



**HARFORD COUNTY PUBLIC SCHOOLS
HIGH SCHOOL GEOMETRY CURRICULUM**

[CLICK HERE](#) for the Maryland College and Career Ready Standards for Geometry.

Unit 1: Points and Lines and the Language and Logic of Geometry

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Two- and three-dimensional objects with or without curved surfaces can be described, classified, and analyzed by their attributes. Objects in space can be oriented in an infinite number of ways and an object's location in space can be described quantitatively.

Essential Questions

- What are the building blocks of geometry?
- How do we use the building blocks of geometry?
- How can real-world situations be modeled by geometry to help solve problems?

Lesson Title	Lesson Overview	Standards
Review of Basic Geometric Concepts	Students will review basic geometric concepts from previous courses. Consider using the resource provided in Canvas.	G.CO.A.1
Betweenness and Distance	Students will define lines, line segments, rays, and opposite rays and how to denote them. Students must also use ratios between parts of a segment to determine lengths.	G.CO.A.1 G.CO.D.12 G.CO.D.13 G.GPE.B.4 G.GPE.B.6
The midpoint of a segment	Students will learn about midpoints of line segments and use their algebra skills to solve midpoint problems that involve quadratics and the addition and subtraction of polynomials.	G.CO.A.1 G.CO.D.12 G.CO.D.13 G.GPE.B.4 G.GPE.B.6



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Triangle Inequality Postulate Special Types of Triangles	Students will determine if three side lengths can form a triangle. Given two side lengths, students will identify possible lengths of the third side of a triangle.	G.CO.A.1
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Unit 2: Angles

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Two- and three-dimensional objects with or without curved surfaces can be described, classified, and analyzed by their attributes. Objects in space can be oriented in an infinite number of ways and an object’s location in space can be described quantitatively.

Essential Questions

- What are the building blocks of geometry?
- How do we use the building blocks of geometry?
- How can real-world situations be modeled by geometry to help solve problems?

Lesson Title	Lesson Overview	Standards
Arcs and Angles	Students will classify arcs and angles and find the measure of an arc based on the central angle.	G.C.A.2 G.CO.A.1
Special Types of Angles	Students will learn about special angles and how these are related.	G.C.A.2 G.CO.A.1
Parallel Lines	Students will write an equation for a line that is parallel to a given line through a given point not on the line. Students will recognize that parallel lines cut by a transversal form corresponding angles.	G.GPE.B.4 G.GPE.B.5 G.CO.A.1
Perpendicular Lines	Students will learn about the relationship between the slopes of perpendicular lines and write an equation for a line that is perpendicular to a given line through a given point not on the line.	G.GPE.B.4 G.GPE.B.5 G.CO.A.1



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Unit 3: Transformations

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Objects in space can be transformed in an infinite number of ways, and those transformations can be described and analyzed mathematically.

Essential Questions

- How does a transformation affect a figure?
- How do congruence transformations and size transformations differ?
- How can real-world situations be modeled by transformations to help solve problems?

Lesson Title	Lesson Overview	Standards
Size Transformations	<p>Students will apply a size transformation to a figure in the coordinate plane.</p> <p>Students will understand that a dilation of a positive magnitude will preserve slope, which means that corresponding segments in a pre-image and image are parallel.</p>	<p>G.CO.A.2 G.SRT.A.1a G.SRT.A.1b G.SRT.A.2</p>
Reflecting Points and Figures, Reflections in the Coordinate Plane	<p>Students will reflect points and figures using both the definition of reflection and other reflection tools.</p> <p>Students will understand that the line of reflection is the perpendicular bisector of the line connecting a preimage and image and how the Figure Transformation Theorem relates to reflecting a figure.</p> <p>Students must reflect images over axes, vertical, and horizontal lines (ex: $y = 5$, $x = -2$, and the lines $y = x$ and $y = -x$).</p>	<p>G.CO.A.2 G.CO.A.3 G.CO.A.4 G.CO.A.5</p>
Translations as Reflections over Parallel Lines	<p>Students will develop a definition for translation based on reflections over parallel lines.</p> <p>Students will identify parallel lines given equations in both standard form and slope-intercept form.</p>	<p>G.CO.A.2 G.CO.A.3 G.CO.A.4 G.CO.A.5</p>



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Translations as Vectors	Students will perform translations using vectors and vectors in the coordinate plane.	G.CO.A.2 G.CO.A.3 G.CO.A.4 G.CO.A.5
Composing Reflections over Intersecting Lines and Rotating Points on the Coordinate Plane (Insert)	Students will develop a definition for rotation. Students will also rotate figures in the coordinate plane. Students will name the properties preserved when this rotation takes place. Students must also complete a composite of transformations in the coordinate plane and identify possible composite transformations that map a preimage onto an image.	G.CO.A.2 G.CO.A.3 G.CO.A.4 G.CO.A.5
Isometry, Glide Reflection	Students will develop a definition for a glide-reflection.	G.SRT.A.1a G.SRT.A.1b G.SRT.A.2



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Unit 4: Proofs Using Congruence

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Objects in space can be transformed in an infinite number of ways, and those transformations can be described and analyzed mathematically.

