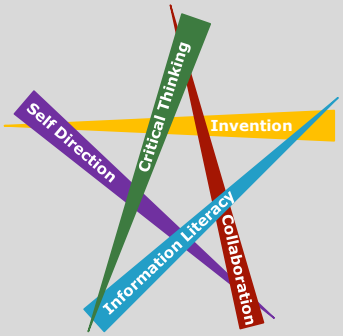
Curriculum Development Course at a Glance
Planning for High School Mathematics

Content Area	Mathematics	**Grade Level**	High School
Course Name/Course Code	Geometry		

Standard	**Grade Level Expectations (GLE)**	**GLE Code**
1. Number Sense, Properties, and Operations	1. The complex number system includes real numbers and imaginary numbers	MA10-GR.HS-S.1-GLE.1
	2. Quantitative reasoning is used to make sense of quantities and their relationships in problem situations	MA10-GR.HS-S.1-GLE.2
2. Patterns, Functions, and Algebraic Structures	1. Functions model situations where one quantity determines another and can be represented algebraically, graphically, and using tables	MA10-GR.HS-S.2-GLE.1
	2. Quantitative relationships in the real world can be modeled and solved using functions	MA10-GR.HS-S.2-GLE.2
	3. Expressions can be represented in multiple, equivalent forms	MA10-GR.HS-S.2-GLE.3
	4. Solutions to equations, inequalities and systems of equations are found using a variety of tools	MA10-GR.HS-S.2-GLE.4
3. Data Analysis, Statistics, and Probability	1. Visual displays and summary statistics condense the information in data sets into usable knowledge	MA10-GR.HS-S.3-GLE.1
	2. Statistical methods take variability into account supporting informed decisions making through quantitative studies designed to answer specific questions	MA10-GR.HS-S.3-GLE.2
	3. Probability models outcomes for situations in which there is inherent randomness	MA10-GR.HS-S.3-GLE.3
4. Shape, Dimension, and Geometric Relationships	1. Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically	MA10-GR.HS-S.4-GLE.1
	2. Concepts of similarity are foundational to geometry and its applications	MA10-GR.HS-S.4-GLE.2
	3. Objects in the plane can be described and analyzed algebraically	MA10-GR.HS-S.4-GLE.3
	4. Attributes of two- and three-dimensional objects are measurable and can be quantified	MA10-GR.HS-S.4-GLE.4
	5. Objects in the real world can be modeled using geometric concepts	MA10-GR.HS-S.4-GLE.5

Colorado 21st Century Skills



Critical Thinking and Reasoning: *Thinking Deeply, Thinking Differently*

Information Literacy: *Untangling the Web*

Collaboration: *Working Together, Learning Together*

Self-Direction: *Own Your Learning*

Invention: *Creating Solutions*

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Unit Titles	Length of Unit/Contact Hours	Unit Number/Sequence
Tools for the Trade	8 weeks	1
Identical Twins and Mini-Me	5 weeks	2
3 Rights Don't Make A …	4 weeks	3
What Goes Around	5 weeks	4
On the Cat Walk	4 weeks	5

Curriculum Development Overview
Unit Planning for High School Mathematics

Unit Title	Tools for the Trade		**Length of Unit**	8 weeks
Focusing Lens(es)	Justification Precision	**Standards and Grade Level Expectations Addressed in this Unit**	MA10-GR.HS-S.4-GLE.1 MA10-GR.HS-S.4-GLE.3	
Inquiry Questions (Engaging-Debatable):	• What happens to the coordinates of the vertices of shapes when different transformations are applied in the plane? (MA10-GR.HS-S.4-GLE.3-IQ.2)			
Unit Strands	Geometry: Congruence Geometry: Expressing Geometric Properties with Equations			
Concepts	undefined terms (point, line, distance), definitions, proofs, transformations, functions, inputs, outputs, rigid transformations, distance, angle, geometric constructions, conjecture, coordinate plane, geometric relationships			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Undefined notions of point, line, and distance create precision definitions for geometric terms upon which concepts and proofs are built. (MA10-GR.HS-S.4-GLE.1-EO.a.i)	How do we define geometric objects such as angle, circle, line segment, parallel and perpendicular lines? What makes a good definition of a shape? (MA10-GR.HS-S.4-GLE.1-IQ.4) What does it mean for two lines to be parallel? (MA10-GR.HS-S.4-GLE.3-IQ.1)	How does knowing precise definitions help create geometric proof?
Geometric constructions create a visual proof by showing a logical progression of statements that prove or disprove a conjecture. (MA10-GR.HS-S.4-GLE.1-EO.a.vi, d.i)	What is formal geometric construction? How does a geometric construction differ from a geometric drawing or sketch? How does the construction of a perpendicular bisector of a line segment help prove that all the points on the bisector are equidistant from the endpoints of the segment? How does the construction of the medians of a triangle help prove they will always meet at a point?	How does a geometric construction connect to terms and definitions?

