

Mathematics – *PLANNED COURSE OUTLINE*

Avon Grove School District

Grade 11- Geometry

State Benchmarks (K,3,5,8,11) & Grade Specific Benchmark	Eligible Content	Learner will be able to:	Instructional Strategies, Resources and Assessments
Standard: 2.1. Numbers, Number Systems and Number Relationships			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> Numbers can be represented in multiple ways. Being able to compute fluently means making smart choices about which tools to use and when to use them. Classifying helps us build mathematical networks of mathematical ideas. There is a need to represent and model numbers verbally, physically, and symbolically. 		Essential Questions <ol style="list-style-type: none"> What makes an answer exact? What makes a solution optimal? Why do we classify numbers? How can numbers be used to compare quantities and describe relationships between them? What numbers should be used to compare quantities and describe relationships between them? 	
A. Use operations (e.g., opposite, reciprocal, absolute value, raising to a power, finding roots, finding logarithms). M11.A Numbers and Operations M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems. M11.A.1.1 Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, exponents and scientific notation). M11.A.2 Understand the meanings of operations, use operations and understand how they relate to each other. M11.A.2.2 Use exponents, roots and/or absolute value to solve problems.	Find the square root of an integer to the nearest tenth using either a calculator or estimation. (2.1.8.A) M11.A.1.1.1 Simplify square roots. (e.g., $\sqrt{24} = 2\sqrt{6}$) (2.1.11.A) Simplify/evaluate expressions involving positive and negative exponents, roots and/or absolute value (may contain all types of real numbers -exponents should not exceed power of 10). (2.1.11.A) M11.A.1.1.3 Simplify/evaluate expressions involving multiplying with exponents (e.g. $x^6 * x^7 = x^{13}$), powers of powers (e.g., $(x^6)^7 = x^{42}$) and powers of products $(2x^3)^2 = 8x^6$ (positive exponents only). (2.1.11.A) M11.A.2.2.2	<ul style="list-style-type: none"> Use a calculator to calculate distance formula and Pythagorean Theorem (Drop In) Simplify square roots (drop-in before 8.1) Add, subtract, multiply, and divide radicals (drop in before 8.1) Rationalize the denominator of radicals (drop in before 8.1) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Grade 11- Geometry

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Standard: 2.2 Computation and Estimation			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> Knowing the reasonableness of an answer comes from using good number sense and estimation strategies. 		Essential Questions 1. What makes an estimate reasonable?	
A. Use estimation to solve problems for which an exact answer is not needed. M11A. Numbers and Operations M11.A.3 Compute accurately and fluently and make reasonable estimates. M11.A.3.1 Apply the order of operations in computation and in problem-solving situations	Use estimates to solve problems. (2.2.11.B) M11.A.3.2.1	<ul style="list-style-type: none"> Solve real world trig problems using estimation (Chapter 8) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Avon Grove School District

Grade 11- Geometry

State Benchmarks (K,3,5,8,11) & Grade Specific Benchmark	Eligible Content	Learner will be able to:	Instructional Strategies, Resources and Assessments
Standard: 2.3. Measurement and Estimation			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> Mathematics can be used to solve problems outside of the mathematics classroom. All measurements are approximations and the precision of the measurement depends on the tool and unit used. Understand measurable attributes of objects and the units, systems, and processes of measurement. Apply appropriate techniques, tools and formulas to determine measurements 		Essential Questions <ol style="list-style-type: none"> Is your plan working? Should you try a different method? How does what we measure affect how we measure? 	
A. Select and use appropriate units and tools to measure to the degree of accuracy required in particular measurement situations. M11.B Measurement M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements. M11.B.2.1 Use and/or compare measurements of angles. M11.B.2.2 Use and/or develop procedures to determine or describe measures of perimeter, circumference, area, surface area and/or volume. (May require conversions within the same system.)	Measure and/or compare angles in degrees (up to 360°) (protractor must be provided or drawn). (2.3.11.A & 2.3.11.B) M11.B.2.1.1 Calculate the surface area of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet. (2.3.8.A & 2.3.8.D) M11.B.2.2.1 Calculate the volume of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet. (2.3.8.A & 2.3.8.D) M11.B.2.2.2 Estimate area, perimeter or circumference of an irregular figure. (2.3.8.A & 2.3.8.D) M11.B.2.2.3 Find the measurement of a missing length given the perimeter, circumference, area or volume. (2.3.8.A & 2.3.8.D) M11.B.2.2.4	<ul style="list-style-type: none"> Find the lengths of segments (1.5) Find the measures of angles (1.6) Identify complementary, supplementary, and vertical pairs of angles (1.6) Find perimeters of rectangles and squares (1.9) Find circumference of circles (1.9 & 10.6) Find areas of rectangles, squares, and circles (1.9 and 10.7) Find areas of parallelograms, triangles, trapezoids, rhombus, kites, and regular polygons (10.1 & 10.3) Find surface area of prisms, cylinders, pyramids, and cones (11.2 & 11.3) Find perimeter and area of an irregular figure (1.9) Find volume of prisms, cylinders, pyramids, and cones (11.4 & 11.5) Find surface area and volume of spheres (11.6) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Avon Grove School District