Essential Questions

- How can we prove that figures are congruent?
- How can we use the building blocks of geometry to extend our knowledge?
- How can congruence proofs be used to help solve real-world problems?

Lesson Title	Lesson Overview	Standards
When are Figures Congruent?	Students will recognize that two figures are congruent when the image is the result of the preimage after an isometry.	G.CO.B.6 G.CO.C.9 G.CO.C.10
The Corresponding Parts of Congruent Figures Theorem	Students will apply the CPCF Theorem to determine congruent parts. Students must determine the corresponding parts based on how the congruent figures are identified.	G.CO.B.6 G.CO.C.9 G.CO.C.10
Congruence Proofs	Students will write simple proofs about congruence.	G.GPE.B.6 G.CO.A.1 G.CO.C.9 G.CO.D.12
Proofs Using Transitivity	Students will examine the relationship between alternate interior and exterior angles. Students will know how to derive the Parallel Lines Theorem. Students must also use alternate interior angles to prove that the sum of the angles in a triangle is 180° .	G.CO.B.6 G.CO.C.9



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Proofs Using Reflections	Students will apply concepts taught from previous units to complete proofs about congruence. Students will find lengths using properties of the perpendicular bisector.	G.CO.C.9 G.CO.D.12
Auxiliary Figures and Uniqueness	Students will construct a line parallel to a given line through a point using the concept of Playfair's Parallel Postulate.	G.CO.C.9 G.CO.D.12



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Unit 5: Polygons and Symmetry

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Two- and three-dimensional objects with or without curved surfaces can be described, classified, and analyzed by their attributes.
- Objects in space can be oriented in an infinite number of ways and an object’s location in space can be described quantitatively.

Essential Questions

- How are congruence transformations and polygons related?
- How are special polygons created?
- How are polygons classified/related?

Lesson Title	Lesson Overview	Standards
Sums of Angle Measures in Polygons	Students will derive a formula for calculating the sum of the interior angles in a polygon based on what they already know about the sum of the angles in triangles. Students will calculate the sum of the exterior angles of any polygon.	G.CO.C.9
Reflection Symmetry, Rotation Symmetry and Regular Polygons	Students will draw regular polygons. Students will draw lines of symmetry in a regular figure, identify the center of rotation, and determine the number of folds of rotation. Students will construct a square and a regular hexagon.	G.CO.A.3 G.CO.D.13
Isosceles Triangles	Students will extend their knowledge of isosceles triangles. Students will know the Isosceles Triangle Base Angles Theorem as well as the Converse of the Isosceles Triangle Base Angles Theorem and be able to explain the difference. Students will apply the Unequal Sides Theorem and Unequal Angles Theorem and explain the relationships between angles and sides.	G.CO.C.10



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Types of Quadrilaterals	Students will identify quadrilaterals and describe how they are related based on the hierarchy.	G.CO.C.10 G.CO.C.11
Properties of Kites	Students will explore the Kite Symmetry Theorem, the Kite Diagonal Theorem, and the Rhombus Diagonal Theorem. Students will use these theorems to find missing sides and angles in a kite or rhombus.	G.CO.C.10 G.CO.C.11
Properties of Trapezoids	Students will explore the Trapezoid Angle Theorem, the Isosceles Trapezoid Symmetry Theorem, the Isosceles Trapezoid Theorem, and the Rectangle Symmetry Theorem. Students will use these theorems to find missing sides and angles of trapezoids, isosceles trapezoids, and rectangles.	G.CO.C.10 G.CO.C.11



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Unit 6: Applications of Congruent Triangles and Similarity

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Objects in space can be transformed in an infinite number of ways, and those transformations can be described and analyzed mathematically.

Essential Questions

- How can we prove figures are congruent?
- How can we prove figures are similar?
- How can we use the building blocks of geometry to extend our knowledge?
- How can real-world situations be modeled by congruent triangles to help solve problems?

