Year At A Glance

10th Grade Mathematics

Semester 1

Unit 14: Developing an Understanding of Geometry Concepts: Transformations and Constructions — **15 blocks**

Unit 15: Developing an Understanding of Geometry Concepts: Properties of Polygons and Circles — **30 blocks**

Unit 16: Developing an Understanding of Trigonometry Concepts: Ratios and Identities — **10 blocks**

Semester 2

Unit 17: Developing an Understanding of Equations and Expressions: Quadratics — **25 blocks**

Unit 18: Developing an Understanding of Functions: Analyzing and Manipulating Various Function Types — **30 blocks**

Unit 19: Developing an Understanding of Complex Number Operations — **20 blocks**

Unit 20: Developing an Understanding of Probability: Calculating Probability — **20 blocks**

Standards for Mathematical Practice

These standards must be addressed within every math course.

8.SMP.1 Make sense of problems and persevere in solving them. In grade 8, students solve real world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, —What is the most efficient way to solve the problem?, —Does this make sense?, and —Can I solve the problem in a different way?

8.SMP.2 Reason abstractly and quantitatively. In grade 8, students represent a wide variety of real world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.

8.SMP.3 Construct viable arguments and critique the reasoning of others. In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like —How did you get that?, —Why is that true? —Does that always work? They explain their thinking to others and respond to others‘ thinking.

8.SMP.4 Model with mathematics. In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.

8.SMP.5 Use appropriate tools strategically. Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.

8.SMP.6 Attend to precision. In grade 8, students continue to refine their mathematical

communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays.

8.SMP.7 Look for and make use of structure. (Deductive Reasoning) Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.

8.SMP.8 Look for and express regularity in repeated reasoning. (Inductive Reasoning) In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. During multiple opportunities to solve and model problems, they notice that the slope of a line and rate of change are the same value. Students flexibly make connections between covariance, rates, and representations showing the relationships between quantities.

Scope and Sequence 10th Grade

Semester 1

Unit 14: Developing an Understanding of Geometry Concepts: Transformations and Constructions

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
In this unit, students will manipulate figures with rigid motions. Students will also perform constructions using a compass and a straightedge.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

G.CO.1. 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.

G-CO.2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G-CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G-CO.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G-CO.5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

G-CO.6. 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.

G-CO.7. 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.

G-CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
G-CO.12. Make formal geometric constructions with a variety of tools and methods (compass and

straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.*

G-CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

G-C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

Reinforcing Standards: *These standards will be reinforced to facilitate learning of the focus standards. Units may, but do not have to have reinforcing standards*

Recurring Standards: *These standards will recur throughout many units of study. Standards of Mathematical Practice should show up here, but may also be focus or reinforcing standards in various units throughout the year.*

Standards for Mathematical Practice

3 Construct viable arguments and critique the reasoning of others.
4 Model with mathematics.
5 Use appropriate tools strategically.
6 Attend to precision.

Unit 15: Developing an Understanding of Geometry Concepts: Properties of Polygons and Circles

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
In this unit, students will prove geometric theorems. The topics will include similarity of triangles, polygons, and circles, line and angle relationships, and volume.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

G-SRT.1. Verify experimentally the properties of dilations given by a center and a scale factor:
a. 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.
b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

G-SRT.2. 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.

G-SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

G-SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
G-C.1. Prove that all circles are similar.

G-CO.9. Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.*

G-CO.10. Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*

G-SRT.4. Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.*

G-CO.11. Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*

G-GPE.4. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*

G-C.2. Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.*

G-C.4. (+) Construct a tangent line from a point outside a given circle to the circle.

G-C.5. 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.

G-GPE.1. 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.

G-GMD.1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.*
G-GMD.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.★

G-GMD.4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

G-MG.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

G-MG.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).★

G-MG.3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).★

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Standards for Mathematical Practice
1 Make sense of problems and persevere in solving them.
2 Reason abstractly and quantitatively.
6 Attend to precision.

Unit 16: Developing an Understanding of Trigonometry Concepts: Ratios and Identities

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
In this unit, the student will use right triangles to explore the beginning concepts of trigonometry.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

G-SRT.6. Understand 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.

G-SRT.7. Explain and use the relationship between the sine and cosine of complementary angles.

G-SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.★

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Standards for Mathematical Practice
5 Use appropriate tools strategically.
7 Look for and make use of structure.
8 Look for and express regularity in repeated reasoning.

Semester 2

Unit 17: Developing an Understanding of Equations and Expressions: Quadratics

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
In this unit students will solve quadratic equations by factoring, completing the square, square root property, and the quadratic formula. Students will also solve systems of quadratic and linear equations algebraically. Students will learn to add, subtract and multiply polynomials.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

A-APR.1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

A-CED.1. Create equations and inequalities in one variable and use them to solve problems.*Include equations arising from ~~linear and~~ quadratic functions, ~~and simple rational and exponential~~ functions.*

A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A-REI.4. Solve quadratic equations in one variable.

a. Use the method of completing the square to transform any quadratic equation in *x* into an e quation of the form (x-p)2=q that has the same solutions. Derive the quadratic formula from this form.

b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. ~~Recognize when the quadratic formula gives complex solutions and write them as *a* ± *bi* for real numbers *a* and *b*.~~

A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★

a. Factor a quadratic expression to reveal the zeros of the function it defines.

b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

~~c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as (1.151/12)12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*~~

A-SSE.2. Use the structure of an expression to identify ways to rewrite it. *For example, see x4-y4 as (x2)2-(y2)2, thus recognizing it as a difference of squares that can be factored as (x2-y2)(x2+y2).*

A-REI.7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically ~~and graphically~~. For example, find the points of intersection between the line $y = -3x$ and the circle x2+y2=3.

