sector.	

Content Area: Mathematics – Honors Geometry

Standard: 4. Shape, Dimension, and Geometric Relationships

Valwood Graduates:

Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics.

GRADE LEVEL EXPECTATION

Concepts and skills students master:

3. Objects in the plane can be described and analyzed algebraically.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Express Geometric Properties with Equations. i. Translate between the geometric description and the equation for a conic section. 1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem. 2. Complete the square to find the center and radius of a circle given by an equation. 3. Derive the equation of a parabola given a focus and directrix. ii. Use coordinates to prove simple geometric theorems algebraically. 1. Use coordinates to prove simple geometric theorems[11] algebraically. 2. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.[12] 3. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. 4. Use coordinates and the distance formula to compute perimeters of polygons and areas of triangles and rectangles.	**Inquiry Questions:** 1. What does it mean for two lines to be parallel? 2. What happens to the coordinates of the vertices of shapes when different transformations are applied in the plane? **Relevance and Application:** 1. Knowledge of right triangle trigonometry allows modeling and application of angle and distance relationships such as surveying land boundaries, shadow problems, angles in a truss, and the design of structures. **Nature of Discipline:** 1. Geometry involves the investigation of invariants. Geometers examine how some things stay the same while other parts change to analyze situations and solve problems. 2. Mathematicians make sense of problems and persevere in solving them. 3. Mathematicians construct viable arguments and critique the reasoning of others.

Content Area: Mathematics – Honors Geometry

Standard: 4. Shape, Dimension, and Geometric Relationships

Valwood Graduates:

Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics.

GRADE LEVEL EXPECTATION

Concepts and skills students master:

4. Attributes of two- and three-dimensional objects are measurable and can be quantified.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Explain volume formulas and use them to solve problems. i. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. ii. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. b. Visualize relationships between two-dimensional and three-dimensional objects. i. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	**Inquiry Questions:** 1. How might surface area and volume be used to explain biological differences in animals? 2. How is the area of an irregular shape measured? 3. How can surface area be minimized while maximizing volume? **Relevance and Application:** 1. Understanding areas and volume enables design and building. For example, a container that maximizes volume and minimizes surface area will reduce costs and increase efficiency. Understanding area helps to decorate a room, or create a blueprint for a new building. **Nature of Discipline:** 1. Mathematicians use geometry to model the physical world. Studying properties and relationships of geometric objects provides insights in to the physical world that would otherwise be hidden. 2. Mathematicians make sense of problems and persevere in solving them. 3. Mathematicians construct viable arguments and critique the reasoning of others. 4. Mathematicians model with mathematics.

Content Area: Mathematics – Honors Geometry

Standard: 4. Shape, Dimension, and Geometric Relationships

Valwood Graduates:

Use critical thinking to recognize problematic aspects of situations, create mathematical models, and present and defend solutions.

GRADE LEVEL EXPECTATION

Concepts and skills students master:

5. Objects in the real world can be modeled using geometric concepts.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Apply geometric concepts in modeling situations. i. Use geometric shapes, their measures, and their properties to describe objects. ii. Apply concepts of density based on area and volume in modeling situations. iii. Apply geometric methods to solve design problems.	**Inquiry Questions:** 1. How are mathematical objects different from the physical objects they model? 2. What makes a good geometric model of a physical object or situation? 3. How are mathematical triangles different from built triangles in the physical world? How are they the same?
	Relevance and Application: 1. Geometry is used to create simplified models of complex physical systems. Analyzing the model helps to understand the system and is used for such applications as creating a floor plan for a house, or creating a schematic diagram for an electrical system.
	Nature of Discipline: 1. Mathematicians use geometry to model the physical world. Studying properties and relationships of geometric objects provides insights in to the physical world that would otherwise be hidden. 2. Mathematicians make sense of problems and persevere in solving them. 3. Mathematicians construct viable arguments and critique the reasoning of others. 4. Mathematicians model with mathematics.