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Standard: 2.3. Measurement and Estimation			
<p>B. Describe how a change in linear dimension in a object affects its perimeter, area and volume. (Grade 8)</p> <p>M11.B Measurement</p> <p>M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.</p> <p>M11.B.2.3 Describe how a change in one dimension of a figure (2 or 3 dimensional) affects other measurements of that figure.</p>	<p>Describe how a change in the linear dimension of a figure affects its perimeter, circumference, area or volume. (2.3.8.E) M11.B.2.3.1</p> <ul style="list-style-type: none"> • How does changing the length of the radius of a circle affect the circumference of the circle? • How does changing the length of the edge of a cube affect the volume of the cube? • How does changing the length of the base of a triangle affect the area of the triangle? 	<ul style="list-style-type: none"> • Analyze the change in area or perimeter of a figure when radius or length is changed (Drop In) • Find perimeters and areas of similar figures (10.4) • Find relationship between ratios of areas and volumes of similar solids (11.7) 	<p>Instructional Strategies:</p> <ul style="list-style-type: none"> Guided Practice Lecture Projects Group Work Discussion Independent Practice <p>Resources:</p> <ul style="list-style-type: none"> Textbook Publisher made supplemental materials Teacher made supplemental materials <p>Assessments:</p> <ul style="list-style-type: none"> Publisher made Teacher made

Board Approved November 8, 2007

Mathematics – *PLANNED COURSE OUTLINE*

Avon Grove School District

Grade 11- Geometry

State Benchmarks (K,3,5,8,11) & Grade Specific Benchmark	Eligible Content	Learner will be able to:	Instructional Strategies, Resources and Assessments
Standard: 2.4. Mathematical Reasoning and Connections			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> • Reasoning allows us to make conjectures and prove conjectures. • Precise language helps us express mathematical ideas and receive them. • Connections can be made to various strands of mathematics as well as other subject areas. • Understand how mathematical ideas interconnect and build on one another to produce a coherent whole. • Recognize reasoning and proof as fundamental aspects of mathematics • Select and use various types of reasoning and methods of proof 		Essential Questions <ol style="list-style-type: none"> 1. How are solving and proving different? 2. How are showing and explaining different? 3. How do you know when you have proven something? 4. How do you develop a convincing argument? 5. What previous learning helps us to learn new materials? 6. What makes a strategy both effective and efficient? 7. Need to add ?'s on Connections _____ 	
A. Direct proofs indirect proofs or proof by contradiction to validate conjectures.		<ul style="list-style-type: none"> • Use indirect reasoning to make conjectures (1.1) • Provide a counterexample to prove a conjecture incorrect (1.1) • Prove that lines are parallel and perpendicular (3.2 and 3.3) • Use indirect reasoning to write an indirect proof (5.4) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
B. Construct valid arguments from stated facts.		<ul style="list-style-type: none"> • Identify if-then statements and their parts (2.1) • Write converses of conditional statements (2.1) • Write inverse and contrapositive of conditional statements (5.4) • Write biconditionals statements (2.2) • Write definitions as biconditionals (2.2) • Use laws of detachment and syllogism (transitive) (2.3) • Justify statements in a deductive argument with properties of algebra (2.4) 	