Stated assumptions, definitions, and previously established results help in the construction of proofs. (MA10-GR.HS-S.4-GLE.1-EO.c)	How are assumptions and definitions used in proof? How can you prove relationships between angles formed when transversal intersects parallel lines? How do previously proved ideas about parallel lines support conjectures and proofs about triangles and parallelograms?	Why are proofs an integral part of geometry? How does writing a proof deepen your understanding of geometric concepts?
The coordinate plane models algebraically two-dimensional geometric relationships. (MA10-GR.HS-S.4-GLE.3-EO.a.ii)	What information is needed to calculate the perimeters of polygons and area of triangles and rectangles in the coordinate plane? How can you determine the slope of line parallel or perpendicular to a given line?	Why is it helpful to model geometric relationships on the coordinate plane?
Geometric transformations create functions that take points in the plane as inputs and give unique corresponding points as outputs. (MA10-GR.HS-S.4-GLE.1-EO.a.iii)	What function operations work with transformations? How can you compare transformations?	Why are transformations functions?
Rigid transformations preserve distance and angle. (MA10-GR.HS-S.4-GLE.1-EO.a)	What do non-rigid transformations preserve? How can I use transformations to prove to figures are congruent?	Why is it important that rigid transformations preserve distance and angle?

Key Knowledge and Skills: **My students will…**	*What students will know and be able to do are so closely linked in the concept-based discipline of mathematics. Therefore, in the mathematics samples what students should know and do are combined.*

- 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. (MA10-GR.HS-S.4-GLE.1-EO.a.i)
- Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. (MA10-GR.HS-S.4-GLE.1-EO.a.vi)
- Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using. (MA10-GR.HS-S.4-GLE.1-EO.a.vii)
- Specify a sequence of transformations that will carry a given figure onto another. (MA10-GR.HS-S.4-GLE.1-EO.a.viii)
- Prove theorems about lines, angles, triangles, and parallelograms. (MA10-GR.HS-S.4-GLE.1-EO.c)
- Use coordinates to prove simple geometric theorems algebraically. (MA10-GR.HS-S.4-GLE.3-EO.a.ii.1)
- Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems. (MA10-GR.HS-S.4-GLE.3-EO.a.ii.2)
- Make formal geometric constructions with a variety of tools and methods. (MA10-GR.HS-S.4-GLE.1-EO.d.i)
- Find the point on a directed line segment between two given points that partitions the segment in a given ratio. (MA10-GR.HS-S.4-GLE.3-EO.a.ii.3)
- Use the distance formula on coordinates to compute perimeters of polygons and areas of triangles and rectangles. (MA10-GR.HS-S.4-GLE.3-EO.a.ii.4)
- Represent transformations in the plane using; describe transformations as functions that take points in the plane as inputs and give other points as outputs. (MA10-GR.HS-S.4-GLE.1-EO.a.ii, iii)
- Compare transformations that preserve distance and angle to those that do not (MA10-GR.HS-S.4-GLE.1-EO.a.iv)

Critical Language: includes the Academic and Technical vocabulary, semantics, and discourse which are particular to and necessary for accessing a given discipline.
EXAMPLE: A student in Language Arts can demonstrate the ability to apply and comprehend critical language through the following statement: *"Mark Twain exposes the hypocrisy of slavery through the use of satire."*

