Time	Unit 1 Families of Functions Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
4.5 weeks Days Are Approx 5 days	**Lesson 1 Function Models Revisited** <u>Investigation 1 Modeling Atmospheric Change</u> *What problem conditions and data patterns suggest use of linear, power, inverse variation, and exponential functions in modeling different aspects of atmospheric change?* Vocab.: families of functions, linear, exponential, direct variation, inverse variation, <u>Investigation 2 It's All in the Family</u> *How do the parameters in the basic function families provide tools for matching function models to specific problem conditions, data patterns, and graphs?* Vocab.: Power, parameters, trigonometric, domain ,range	Review properties and applications of linear, exponential, power, and inverse variation functions Develop a taxonomy of function rule, graph, and numerical patterns	A SSE 1 A SSE 3 A CED 1 A CED 2 F IF 1 F IF 4 F IF 5 F IF 7 F IF 7a F IF 7b F IF 7e F IF 8 F IF 9 F BF 1 F LE 5 G CO 2 G GMD 3	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

7 days	**Lesson 2 Customizing Models I: Translation and Reflection** <u>Investigation 1 Vertical Translation</u> *What are the connections between rules for functions whose graphs are related by vertical translation?* *How can functions with graphs obtained by vertical translation expand the supply of models for important patterns of variation?* Vocab.: translations, absolute value, extrema, maxima, minima, intercepts, zeroes <u>Investigation 2 Reflection Across the x-Axis</u> *How can functions with graphs obtained by reflection across the x-axis expand the supply of models for important patterns of variation?* Vocab.: reflection, variation, interval, domain, range, <u>Investigation 3 Horizontal Translation</u> *How are the rules of functions f(x) and g(x) related if their graphs are related by horizontal translation?* Vocab.: Horizontal,	Discover the connections between rules of functions whose graphs are related by vertical translation, reflection across the x-axis, and horizontal translation Discover ways that maximum and minimum points, zeroes, and y-intercepts of two functions are related if their graphs are related by vertical translation, reflection across the x-axis, and horizontal translation Develop strategies for using the connections between graph transformations and function rules to develop models for relationships that are based on the core function families	A SSE 3 A REI 4b F IF 4 F IF 7 F IF 7a F IF 7b F IF 8 F BF 1 F BF 3 F LE 5	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

7 days	**Lesson 3 Customizing Models II: Stretching and Compressing** <u>Investigation 1 Vertical Stretching and Compression</u> *What are the connections between rules for functions whose graphs are related by vertical stretching or compressing?* *How can those connections be used to build related models for important data patterns?* Vocab.: vertical stretch, compress, <u>Investigation 2 Horizontal Stretching and Compressing</u> *What are the connections between rules for functions whose graphs are related by horizontal stretching or compressing?* *How can those connections be used to build related models for important data patterns?* Vocab.: amplitude, period, frequency	Discover the connections between rules for functions that are related by horizontal and/or vertical stretching and compressing Develop strategies for adjusting basic sine and cosine functions to vary amplitude and period Discover relationships among maximum and minimum points, zeroes, and y – intercepts of functions whose graphs are related by vertical and/or horizontal stretching and compressing Use ideas of vertical and horizontal stretching/compressing of graphs to construct models of periodic variation	A SSE 3 A SSE 3a A CED 1 F IF 7 F IF 7b F IF 7e F IF 8 F BF 1 F BF 3 F TF 5 G CO 2	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