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Avon Grove School District

Grade 11- Geometry

State Benchmarks (K,3,5,8,11) & Grade Specific Benchmark	Eligible Content	Learner will be able to:	Instructional Strategies, Resources and Assessments
Standard: 2.5. Mathematical Problem Solving and Communication			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> • Mathematics can be used to solve problems outside of the mathematics classroom. • Mathematics is built on reasoning. • To demonstrate understanding of a given mathematical problem, it is essential to effectively represent and communicate our thinking using pictures, numbers, and words. • Use the language of mathematics to express mathematical ideas precisely. 		Essential Questions <ol style="list-style-type: none"> 1. How do you make sense of different strategies? 2. How do you determine their strengths and weaknesses? 3. How do you determine similarities and differences? 4. What information in the problem is relevant to solve the problem? 5. How do we determine the appropriate strategy to solve a problem? 6. What should be included in the work shown to affectively represent our thinking and understanding? 7. What should be included in our writing to effectively communicate our thinking and understanding? 8. Why is it important to use mathematical words in our writing? 	
A. Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas and results.		<ul style="list-style-type: none"> • Identify points, lines and planes using appropriate notation (1.3) • Identify segments and rays (1.4) • Apply the basic postulates of geometry (1.3) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made

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Mathematics – *PLANNED COURSE OUTLINE*

Avon Grove School District

Grade 11- Geometry

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Standard: 2.8 Algebra and Functions			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> • Change is fundamental to understanding functions. • Numbers or objects that repeat in predicable ways can be described or generalized. • An operation can be undone by its inverse. • Rules of arithmetic and algebra can be used together with notions of equivalents to transform equations and inequalities so solutions can be found. • Mathematical situations can be represented using patterns, symbols, and rules to describe relationships. • Algebra solves real life problems when numbers are unknown. 		Essential Questions <ol style="list-style-type: none"> 1. How can change be described mathematically? 2. How are patterns of change related to the behavior of functions? 3. How do mathematical models/representations shape our understanding of mathematics? 4. How can we use patterns, symbols, and rules to represent and describe mathematical relationships? 5. In what ways can data and data displays be misleading? 	
A. Analyze a given set of data for the existence of a pattern and represent the pattern algebraically and graphically. M11.D Algebraic Concepts M11.D.1 Demonstrate an understanding of patterns, relations and functions. M11.D.1.1 Analyze and/or use patterns or relations.	Determine if a relation is a function given a set of points or a graph. (2.8.11.A) M11.D.1.1.2	<ul style="list-style-type: none"> • Analyze a sequence to find and/or extend a pattern (1.1) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
B. Give examples of patterns that occur in data from other disciplines. M11.D Algebraic Concepts M11.D.3 Analyze change in various contexts. M11.D.3.1 Describe and/or determine change.	Determine how a change in one variable relates to a change in a second variable (e.g., $y=4/x$, if x doubles, what happens to y ?). (2.11.8.B) M11.D.3.1.2		

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Avon Grove School District

Grade 11- Geometry

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Standard: 2.8 Algebra and Functions			
<p>B. Represent functional relationships in tables, charts and graphs.</p> <p>M11.A Numbers and Operations</p> <p>M11.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.</p> <p>M11.A.2.1 Apply ratio and/or proportion in problem-solving situations.</p>	<p>Solve problems using direct and inverse proportions. (2.8.11.P) M11.A.2.1.2</p> <p>Identify and/or use proportional relationships in problem solving settings. (2.8.11.P) M11.A.2.1.3</p>	<ul style="list-style-type: none"> • Write ratios & solve proportions (7.1) • Calculate the geometric mean (7.4) • Use the side-splitter and triangle-angle bisector theorems (7.5) 	<p>Instructional Strategies:</p> <p>Guided Practice Lecture Projects Group Work Discussion Independent Practice</p> <p>Resources:</p> <p>Textbook Publisher made supplemental materials Teacher made supplemental materials</p> <p>Assessments:</p> <p>Publisher made Teacher made</p>