A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*I can use coordinates of the vertices of a quadrilateral to show it is a rectangle by calculating the slopes and lengths of each side.*
Academic Vocabulary:	definitions, inputs, outputs, , distance, angle, conjecture, point, circle, define, represent, compare, develop, prove, triangles, rectangles
Technical Vocabulary:	undefined terms, proofs, transformations, functions, rigid transformations, geometric constructions, coordinate plane, perpendicular lines, parallel lines, line segment, rotations, reflections, translations, distance formula, slope, partitions,

Unit Title	Identical Twins and Mini-Me		**Length of Unit**	4 weeks
Focusing Lens(es)	Transformation Similarity	**Standards and Grade Level Expectations Addressed in this Unit**	MA10-GR.HS-S.4-GLE.1 MA10-GR.HS-S.4-GLE.2	
Inquiry Questions (Engaging- Debatable):	• How would the idea of congruency be used outside of mathematics? (MA10-GR.HS-S.4-GLE.1-IQ.2) • What does it mean for two things to the same? Are there different degrees of sameness? (MA10-GR.HS-S.4-GLE.1-IQ.3)			
Unit Strands	Geometry: Congruence Geometry: Circles Geometry: Similarity, Right Triangles, and Trigonometry			
Concepts	dilation, center, transformation, scale factor, magnitude, direction, congruence, corresponding angles and sides, proportionality, rigid transformation			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
A sequence of rigid transformation creates congruent figures. (MA10-GR.HS-S.4-GLE.1-EO.b.i, ii)	How can you describe the sequence of transformation that carry a geometric figure onto itself? How can transformations be used to show to two figures congruent without directly measure each part of the figure?	How does the definition of congruence in terms of rigid motion explain the criteria for triangle congruence?
Congruent triangles create six pairs of congruent corresponding sides and angles. (MA10-GR.HS-S.4-GLE.1-EO.b.iii)	What combinations of sides and angles are sufficient to prove congruency of triangles? Which combinations of congruent side and/or angle pairs do not prove congruent triangles?	Why is three the fewest number of congruent sides and/or angle pairs necessary to prove two triangles congruent?
Dilations require a center from which the transformation originates and a scale factor which describes magnitude and direction. (MA10-GR.HS-S.4-GLE2-EO.a.i)	What happens to point on a line passing through the center of dilation? What happens to a line not passing through the center of dilation? How can you predict if dilation will make a line segment longer or shorter? How does dilation prove all circles are similar?	Why do dilations create similar figures? Why are angle measures preserved in dilation?
Dilations of polygons preserve congruence of corresponding angles and create proportionality amongst corresponding sides. (MA10-GR.HS-S.4-GLE2-EO.a.ii, iii, iv)	What is the relationship between the Pythagorean Theorem and triangle similarity?	Why is it necessary to have three pieces of information to prove congruency of triangles but it is sufficient to use two pieces to prove similarity?

Key Knowledge and Skills: **My students will…**	*What students will know and be able to do are so closely linked in the concept-based discipline of mathematics. Therefore, in the mathematics samples what students should know and do are combined.*

- Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. (MA10-GR.HS-S.4-GLE.1-EO.a.v)
- Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. (MA10-GR.HS-S.4-GLE.1-EO.b.i, ii)
- 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. (MA10-GR.HS-S.4-GLE.1-EO.b.iii)
- Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. ((MA10-GR.HS-S.4-GLE.1-EO.b.iv)
- Verify experimentally the properties of dilations given by a center and a scale factor. (MA10-GR.HS-S.4-GLE2-EO.a.i)
- Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. (MA10-GR.HS-S.4-GLE2-EO.a.ii, iii)
- Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. (MA10-GR.HS-S.4-GLE2-EO.a.iv)
- Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. (MA10-GR.HS-S.4-GLE2-EO.b.iii)
- Prove that all circles are similar. (MA10-GR.HS-S.4-GLE2-EO.b.ii)

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EXAMPLE: A student in Language Arts can demonstrate the ability to apply and comprehend critical language through the following statement: *"Mark Twain exposes the hypocrisy of slavery through the use of satire."*

A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*I can use rigid transformations to show that necessary and sufficient combinations of congruent sides and angles prove triangles congruent.* *The dilation is the only transformation that produces similar polygons because it stretches or shrinks line segments.*
Academic Vocabulary:	prove, verify, identify, compare, analyze, develop, sufficient, necessary, transformation, definition, criteria
Technical Vocabulary:	dilation, center, transformation, scale factor, magnitude, direction, congruence, corresponding angles, corresponding sides, proportionality, rigid transformations, vertical angles, rotation, translation, reflection, congruence, theorem, similarity, congruence, proportionality