4 days (2-3 days)	**Lesson 4 Combining Functions** <u>Investigation 1 Arithmetic with Functions</u> *When do the sum, difference, product, and quotient of two given functions provide useful models for patterns of change in other variables?* *How can you determine properties of functions that have been constructed from two or more simpler functions by arithmetic operations?* Vocab.: algebraic expressions, independent variable, function, notation <u>Investigation 2 Composition of Functions</u> *What does it mean to combine functions by composition?* *When and how can rules for given functions be combined to produce rules for composite functions?* *How can rules for given functions be analyzed to fid simpler functions that are composed to give those rules?* Vocab.: function composition, notation, commutative, inside/outside function (Lesson 5 Looking Back)	Develop the definitions and important properties of arithmetic operations on functions Discover meaningful ways to combine functions by arithmetic operations Develop understanding of function composition and skill in constructing rule for composite functions from rules of the component functions (Review and synthesize the major objectives of the unit)	A SSE 1 A SSE 3 A APR 1 F IF 7 F IF 7e F IF 8 F BF 1 F BF 1b F BF 1c F TF 5	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 2 Vectors and Motion Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
5 weeks Days are approx 7 days	**Lesson 1 Linear Motion** <u>Investigation 1 Navigation: What Direction and How Far?</u> *How can vectors be represented geometrically with directed line segments?* *How can vectors and scalar multiples of vectors be used to model navigation routes?* Vocab.: heading, direction, initial point, tail, terminal point, head, vector, nautical mile, scalar, scalar multiple, opposite of a vector, equal vectors, magnitude <u>Investigation 2 Changing Course</u> *How can vectors be used to model routes when there is a change of course during the trip?* Vocab.: sum, resultant, components <u>Investigation 3 Go with the Flow</u> *How can vectors be used to analyze the effect of two or more forces acting on an object simultaneously?* Vocab.: component analysis of vectors, law of cosines	Represent vectors as directed line segments with both direction and magnitude Describe and illustrate the scalar multiple and the opposite of a vector Describe and illustrate the components of a vector Add two vectors geometrically and by using components Model linear motions and forces with vectors	N VM 1 N VM 2 N VM 3 N VM 4a N VM 4b N VM 5a A SSE 3 G SRT 8 G SRT 10 G SRT 11 G MG 3	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

7 days	**Lesson 2 Vectors and Parametric Equations** <u>Investigation 1 Coordinates and Vectors</u> *What are some of the advantages of representing vectors in a standard (x,y) coordinate system?* Vocab.: standard position, position vector, length of vector, rectangular coordinates, polar coordinates <u>Investigation 2 Vector Algebra with Coordinates</u> *What are some important properties of vectors and their operations? How are these properties similar to, and different from, properties of operations with real numbers? How can vectors and their properties be use to prove geometric statements?* Vocab.: zero vector, dot product, inner product <u>Investigation 3 Follow that Dot</u> *What are parametric equations and how can they be used to simulate linear motion?* Vocab.: parametric equations, parametric function, parameter, velocity, constant	Describe and illustrate the relationship between the coordinates of the terminal point of a position vector and its components Explore and prove properties of scalar products and addition of vectors Describe and illustrate the dot product of two vectors, use it to compute the cosine of the angle formed by the vectors and to test whether or not those vectors are perpendicular Use vectors to prove properties of triangles and quadrilaterals Write parametric equations that model linear motion Simulate linear motion using technology	N VM 3 N VM 4c N VM 5a N VM 5b A SSE 1 A SSE 1b A SSE 3 A CED 2 G GPE 4	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

7 days (3 days)	**Lesson 3 Simulating Nonlinear Motion** <u>Investigation 1 What Goes Up, Must Come Down</u> *How can parametric equations be used to simulate nonlinear motion like that of a projectile?* Vocab.: initial height, initial velocity, horizontal and vertical displacement, projectile <u>Investigation 2 Representing Circles and Arc Parametrically</u> *How can parametric equations be used to represent circles and arcs?* Vocab.: Radian, arc (Lesson 4 Looking Back)	Write parametric equations to simulate projectile, circular, and elliptical motion Identify important forces affecting motion Use both radian and degree measurements to describe angular velocity (Review and synthesize the major objectives of the unit)	N VM 3 A SSE 1 A SSE 1b A SSE 3 A CED 2	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 3 Algebraic Functions and Equations Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
5 weeks Days are approx 6 days	**Lesson 1 Polynomial Function Models and Operations** <u>Investigation 1 Constructing Polynomial Function Models</u> *What efficient strategies will find polynomial functions with graphs that have two or more local maximum and minimum points?* Vocab.: polynomial, max., min., method of undetermined coefficients, matrix, statistical curve fitting tool <u>Investigation 2 Zeroes and Factors of Polynomials</u> *How can polynomials be written in equivalent forms that make the solution of problems simpler and computations quicker?* *How can inspection of the coefficients and degree of a polynomial reveal the end behavior of the graph of the corresponding polynomial function?* Vocab.: Equivalent expressions, zeroes, factors, expanded form, standard form, nested form, end behavior, coefficients, degree, multiplicity <u>Investigation 3 Division of Polynomials</u> *How can division be used to express a polynomial as a product of simpler factors?* Vocab.: polynomial division, synthetic division, factor theorem	Fit polynomial function models to data and graph patterns using problem conditions, statistical regression, and the method of undetermined coefficients Extend the relationship between standard, factored, and nested multiplication forms of polynomials Develop polynomial division and the division algorithm $p(x) = (x - k)q(x) + r(x)$ Solve polynomial equations and inequalities	A SSE 2 A SSE 3 A SSE 3a A APR 1 A APR 3 A APR 4 A CED 2 A CED 3 A REI 4 A REI 4a A REI 8 A REI 9 F IF 2 F IF 4 F IF 5 F IF 7 F IF 7c F IF 8 F BF 1 G GMD 3	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