Lesson Title	Lesson Overview	Standards
Triangle Congruence Theorems	Students will apply triangle congruence theorems.	G.CO.B.7 G.CO.B.8
Using Triangle Congruence Theorems	Students will apply theorems from previous lessons to prove that parts of triangles are congruent.	G.CO.B.7 G.CO.B.8 G.CO.C.9 G.CO.C.10
Overlapping Triangles	Students will apply theorems from previous lessons to prove that parts of overlapping triangles are congruent.	G.CO.B.7 G.CO.B.8 G.CO.C.9 G.CO.C.10
The SSA Condition and HL Congruence & Properties of Parallelograms	Students will determine when the HL and SsA Congruence theorems can be applied and use them to prove figures are congruent. Students will examine the properties of parallelograms.	G.CO.B.8 G.CO.C.9 G.CO.C.10 G.CO.C.11



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Sufficient Conditions for Parallelograms & Diagonals of Quadrilaterals	<p>Students will examine sufficient conditions for a parallelogram and will prove the sufficient conditions are met using triangle congruence proofs.</p> <p>Students will examine how the diagonals of different quadrilaterals are related and will use properties of diagonals to classify quadrilaterals.</p>	<p>G.CO.C.9 G.CO.C.10 G.CO.C.11</p>
<p>Similar Figures</p> <p>Fundamental Theorem of Similarity</p>	<p>Students will learn about similar figures: what they are, as well as properties that are preserved under a size change.</p> <p>Students will compare surface areas and volumes of similar figures by utilizing the ratio of similitude.</p> <p>Given surface areas or volumes of similar shapes, students will calculate the ratio of similitude.</p>	<p>G.SRT.A.1a G.SRT.A.1b G.SRT.A.2</p>
<p>The SSS Similarity Theorem</p> <p>The AA and SAS Triangle Similarity Theorems</p>	<p>Students will explore the SSS Similarity Theorem and use it to prove that two figures are similar.</p> <p>Students will use the AA and SAS Similarity Theorems in proofs.</p> <p>Students will determine which congruence theorems have a related similarity theorem and why.</p> <p>Students will also prove that all circles are similar.</p>	<p>G.SRT.A.1a G.SRT.A.1b G.SRT.A.2 G.SRT.A.3 G.SRT.B.4 G.SRT.B.5</p>



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Unit 7: Lengths and Areas

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Some attributes of objects are measurable and can be quantified using unit amounts.
- The Pythagorean Relationship can be represented algebraically and geometrically and can be verified through measurement.

Essential Questions

- How can we calculate the area and perimeter of a figure?
- How is the Pythagorean Theorem applied to solve real-world problems?

Lesson Title	Lesson Overview	Standards
Fundamental Properties of Area Areas of Triangles Areas of Quadrilaterals	Students will derive the formulas for areas of figures using the area model algebraically. Students will calculate the area of triangles and quadrilaterals.	G.GPE.B.7 G.MG.A.1 G.MG.A.2
The Pythagorean Theorem	Students will prove the Pythagorean Theorem and use the theorem to solve real-world and mathematical problems.	G.MG.A.1 G.SRT.B.4 G.SRT.C.8
Simplifying Square Roots, Could it be Groovy to be a Square?	Students will simplify square roots.	N.RN.A.2 A.CED.A.1
Special Right Triangles	Students will determine exact measures of the sides of 45-45-90 and 30-60-90 triangles.	G.SRT.C.6 G.SRT.C.8



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Unit 8: Circles

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Some attributes of objects are measurable and can be quantified using unit amounts.

Essential Questions

- How is the measure of an inscribed angle of a circle related to the measure of the arc it intercepts?
- How is the circumference of a circle related to its diameter and its area?
- How can real-world situations be modeled by geometric figures to help solve problems?

Lesson Title	Lesson Overview	Standards
Angles Inscribed in Circles	Students will identify inscribed angles and their measures in relationship to arcs and central angles. Students will apply the concept of Thales' Theorem in circles to find missing angles and arcs.	G.C.A.2
Arc Length and Circumference	Students will derive the formula for the circumference of a circle and apply the formula to a variety of situations. Students will determine the length of an arc using central angles.	G.C.B.5 G.GMD.A.1 G.MG.A.1
The Area of a Circle	Students will derive the formula for the area of a circle. Students will determine the area of a sector using central angles.	G.C.B.5 G.GMD.A.1 G.MG.A.1



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Unit 9: Similar Triangles and Trigonometry

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Relationships can be described, and generalizations made for mathematical situations that have numbers or objects that repeat in predictable ways.