Unit Title	3 Rights Don't Make A….	**Length of Unit**	4 weeks
Focusing Lens(es)	Relationships	**Standards and Grade Level Expectations Addressed in this Unit**	MA10-GR.HS-S.4-GLE.2
Inquiry Questions (Engaging-Debatable):	• How can you determine the measure of something that you cannot measure physically? (MA10-GR.HS-S.4-GLE.2-IQ.1)		
Unit Strands	Geometry: Similarity, Right Triangles, and Trigonometry		
Concepts	sides ratios, angles, right triangle, trigonometric functions, similar triangles		

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
The relationship between the side ratios and angles of a right triangle define the trigonometric functions. (MA10-GR.HS-S.4-GLE.2-EO.c)	What are trigonometric ratios? What is the relationship of the sine and cosine of complementary angles?	How does similarity explain that the side ratios in right triangles are a function of the angles of the triangle? How do we know that the sine of all 30 degree angles is the same?
Mathematicians use similar triangles to prove generalizable relationships. (MA10-GR.HS-S.4-GLE.2-EO.b.i)	How can you use right triangle similarity to prove the Pythagorean Theorem? How can similar triangle be used to prove that a line parallel to one side of a triangle divides the other two proportionally?	Why are similar triangles the foundation for mathematical proofs about side lengths of triangles?

Key Knowledge and Skills: **My students will…**	*What students will know and be able to do are so closely linked in the concept-based discipline of mathematics. Therefore, in the mathematics samples what students should know and do are combined.*

- Prove theorems about similar triangles. (MA10-GR.HS-S.4-GLE.2-EO.b.i)
- Understand through similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. (MA10-GR.HS-S.4-GLE.2-EO.c.i)
- Explain and use the relationship between the sine and cosine of complementary angles. (MA10-GR.HS-S.4-GLE.2-EO.c.ii)
- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. (MA10-GR.HS-S.4-GLE.2-EO.c.iii)

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A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*I know the sine and cosine of the acute angles in a isosceles right triangle are the same.*
Academic Vocabulary:	prove, explain, right triangles,
Technical Vocabulary:	similar triangles, sine, cosine, tangent, trigonometric ratios, Pythagorean Theorem, complementary angles, parallel lines

Unit Title	What Goes Around		**Length of Unit**	4 weeks
Focusing Lens(es)	Interdependence	**Standards and Grade Level Expectations Addressed in this Unit**	MA10-GR.HS-S.4-GLE.1 MA10-GR.HS-S.4-GLE.2 MA10-GR.HS-S.4-GLE.3	
Inquiry Questions (Engaging-Debatable):	• Do perfect circles naturally occur in the physical world? If so, how do we model them? (MA10-GR.HS-S.4-GLE.2-IQ.4) • Why are circles at the foundation of constructions?			
Unit Strands	Geometry: Circles Geometry: Expressing Geometric Properties with Equations Geometry: Congruence			
Concepts	arc length, inscribed angles, circumscribed angles, central angles, circles, center, radius, equation, chords, arcs, proportionally			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Arc length determines the interdependent relationship of inscribed, circumscribed and central angles of a circle. (MA10-GR.HS-S.4-GLE.2-EO.e)	What is the relationship between inscribed, central, and circumscribed angles of a circle that subtend to the same arc? How does the measure of the central angle help you find the area of the corresponding sector?	Why are inscribed, central, and circumscribed angles of a circle independent with each other when they subtend the same arc?
The center and radius of the circle constrain the equation by providing location and size. (MA10-GR.HS-S.4-GLE.3-EO.a.i.1, 2)	What is equation of a circle? Within the equation of the circle, where is the center and the radius?	How does the Pythagorean Theorem define all points on a circle with a given center and radius? Why is the radius of a circle perpendicular to the tangent where the radius intersects the circle?
The length of chords and their corresponding arcs vary proportionally. (MA10-GR.HS-S.4-GLE.2-EO.f)	What is the longest chord in a circle and how do you know?	Why does a radius that bisects an arc also bisect the corresponding chord?