5 days	**Lesson 2 Complex Numbers** <u>Investigation 1 A Complex Solution</u> *What kind of number system allows square roots for negative numbers?* *How can the familiar operations of arithmetic be generalized in useful ways to the new kinds of numbers?* Vocab.: Complex number system, imaginary numbers, conjugates <u>Investigation 2 Properties of Complex Numbers</u> *How can complex numbers be represented visually on a coordinate grid?* *How do the algebraic properties of complex numbers compare to those of real numbers?* Vocab.: absolute value, coordinate plane, complex number plane, properties - commutative, associative, distributive, identity, inverse, closure	Develop understanding of the need for complex numbers to solve quadratic equations and the definition of the new numbers in the form a + bi, with a and b real numbers and i = square root of -1. Use definitions of addition, subtraction, multiplication, and division of complex numbers to establish algebraic properties of complex number operations Develop geometric representation of complex numbers, including absolute value for magnitude, and the connection between complex number operations and basic geometric transformations	N CN 1 N CN 3 N CN 4 N CN 5 N CN 7 A SSE 1a A SSE 2 A SSE 3 A SSE 3a A REI 4 A REI 4a F IF 7 F IF 8 F BF 1	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

6 days	**Lesson 3 Rational Function Models and Operations** <u>Investigation 1 Rational Function Models</u> What patterns of change are modeled well by rational functions? How can rational functions be expressed in different equivalent ways? Vocab.: rational, equivalent, domain, range, asymptotes <u>Investigation 2 Properties of Rational Functions</u> How can rational expressions be analyzed to reveal important features of the corresponding function graphs? What rules govern operations with rational expressions? Vocab.: vertical, horizontal, and oblique asymptotes, polynomial division, synthetic division, inequalities	Write expressions for rules of rational functions that model patterns in experimental data, geometric curves, and problem conditions Identify asymptotes (horizontal, vertical, and oblique) for graphs of rational functions Review and extend skills in manipulating rational expressions into useful equivalent forms Solve rational equations and inequalities	N CN 3 N CN 5 A SSE 1b A SSE 3 A APR 6 A APR 7 A CED 1 A REI 4 F IF 1 F IF 4 F IF 5 F IF 7 F IF 7d F IF 8 F BF 1	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

4 days (2-3 days)	**Lesson 4 Algebraic Strategy** <u>Investigation 1 Dealing with Radicals</u> *How can functions and equations involving radicals be expressed in different equivalent ways?* Vocab.: radical, parabola, focus, directrix, equidistant, <u>Investigation 2 Seeing the Big Picture</u> *How do the forms of algebraic problems suggest overall solution strategies and possibilities?* Vocab.: domain, range, system of equations, polynomial expression (Lesson 5 Looking Back)	Write algebraic expressions for relationships that involve radicals Solve equations and inequalities involving radicals Review strategies for manipulating algebraic expressions and equations into equivalent forms and the justifications for those maneuvers Advance strategic thinking using symbol sense to analyze problem situations and their algebraic models both as an enhancement of and method for avoiding algebraic calculation (Review and synthesize the major objectives of the unit)	A SSE 1 A SSE 1b A SSE 3 A APR 3 A APR 6 A REI 2 A REI 4 F IF 1 F IF 7 F IF 8 F BF 1 F BF 4d G GPE 2	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 4 Trigonometric Functions and Equations Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
5 weeks Days are approx 11 days	**Lesson 1 Reasoning with Trigonometric Functions** Investigation 1 Proving Trigonometric Identities *What strategies are useful in proving trigonometric identities?* *How are the sine, cosine, and tangent values of an angle and its opposite related?* Vocab.: trigonometric identity, range of a projectile, Pythagorean identity, opposite-angle identity, reciprocal identity, quotient identity Investigation 2 Sum and Difference Identities *How can you express the sine or cosine of an angle X in terms of pi/2 – X, the complement of X?* *What are trigonometric identities for the sum and difference of two angles?* *How can these identities be used to verify other identities?* Vocab.: Co-function identity, sum and difference identities, Double-angle identities, Investigation 3 Extending the Family of Trigonometric Functions *What are the three reciprocal trigonometric functions?* *What are characteristics of the graphs of these functions?* *What are the fundamental trigonometric identities involving these functions?* Vocab.: secant, cosecant, contangent	Know and be able to u se the definitions of the six trigonometric functions Describe the graph and period of each trigonometric function Derive and use the fundamental trigonometric identities Develop strategies for proving trigonometric identities Derive and use the opposite-angle, co-function, sum, difference, and double-angle identities for sine and cosine	A SSE 3 A SSE 3a F IF 1 F IF 7 F IF 8 F TF 3 F TF 8 F TF 9 G SRT 7	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