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Standard: 2.9. Geometry			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> Two- and three-dimensional objects can be described, classified, and analyzed by their attributes. An object in a plane or in space can be oriented in an infinite number of ways while maintaining its size or shape. An object's location on a plane or in space can be described quantitatively. Linear measure, area, and volume are fundamentally different but may be related to one another in ways that permit calculation of one given the other. Reasoning allows us to make conjectures and prove conjectures.(already in 2.4) Trigonometry is using the relationships between the sides and the angles of triangles to solve problems. Visualization, spatial reasoning and geometric modeling are used to solve problems. 		Essential Questions <ol style="list-style-type: none"> How measurement and counting are related? How does what we measure affect how we measure? (move to 2.3) How can space be defined through numbers/measurement? Why do we compare, contrast, and classify objects? How do decomposing and recomposing shapes help us build our understanding of mathematics? How can transformations be described mathematically? How are solving and proving different? How are showing and explaining different? How do you know when you have proven something? What is trigonometry? How does it help us? 	
A. Construct geometric figures using dynamic geometry tools (e.g., Geometer's Sketchpad, Cabri Geometre).		<ul style="list-style-type: none"> Draw 3-dimensional pictures of planes and figures (1.4) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
B. Prove that two triangles or two polygons are congruent or similar using algebraic, coordinate and deductive proofs. M11.C Geometry M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships. M11.C.1.3 Use properties of congruence, correspondence and similarity in problem solving settings involving two- and three-dimensional figures.	Identify and/or use properties of congruent and similar polygons or solids. (2.9.11.B) M11.C.1.3.1	<ul style="list-style-type: none"> Classify polygons (3.5) Find sums of measures of internal and external angles of polygons (3.5) Recognize congruent figures and corresponding parts (4.1) Prove two triangles are congruent using SSS, SAS, ASA postulates, HL and AAS theorems (4.2, 4.3, & 4.6) Use congruent triangles and CPCTC to prove that other parts of of triangles are congruent (4.4) Identify and apply similar polygons (7.2) Prove two triangles are similar using AA, SAS, and SSS using similarity theorems (7.3) Recognize polyhedral and identify their parts (11.1) 	

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Standard: 2.9. Geometry			
<p>C. Identify and prove the properties of quadrilaterals involving opposite sides and angles, consecutive sides and angles and diagonals using deductive proofs.</p> <p>M11.C Geometry</p> <p>M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships.</p> <p>M11.C.1.2 Recognize and/or apply properties of angles, triangles and quadrilaterals.</p>	<p>Identify and/or use properties of quadrilaterals (e.g., parallel sides, diagonals, bisectors, congruent sides/angles and supplementary angles). (2.9.11.C) M11.C.1.2.2</p> <p>Identify and/or use properties of isosceles and equilateral triangles. (2.9.11.C) M11.C.1.2.3</p>	<ul style="list-style-type: none"> Define and classify special types of quadrilateral (6.1) Use the properties of parallelograms (6.2) Use the relationship involving diagonals of parallelograms (6.2) Prove a quadrilateral is a parallelogram (6.3) Use properties of the diagonals of rhombus and rectangles (6.4) Prove a parallelogram is a rectangle, a rhombus, or a square (6.4) Verify and use the properties of trapezoids and kites (6.5) Use and apply properties of isosceles triangles (4.5) 	<p>Instructional Strategies:</p> <p>Guided Practice Lecture Projects Group Work Discussion Independent Practice</p> <p>Resources:</p> <p>Textbook Publisher made supplemental materials Teacher made supplemental materials</p> <p>Assessments:</p> <p>Publisher made Teacher made</p>
<p>D. Identify corresponding parts in congruent triangles to solve problems.</p> <p>M11.C Geometry</p> <p>M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships.</p> <p>M11.C.1.2 Recognize and/or apply properties of angles, triangles and quadrilaterals.</p>	<p>Identify and/or use properties of triangles (e.g., medians, altitudes, angle bisectors, side/angle relationships, Triangle Inequality Theorem). (2.9.8.D) M11.C.1.2.1</p>	<ul style="list-style-type: none"> Classify triangles and find measures of their angles (3.4) Use external angles of triangles (3.4) Use and identify properties of mid-segments, perpendicular bisectors, and angles bisectors to solve problems (5.1 and 5.3) Identify properties of medians and altitudes of triangles (5.3) Use inequalities involving angles and sides of triangles (5.5) Use the side-splitter (triangle proportionality) and triangle-angle bisector theorems (7.5) 	

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Standard: 2.9. Geometry			
E. Solve problems involving inscribed and circumscribed polygons.		<ul style="list-style-type: none"> Define and draw inscribed and circumscribed polygons and circles (12.1) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made
F. Use the properties of angles, arcs, chords, tangents and secants to solve problems involving circles. M11.C Geometry M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships. M11.C.1.1 Identify and/or use parts of circles and segments associated with circles.	Identify and/or use the properties of a radius, diameter and/or tangent of a circle (given numbers should be whole.) (2.9.11.F) M11.C.1.1.1 Identify and/or use the properties of arcs, semicircles, inscribed angles and/or central angles. (2.9.11.F) M11.C.1.1.2	<ul style="list-style-type: none"> Find the measures of central angles, arcs, and arc lengths (10.6) Find areas of sectors and segments of circles (10.7) Use the relationship between radius and tangent (12.1) Use the relationship between two tangent lines from 1 point (12.1) Use congruent chords, arcs, and central angles (12.2) Recognize properties of the diameter of circles (12.2) Find measures of inscribed angles (12.3) Find measures of tangent-chord angles (12.3) Find measures of angles formed with secants, chords and tangents (12.4) 	