Key Knowledge and Skills: **My students will…**	*What students will know and be able to do are so closely linked in the concept-based discipline of mathematics. Therefore, in the mathematics samples what students should know and do are combined.*

- Identify and describe relationships among inscribed angles, radii, and chords. (MA10-GR.HS-S.4-GLE.2-EO.e.i)
- Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. (MA10-GR.HS-S.4-GLE.2-EO.e.ii, iii)
- 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. (MA10-GR.HS-S.4-GLE.2-EO.f)
- 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. (MA10-GR.HS-S.4-GLE.3-EO.a.i.1, 2)
- Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. (MA10-GR.HS-S.4-GLE.1-EO.d.ii)

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A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*The central angle of a circle is twice the measure of its corresponding inscribed angle.*
Academic Vocabulary:	prove, construct, derive, area, equilateral triangle, square, regular hexagon
Technical Vocabulary:	arc length, inscribed angles, circumscribed angles, central angles, circles, center, radius, equation, chords, arcs, proportionally, sector, diameter, perpendicular, tangent, quadrilateral, equation, bisect, similarity

Curriculum Development Overview
Unit Planning for High School Mathematics

Unit Title	On The Catwalk		**Length of Unit**	4 weeks
Focusing Lens(es)	Structure Modeling	**Standards and Grade Level Expectations Addressed in this Unit**	MA10-GR.HS-S.4-GLE.4 MA10-GR.HS-S.4-GLE.5	
Inquiry Questions (Engaging-Debatable):	• How might surface area and volume be used to explain biological differences in animals? (MA10-GR.HS-S.4-GLE.3-IQ.1)			
Unit Strands	Geometry: Modeling with Geometry Geometry: Geometric Measurement and Dimension			
Concepts	perimeter, area, volume, patterns, models, measurements, decisions			

Generalizations **My students will Understand that…**	**Guiding Questions** **Factual**	**Conceptual**
Underlying and related structures of perimeter, area and volume can reveal patterns within complex objects. (MA10-GR.HS-S.4-GLE.4-EO.a, b)	How does the relationship between the volumes of a cone and its corresponding cylinder help us find the volume of a pyramid? How is the area of an irregular shape measured? (MA10-GR.HS-S.4-GLE.4-IQ.2) How can surface area be minimized while maximizing volume? (MA10-GR.HS-S.4-GLE.4-IQ.3)	Why is the formula for the circumference of a circle necessary for deriving the area of a circle? How can the relationship between area and volume be explained through cross-sections and rotations?
Geometric models chosen and created with the use of appropriate measurements deepen understandings of empirical situations and improve decision-making. (MA10-GR.HS-S.4-GLE.5-EO.a)	How are mathematical objects different from the physical objects they model? (MA10-GR.HS-S.4-GLE.5-IQ.1) How can the geometric concepts of area and volume model density? What makes a good geometric model of a physical object or situation? (MA10-GR.HS-S.4-GLE.5-IQ.2)	Why are ratios an important component of geometric modeling?

Key Knowledge and Skills: **My students will…**	*What students will know and be able to do are so closely linked in the concept-based discipline of mathematics. Therefore, in the mathematics samples what students should know and do are combined.*

- Use geometric shapes, their measures, and their properties to describe objects. (MA10-GR.HS-S.4-GLE.5-EO.a.i)
- Apply concepts of density based on area and volume in modeling situations. (MA10-GR.HS-S.4-GLE.5-EO.a.ii)
- Apply geometric methods to solve design problems. (MA10-GR.HS-S.4-GLE.5-EO.a.iii)
- Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. (MA10-GR.HS-S.4-GLE.4-EO.a.i)
- Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. (MA10-GR.HS-S.4-GLE.4-EO.a.ii)
- Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. (MA10-GR.HS-S.4-GLE.4-EO.b.i)

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A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):	*I can see how a human torso can be modeled as a cylinder for purposes of volume and surface area.*
Academic Vocabulary:	perimeter, area, volume, patterns, models, measurements, decisions, apply, design problems, informal arguments, two-dimensional, three-dimensional
Technical Vocabulary:	geometric properties, density, formulas, cylinders, pyramids, cones, spheres, cross-sections, rotations, circumference