6 days	**Lesson 2 Solving Trigonometric Equations** <u>Solving Linear Trigonometric Equations</u> *Given an equation of af(b(x + c)) = d, where f(x) is a trigonometric function and a,b not equal to 0, how can you tell if solutions exist?* *If solutions exist, how do you find them?* Vocab.: domain, range, inverse trig. functions, period <u>Investigation 2 Using Identities to Solve Trigonometric Equations</u> *How can you solve more complex equations that involve more than one trigonometric function?* Vocab.: Equations in Quadratic Form	Solve linear and quadratic trigonometric equations Solve equations of the form af(bx + c) = d, where f is a trigonometric function Express the general solutions of a trigonometric equation in forms such as x = a + 2*pi*n or x = a + 360*n, for any integer n Use identities to transform trigonometric equations into more easily solved forms	A SSE 3 A REI 1 A REI 4a F IF 7 F IF 8 F TF 6 F TF 7	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

5 days (3 days)	**Lesson 3 The Geometry of Complex Numbers** <u>Investigation 1 Trigonometric Form of Complex Numbers</u> *Given a complex number in standard form, how can you re-express it in trigonometric form and vice versa?* *How can you find the product and quotient of two complex numbers expressed in trigonometric form?* *How can you geometrically interpret complex number multiplication? Division?* Vocab.: Absolute value or modulus, complex numbers, trigonometric form, standard complex form, complex number plane (Lesson 4 Looking Back)	Express a complex number in both standard and trigonometric forms Use complex number multiplication and division to size transform, rotate, or rotate and size transform the point or vector associated with a complex number (Review and synthesize the major objectives of the unit)	N CN 4 N CN 6 A SSE 2 A SSE 3 A REI 4a F IF 7 F IF 8	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 5 Exponential Functions, Logarithms, and Data Modeling Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
3 weeks Days are approx 8 days	**Lesson 1 Exponents and Natural Logarithms** Investigation 1 What is e^x? *What is the number e and how can it be used as a kind of universal exponential base for expressing every type of growth or decay function?* Vocab.: exponential growth (decay), base, effective annual interest rate, Euler's number or the natural number e, continuous compounding Investigation 2 Applications of e^x and ln x *How can problems involving exponential growth and decay be expressed and solved using base-e exponential and logarithmic functions?* Vocab.: natural logarithm, base-e logarithm, half life Investigation 3 Properties of e^x and ln x *How can any exponential function $y = b^x$ be expressed in equivalent form using e as the base?* *How are logarithms with different bases related to each other?* *How can properties of logarithms and exponents be used to solve equations and rewrite algebraic expressions in useful equivalent forms?* Vocab.: inverse, properties of ln – quotient, product, power, change of base formula	Understand e as the limit of $(1+1/n)^n$ as n approaches infinity Use e^r as an approximation for $(1+r/n)^n$ and e^{rt} as an approximation for $(1+r/n)^{nt}$ Use functions of the form $y = Ae^{rt}$ to solve exponential growth and decay problems Show how any exponential function can be expressed in equivalent form using base e and how any logarithm can be expressed in equivalent form using base 10 or base e Use properties of exponents and logarithms to write algebraic expression in equivalent form sand solve equations involving logs and exponents	A SSE 1 A SSE 1b A SSE 2 A SSE 3 A SSE 3c A CED 1 F IF 7 F IF 7e F IF 8b F BF 4d F BF 5 F LE 4	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