Reinforcing Standards: *These standards will be reinforced to facilitate learning of the focus standards. Units may, but do not have to have reinforcing standards*

A-SSE.1. Interpret expressions that represent a quantity in terms of its context.

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1+r)n as the product of P and a factor not depending on P.*

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Standards for Mathematical Practice

1 Make sense of problems and persevere in solving them.

2 Reason abstractly and quantitatively.

5 Use appropriate tools strategically.

7 Look for and make use of structure.

Unit 18: Developing an Understanding of Functions: Analyzing and Manipulating Various Function Types

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
In this unit students will develop an understanding of various functions through the manipulation of key features of their graphs. Students will also learn to identify various function types by their graphs, equations, and/or table of values.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

F-IF.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior*

F-LE.3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing ~~linearly,~~ quadratically, or (more generally) as a polynomial function.

F-IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★

F-IF.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★

F-IF.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★

a. Graph quadratic functions and show intercepts, maxima, and minima.
b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
~~c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.~~
~~d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.~~
e. Graph exponential ~~and logarithmic~~ functions, showing intercepts and end behavior, ~~and trigonometric functions, showing period, midline, and amplitude.~~

A-CED.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from ~~linear and~~ quadratic functions, ~~and simple rational and~~ exponential functions.*

A-REI.7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables

~~algebraically and~~ graphically. *For example, find the points of intersection between the line y = –3x and the circle* $x^2 + y^2 = 3$.

A-REI.11. Explain why the *x*-coordinates of the points where the graphs of the equations *y* = *f*(*x*) and *y* = *g*(*x*) intersect are the solutions of the equation *f*(*x*) = *g*(*x*); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f*(*x*) and/or *g*(*x*) are linear~~, polynomial, rational,~~ absolute value, exponential~~, and logarithmic~~ functions.

F-IF.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as

$y = (1.02)^t, y = (0.97)^t, y = (1.01)^{12t}, y = (1.2)^{t/10}$ and classify them as representing exponential growth or decay.

F-IF.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

F-BF.3. Identify the effect on the graph of replacing *f*(*x*) by *f*(*x*) + *k*, *k f*(*x*), *f*(*kx*), and *f*(*x* + *k*) for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

G-GPE.2. Derive the equation of a parabola given a focus and directrix.

F-BF.1. Write a function that describes a relationship between two quantities.★

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*

c. (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*

F-BF.4. Find inverse functions.

a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2 x3 or f(x) = (x+1)/(x–1) for* $x \neq 1$.

b. (+) Verify by composition that one function is the inverse of another.

~~c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.~~

~~d. (+) Produce an invertible function from a non-invertible function by restricting the domain.~~

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Standards for Mathematical Practice

3 Construct viable arguments and critique the reasoning of others.

4 Model with mathematics.

7 Look for and make use of structure.

8 Look for and express regularity in repeated reasoning.

Unit 19: Developing an Understanding of Complex Number Operations

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
Using the properties of both integer and rational exponents, students will develop an understanding of complex numbers.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

N-RN.1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{\frac{1}{3}}$ *to be the cube root of 5 because we want (5^1/3)^3=5^(1/3)^3 to hold, so 5^1/3^3 must equal 5.*

N-RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.

N-RN.3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

N-CN.1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.

N-CN.2. Use the relation $i^2 = -1$and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N-CN.7. Solve quadratic equations with real coefficients that have complex solutions.

A-REI.4. Solve quadratic equations in one variable.

~~a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x-p)2=q that has the same solutions. Derive the quadratic formula from this form.~~

~~b. Solve quadratic equations by inspection (e.g., for~~ x2=49), ~~taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.~~

Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

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Standards for Mathematical Practice

2 Reason abstractly and quantitatively.

6 Attend to precision.

Unit 20: Developing an Understanding of Probability: Calculating Probability

Unit Summary: (Unit at a Glance, Competency Statements, Essential Questions and Big Ideas)
In this unit, the students will define, calculate, and apply a variety of probability concepts.

Common Core State Standards Addressed
Focus Standards: *These standards should be taught to mastery and assessed in this unit.*

S-CP.1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").

S-CP.2. Understand 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.

S-CP.5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

S-CP.3. Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret 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*.

S-CP.6. 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 (uniform probability) model.

S-CP.4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

S-CP.7. Apply the Addition Rule (in a uniform probability model), P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the (uniform probability) model.

S-CP.8. (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the (uniform probability) model.

S-CP.9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

S-MD.6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

S-MD.7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

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Standards for Mathematical Practice

3 Construct viable arguments and critique the reasoning of others.

4 Model with mathematics.

Graduation Standards Alignment

	Algebra	Functions	Geometry	Number and Quantity	Statistics and Probability
SEMESTER 1					
Unit 14: Developing an Understanding of Geometry Concepts: Transformations and Constructions			X		
Unit 15: Developing an Understanding of Geometry Concepts: Properties of Polygons and Circles			X		
Unit 16: Developing an Understanding of Trigonometry Concepts: Ratios and Identities			X		
SEMESTER 2					
Unit 17: Developing an Understanding of Equations and Expressions: Quadratics	X				
Unit 18: Developing an Understanding of Functions: Analyzing and Manipulating Various Function Types		X			
Unit 19: Developing an Understanding of Complex Number Operations				X	
Unit 20: Developing an Understanding of Probability: Calculating Probability					X