Board Approved November 8, 2007

Mathematics – PLANNED COURSE OUTLINE

Avon Grove School District

Grade 11- Geometry

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Standard: 2.9. Geometry			
<p>G. Solve problems using analytic geometry.</p> <p>M11.C Geometry</p> <p>M11.C.3 Locate points or describe relationships using the coordinate plane.</p> <p>M11.C.3.1 Solve problems using analytic geometry.</p>	<p>Calculate the distance and/or midpoint between 2 points on a number line or on a coordinate plane (formula provided on the reference sheet). (2.9.11.G)</p> <p>M11.C.3.1.1</p> <p>Relate slope to perpendicularity and/or parallelism (limit to linear algebraic expressions; slope formula provided on the reference sheet). (2.9.11.G)</p> <p>M11.C.3.1.2</p>	<ul style="list-style-type: none"> • Find the distance between two points in the coordinate plane (1.8) • Find the coordinates of the midpoint of a segment in the coordinate plane (1.8) • Name the coordinates of specific figures using their properties (6.6) 	<p>Instructional Strategies:</p> <p>Guided Practice Lecture Projects Group Work Discussion Independent Practice</p> <p>Resources:</p> <p>Textbook Publisher made supplemental materials Teacher made supplemental materials</p>
		<ul style="list-style-type: none"> • Recognize parallel and skew lines (1.4) • Prove and apply theorems about angles (2.5) • Name pairs of angles formed by 2 lines and a transversal (3.1) • Find measures of angles using properties of parallel lines (3.1) • Prove angles are congruent given parallel lines (3.1) • Relate parallel and perpendicular lines (3.3) • Use and apply the Trapezoid Midsegment Thm (6.7) 	<p>Assessments:</p> <p>Publisher made Teacher made</p>

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Avon Grove School District

Grade 11- Geometry

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Standard: 2.10. Trigonometry			
Enduring Understandings Students will understand that: <ul style="list-style-type: none"> • Six trigonometric functions and their inverses. • Trig graphs have practical applications. • Identities are used to evaluate, simplify, and solve trigonometric expressions and equations. • The law of cosines and the law of sines can be used to find missing measures. • Complex numbers can be used to convert from rectangular to polar coordinates and vice versa. • Vectors are added and multiplied and this helps with mathematical calculations for engineering and physics. 		Essential Questions <ol style="list-style-type: none"> 1. How is trigonometry used to find unknown values? 2. Why are certain values undefined for certain functions? 3. How can you compare the graphs of the sine, cosine, tangent functions and their inverses? 4. What approaches can be used to verify an identity? 5. What is the best approach? 6. How can you determine if a triangle had no solution, one solution, or two solutions? 7. How can you solve triangles using these laws? 8. Why is it important to understand complex numbers to understand polar coordinates? 9. Why can't physical models of vector quantities be represented by scalar quantities? 	
A. Identify, create and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean Theorem. M11.C Geometry M11.C.1 Analyze characteristics and properties of two- and three-dimensional geometric shapes and demonstrate understanding of geometric relationships. M11.C.1.4 Solve problems involving right triangles using the Pythagorean Theorem.	Find the measure of a side of a right triangle using the Pythagorean Theorem (Pythagorean Theorem included on the reference sheet). (2.10.11.B) M11.C.1.4.1	<ul style="list-style-type: none"> • Use the Pythagorean Theorem and its converse (8.1) • Use properties of 45-45-90 and 30-60-90 triangles (8.2) • Use sine, cosine, and tangent ratios to determine side lengths and angle measurement in right triangles (8.3 and 8.4) • Use angles of elevation and depression to solve problems (8.5) 	Instructional Strategies: Guided Practice Lecture Projects Group Work Discussion Independent Practice Resources: Textbook Publisher made supplemental materials Teacher made supplemental materials Assessments: Publisher made Teacher made