7days (2-3 days)	**Lesson 2 Linearization and Data Modeling** <u>Investigation 1 Assessing the Fit of a Linear Model</u> *How can analysis of residuals be used to assess the goodness of fit of linear functions to data patterns?* Vocab.: residuals, goodness of fit, residual plot, actual, predicted <u>Investigation 2 Log Transformations</u> How can logarithms be used to "straighten" the graphs of exponential data patterns and help find rules for the underlying functions? Vocab.: Log Transformations, linearize, exponential model <u>Investigation 3 Log-Log Transformations</u> *How can logarithmic transformations of data reveal patterns relating variables when the values of the variables are of different magnitudes and skewed distributions?* *How can taking logarithms of both independent and dependent variable values aid in finding the relationship between those variables?* Vocab.: dependent, independent, magnitude, skewed, log-log transformation, power model (Lesson 3 Looking Back)	Use residual plots to assess the goodness of fit for linear models of data patterns Use logarithmic transformations of data to find linearized data patterns Use linear regression equations and back transformation (solving for y) to determine exponential and power functions that model data patterns (Review and synthesize the major objectives of the unit)	A SSE 3 F IF 7 F IF 8b F BF 5 S ID 6a S ID 6b S ID 6c S CP 9	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 6 Surfaces and Cross Sections Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
2 weeks Days are approx 10 days	**Lesson 1 Representing Three-Dimensional Shapes** <u>Investigation 1 Using Data to Determine Surfaces</u> *How can you use altitude data to make and interpret a contour diagram of a surface?* *How can you use coordinates to identify locations in space?* Vocab.: surfaces, contour diagrams, elevations, coordinate planes, 3-D, z-axis, contour lines <u>Investigation 2 Visualizing and Reasoning with Cross Sections</u> *How can you interpret and draw a profile of a region?* *How can horizontal and vertical cross sections of a three-dimensional figure be used to determine and sketch the figure?* Vocab.: cross section, topography, topographic profile, relief line, cone, pyramid, cylinder, parabaloid <u>Investigation 3 Conic Sections</u> *What is the general x-y form of an equation of each conic section?* *How can you rewrite the general form of a particular conic in a form from which it is easier to sketch its graph?* Vocab.: conic sections, infinite double-cone, circle, standard equation of ..., parabola, ellipse, hyperbola, vertex form, foci, major and minor axis, vertices, branch	Draw a contour diagram from appropriate data Describe and plot the location of a point in three dimensions using (x, y, z) coordinates Make a topographic profile that corresponds to a vertical cross section on a map displaying contour lines Identify cross sections of three-dimensional surfaces or objects Describe a surface given its contour diagram Sketch a three-dimensional object given a set of horizontal and vertical cross sections Identify and sketch graphs of conic sections given an equation in the form $ax^2 + by^2 + cx + dy + e = 0$ Write equations that match graphs of conic sections	A SSE 3 A SSE 3a A REI 4 A REI 4a G GPE 1 G GPE 2 G GPE 3 G GMD 1 S CP 9	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 7 Concepts of Calculus Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
4 weeks Days are approx 12 days	**Lesson 1 Introduction to the Derivative** <u>Investigation 1 Instantaneous Rates of Change I</u> *How can data in a table or graph be used to describe the rate of change in the dependent variable?* Vocab.: differential calculus, velocity, instantaneous velocity, rate of change, average velocity <u>Investigation 2 Instantaneous Rates of Change II</u> *How can function rules be used to make good estimates for instantaneous rates of change in the quantities that those functions represent?* *How does the instantaneous rate of change in a function f(x) give meaning to the idea of slope for a curved graph?* Vocab.: slope of a curve, slope at a point, tangent line <u>Investigation 3 The Derivative</u> *What general procedure shows how to find f'(x) for any function f(x) and any value of x?* *How is the derivative of a function related to the shape of its graph?* *What are some rules for finding derivatives in familiar function families?* Vocab.: derivative, f-prime, limit, difference quotient, <u>Investigation 4 From Function Graph to Derivative Graph</u> *How can the graph of the derivative of a function be sketched from information obtained by analysis of the graph of the function itself?* Vocab.: local maximum, minimum	Develop the concept of instantaneous rate of change in a continuous variable and strategies for estimating those rates of change Define the derivative of a function at a point in its domain Connect the derivative of a function to local approximation of slope of its graph Develop derivatives formulas for linear and quadratic functions	A SSE 1b F IF 6 F BF 1	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