Essential Questions

- How do the relationships between the sides and angles in right triangle create the rules for trigonometry?
- How can similarity be used to determine unknown quantities?
- How can real-world situations be modeled by geometric figures to help solve problems?

Lesson Title	Lesson Overview	Standards
The Tangent of an Angle	Students will calculate and apply the tangent of an angle.	G.SRT.C.6 G.SRT.C.7 G.SRT.C.8
The Sine and Cosine Ratios	Students will calculate and apply the tangent, sine, and cosine of an angle with a focus on missing side lengths.	G.SRT.C.6 G.SRT.C.7 G.SRT.C.8
The Side-Splitting Theorems	Students will explore the Side-Splitting Theorem. Students will prove that a line parallel to one side of a triangle divides the other two proportionally. Students must also prove its converse.	G.SRT.B.4 G.SRT.C.6 G.SRT.C.8
The Angle Bisector Theorem	Students will find the length of sides in triangles using the Angle Bisector Theorem.	G.SRT.C.6
Geometric Means in Right Triangles	Students will use the Right-Triangle Altitude Theorem to determine the missing length in a right triangle.	G.SRT.C.6



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Unit 10: Three-Dimensional Figures and Formulas for Volume

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Two- and three-dimensional objects with or without curved surfaces can be described, classified, and analyzed by their attributes.
- Some attributes of objects are measurable and can be quantified using unit amounts.

Essential Questions

- How is surface area different than volume?
- How does the shape of its figure determine its surface area or volume?
- How can real-world situations be modeled by 3-dimensional geometry to help solve problems?

Lesson Title	Lesson Overview	Standards
Prisms and Cylinders, Pyramids and Cones	Students will study the attributes of prisms, pyramids, cylinders, and cones including the number of faces, vertices, and edges. Students will apply the Pythagorean Theorem to identify missing information within a figure such as the height or the slant height.	G.MG.A.1 G.SRT.C.8
Surface Areas of Prisms and Cylinders	Students will calculate both the lateral area and the surface area of prisms and cylinders. Students will draw nets and use nets to find lateral/surface area.	G.MG.A.1 G.MG.A.2 G.MG.A.3 G.GMD.B.4
Spheres and Sections Making Polyhedral and Other Surfaces	Students will provide 2-dimensional representations for 3-dimensional figures. Students will identify what 3-dimensional figure is created when a given 2-dimensional figure representation.	G.MG.A.1 G.GMD.B.4
Surface Areas of Pyramids and Cones	Students will calculate both the lateral area and surface area of pyramids and cones. Given lateral area or surface area, students will solve for missing information.	G.MG.A.1 G.MG.A.2 G.MG.A.3 G.GMD.B.4



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<p>Fundamental Properties of Volume</p>	<p>Students will determine the volume of a rectangular prism. Students will connect volume to density.</p>	<p>G.MG.A.1 G.MG.A.2 G.MG.A.3</p>
<p>Multiplication, Area, and Volume</p>	<p>Through 3-dimensional figures, students will connect algebra and geometry.</p>	<p>G.MG.A.1 G.MG.A.2 G.MG.A.3</p>
<p>Volumes of Prisms and Cylinders</p>	<p>Students will apply Cavalieri's Principle in real world contexts. Students will calculate the volume of prisms and cylinders. Given the volume of prisms or cylinders, students will solve for missing information.</p>	<p>G.MG.A.1 G.MG.A.3 G.GMD.A.1 G.GMD.A.3</p>
<p>Volumes of Pyramids and Cones</p>	<p>Students will calculate the volume of pyramids and cones.</p>	<p>G.MG.A.1 G.MG.A.3 G.GMD.A.1 G.GMD.A.3</p>
<p>The Volume of a Sphere The Surface Area of a Sphere</p>	<p>Students will calculate the volume of spheres and hemispheres. Students will calculate the surface area of spheres and hemispheres, including other polyhedral figures that are a composite of spheres, prisms, and cones.</p>	<p>G.MG.A.1 G.MG.A.3 G.GMD.A.1 G.GMD.A.3</p>



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Unit 11: Indirect Proofs and Coordinate Proofs

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Two- and three-dimensional objects with or without curved surfaces can be described, classified, and analyzed by their attributes. Some attributes of objects are measurable and can be quantified using unit amounts.

Essential Questions

- How is the Pythagorean Theorem used in real-life situations?
- How can we prove that figures are specific quadrilaterals?
- How can real-world situations be modeled by indirect or coordinate proofs to help solve problems?

Lesson Title	Lesson Overview	Standards
Proofs with Coordinates	Students will use properties of slope and properties of quadrilaterals in coordinate proofs.	G.CO.C.11 G.GPE.B.4
The Pythagorean Distance Formula	Students will derive the distance formula from the Pythagorean Theorem and will use it to solve real-world and mathematical problems.	G.CO.C.10 G.GPE.B.4
Finding the Equation of a Parabola	Students will find the equation of a parabola given its focus and directrix and students will find the focus and directrix of a parabola given its equation.	G.GPE.A.2
Equation for a Circle Theorem	Students will derive the formula for a circle using the Distance Formula. Based on given information, students will write the equation of a circle, graph it, and identify at least four points that lie on the circle. Students will rewrite a given equation that represents a circle into the form $(x - h)^2 + (y - k)^2 = r^2$ by completing the square and factoring perfect square trinomials.	G.GPE.A.1
Means and Midpoints	Students will use the midpoint formula to write an equation that describes a perpendicular bisector. Students will use the midpoint formula to find the center of a circle.	G.GPE.B.4



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Theorems Involving Midpoints	Students will derive the midsegment of a Triangle and Trapezoid Theorem and find missing segment lengths based on midsegments and medial triangles. Students will prove that the medians of a triangle are concurrent.	G.CO.C.10
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Unit 12: Further Work with Circles

Primary Resource: *Geometry*, 3rd Ed., University of Chicago School Mathematics.

Enduring Understandings

- Some attributes of objects are measurable and can be quantified using unit amounts.

Essential Questions

- What is the relationship between secants, chords, tangents, and the angles that they form?

Lesson Title	Lesson Overview	Standards
Chord Length and Arc Measure Angles Formed by Chords or Secants	Students will calculate the length of a chord by using special right triangles and trigonometric ratios. Students will explore the relationship between angles and secants and chords.	G.C.A.2
Tangents to Circles and Spheres Angles Formed by Tangents	Students will explore the relationship between the radius of a circle and tangents. Students will explore the relationship between tangents and angles. Students will know that the sum of the angles formed by two tangents and its first intercepted arc equals 180 degrees.	G.C.A.2
Three Circles Associated with a Triangle	Students will construct inscribed circles and circumscribe figures using perpendicular lines.	G.C.A.3
Lengths of Chords, Secants, and Tangents	Students will calculate the length of chords, secants, and tangents.	G.C.A.2



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Additional Topic: Quadratics

Primary Resource: *Algebra*, Carnegie Learning, 2012.

Enduring Understandings

- Variable: Mathematical situations and structures can be translated and represented abstractly using variables, expressions, and equations.
- Relations & Functions: Mathematical rules (relations) can be used to assign members of one set to members of another set. A special rule (function) assigns each member of one set to a unique member of the other set.
- Transformations: Objects in space can be transformed in an infinite number of ways, and those transformations can be described and analyzed mathematically.

Essential Questions

- How are coefficients and exponents used when adding and subtracting polynomials?
- How does multiplication of polynomials differ from adding and subtracting polynomials?
- What does it mean for an operation to be closed?
- How is GCF used to factor a polynomial?
- How is factoring related to the Distributive Property?
- When factoring a trinomial, if the middle term is negative and the constant is negative, what are the signs in the binomial factors?

Lesson Title	Lesson Overview	Standards
Controlling the Population: Adding and Subtracting Polynomials	<p>While quadratic relationships have been integrated throughout the geometry course, some students may need a more robust review on quadratics.</p> <p>Students will identify the terms and coefficients of polynomials.</p> <p>Students will sort polynomials by the number of terms, rewrite in standard form if possible, and identify the degree.</p> <p>Students will add and subtract polynomial functions algebraically and graphically and then determine that polynomials are closed under addition and subtraction.</p>	<p>A.APR.A.1 A.CED.A.1 A.CED.A.2 A.SSE.A.1a F.BF.A.1b</p>
Multiplying Like Polynomials: Multiplying Polynomials	<p>Students use area models and the Distributive Property to determine the product of binomials.</p>	<p>A.APR.A.1</p>



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What Factored Into It? - Factoring Polynomials	Students will write quadratic expressions as products of factors. Students will use GCF and multiplication tables to factor polynomials.	A.APR.A.1 A.SSE.B.3a
Zeroing In - Solving Quadratics by Factoring	Students will use the Zero Product Property as a strategy to calculate the roots of a quadratic equation. Students will connect the solutions to a quadratic equation to the x -intercepts of the graph of its equation.	A.REI.B.4b A.SSE.B.3a
Ladies and Gentlemen: Please Welcome the Quadratic Formula	Students will solve quadratic equations using the Quadratic Formula.	A.REI.B.4b