8 days (3 days)	**Lesson 2 Introduction to the Definite Integral** <u>Investigation 1 What is the Total?</u> *How can the information provided by a rate of change graph be used to calculate total change over some time interval?* Vocab.: total distance, net change <u>Investigation 2 Velocity and Net Change</u> *How can graphs indicate both rate and direction of change in a quantity?* *How can such directional rate graphs be used to calculate the net change in position of a moving object or the net flow in a pipeline?* Vocab.: velocity, directed motion, aquifer, net change <u>Investigation 3 The Definite Integral</u> *What does it mean to find the definite integral of a function f(x) over and interval [a, b]?* *What strategies are useful for finding approximate and exact values of definite integrals?* Vocab.: Definite integral, notation (Lesson 3 Looking Back)	Develop understanding of the connection between cumulative change and area bounded by a rate of change graph Develop beginning understanding of the ways that areas (and thus definite integrals) can be approximated by Riemann sums and the effects of refining the approximation by letting the change in x approach zero (Review and synthesize the major objectives of the unit)	A SSE 1 F BF 1	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

Time	Unit 8 Counting Methods and Induction Essential Q's/Vocabulary	CPMP Lesson Objective	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
4.5 weeks Days are approx 7 days	**Lesson 1 Counting Strategies** <u>Investigation 1 Careful Counting</u> *What are some useful methods and principles of systematic counting?* Vocab.: combinatorics, tree diagram, multiplication principle of counting, addition principle of counting <u>Investigation 2 Order and Repetition I</u> *How are order and repetition involved in counting situations? What strategies and formulas are useful in counting situations, not involving repetitions, where order is important? Where order is not important?* Vocab.: repetition, order, combinations, permutations, <u>Investigation 2 Order and Repetition II</u> *What are similarities and differences between permutations and combinations?* *How must the formulas for permutations and combinations be adjusted if repetitions are allowed? Why does this make sense?* Vocab.: subset, empty set, notation, factorial, factors, sequence	Develop the skill of systematic counting by thinking carefully about the number of possibilities in a variety of contexts Understand and apply basic counting strategies, such as making tree diagrams (counting trees), making systematic lists, and using the Multiplication Principle of Counting Understand and apply the issues of order and repetition when counting the number of possible choices from a collection Solve counting problems involving combinations and permutations	S CP 9	Close Reading Teacher/Student Think Alouds Contextual Problem Solving Turn and Talk	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.

11 days	**Lesson 2 Counting Throughout Mathematics** <u>Investigation 1 Counting and Multiplications Rules for Probability</u> *How can counting methods be used in determining probabilities?* *How are the Multiplication Rules for probability similar to, and different from, the Multiplication Principle of Counting?* Vocab.: probability, independent events, probability distributions, Multiplication rule for independent events, General Multiplication rule, replacement, mutually exclusive <u>Investigation 2 Combinations, the Binomial Theorem, and Pascal's Triangle</u> *What are some connections among combinations, Pascal's triangle, and expansions of binomial expressions of the form $(a + b)^n$?* *How can you explain and prove some of these connections?* Vocab.: binomial, expansion, binomial theorem, Pascal's triangle, coefficient	Apply counting methods to probability situations in which all outcomes are equally likely Extend understanding of and apply the General Multiplication Principle for Probability Understand and apply the Binomial Theorem Understand and apply connections among combinations, the Binomial Theorem, and Pascal's triangle Develop the skill of combinatorial reasoning, including its use in proofs	A APR 5 S CP 5 S CP 7 S CP 8	Close Reading Teacher Think Aloud Contextual Problem Solving Turn and Talk	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.
3-4 days	Lesson 4 Looking Back	Review and Synthesize objectives			

Time	**Mathematics Review Unit Essential Q's/Vocabulary**	CPMP Lesson Objectives	Common Core Obj.	Literacy Activities	Skills/Mathematical Practices
2-3 weeks	*Mathematics Review and Practice of a variety of mathematics topics*	numerous selected review and practice of objectives	Variety of selected Common Common Core Objectives		