# Clayton County Public Schools
# Mathematics IV

## Overview

This is the third course in a sequence of courses designed to provide students with a rigorous program of study in mathematics. It includes data analysis, sequences and series, rational functions, trigonometry, and investigation of functions.
(*Prerequisite: Successful completion of Mathematics III.*)

Instruction and assessment should include the appropriate use of manipulatives and technology. Topics should be represented in multiple ways, such as concrete/pictorial, verbal/written, numeric/data-based, graphical, and symbolic. Concepts should be introduced and used, where appropriate, in the context of realistic phenomena.

# Mathematics IV

## Technology Resources

National Library of Virtual Manipulatives (NLVM)- provides interactive online math lessons, activities, and assessments. Topics include fractions, functions, geometric transformations, integer arithmetic, etc.

Math OpenRef Geometry Tools- enable users to help each other use technology effectively in the math classroom. By sharing experiences, activities, comments, and needs, we can help each other find tools that are known to work well and learn how to use them and improve them.

GeoGebra- GeoGebra is a free interactive geometry software for education in schools.

PurpleMath- contains practical algebra lessons demonstrating useful techniques and pointing out common errors. Lessons are written with the struggling student in mind.

InterMath- InterMath is a professional development effort designed to support teachers in becoming better mathematics educators. It focuses on building teachers' mathematical content knowledge through mathematical investigations that are supported by technology. InterMath includes a workshop component and materials to support instructors.

Wolfram MathWorld- *MathWorld* currently features a number of innovative interactive elements that enhance its usability for a variety of different readers. These features include:

- The *MathWorld* Classroom, which provides a set of pop-up "capsule summaries" for more than 300 mathematical terms..
- Several types of interactive entries, including LiveGraphics3D applets for interactive three-dimensional geometry.
- A powerful full-text search engine with both basic and advanced searching capabilities.
- Dublin Core and Mathematics Subject Classification metadata in the HTML headers of each page.

NCTM Illuminations-The free Online ExPreSS Tutorial Program is also offered by the Georgia Department of Education (GaDOE) for high school students and certificate of attendance recipients who were unsuccessful on or who have not yet taken the Science and/or Social Studies Georgia High School Graduation Tests (GHSGT). The Online ExPreSS modules are self-paced and are based on the instructional plans created for the summer ExPreSS Program. Students must have access to their Georgia Testing Identifier (GTID) in order to create their own registration account. Participants will be able to access both the science and social studies tutorial program.

**Verizon Thinkfinity**-This comprehensive web site provides a wealth of educational and literacy resources for students, parents and after-school programs. The goal of Verizon Thinkfinity is to provide resources to strengthen problem-solving, creativity, and critical thinking skills; homework help; and interactive games and activities that make learning fun.

# Mathematics IV

| YEAR AT A GLANCE | | | | | | | | |
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| **FIRST SEMESTER** | | | | | **SECOND SEMESTER** | | | |
| | **Unit 1** | **Unit 2** | **Unit 3** | **Unit 4** | **Unit 5** | **Unit 6** | **Unit 7** | **Unit 8** |
| Unit Name | Data Analysis | Sequences and Series | Rational Functions | Introduction to Trigonometry | Graphs and Inverses of Trigonometric Functions | Trigonometric Identities | Extended Trigonometry | Investigation of Functions |
| **Teaching Time** | **3 Weeks** | **3 Weeks** | **5 Weeks** | **5 Weeks** | **4 Weeks** | **4 Weeks** | **6 Weeks** | **2 Weeks** |
| **Unit Assessment Dates** | 8/24/11-8/30/11 | 9/15/11-9/21/11 | 9/25/11-10/31/11 | 12/2/11-12/8/11 | 1/24/12-1/30/12 | 2/24/12-3/1/12 | 3/16/12-4/20/12 | 4/30/12-5/4/12 |
| **Other Assessment Dates** | | District Assessment 1<br>9/6/11 -9/9/11 | | District Assessment 2<br>12/12/11 -12/16/11 | | District Assessment 3<br>2/21/12 -2/24/12 | | |
| **NOTE: Mathematical standards are interwoven and should be addressed throughout the year in as many units and activities as possible in order to stress the natural connections that exist between mathematical topics.** | | | | | | | | |

# Mathematics IV
# Scope and Sequence

| Unit 1: Data Analysis | | | |
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| **3 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3D1. Using simulation, students will develop the idea of the central limit theorem.**<br><br>**MA3D2. Using student-generated data from random samples of at least 30 members, students will determine the margin of error and confidence interval for a specified level of confidence.**<br><br>**MA3D3. Students will use confidence intervals and margin of error to make inferences from data about a population. Technology is used to evaluate confidence intervals, but students will be aware of the ideas involved.** | • **Dot plot**<br>• **Mean**<br>• **Median**<br>• **Mode**<br>• **Normal distribution**<br>• **Skewed distribution**<br>• **Confidence interval**<br>• **Population parameter**<br>• **Point estimate**<br>• **Margin of error** | **Mandatory Tasks**<br>• **Colors of Reese's Pieces Candies Learning Task**<br>• **Pennies Learning Task**<br>• **Confidence Intervals Learning Tasks**<br><br>**Optional Tasks**<br>• **Gettysburg Address Learning Task**<br>• **Culminating Task: Draw Your Own Conclusion** | ***Accelerated Math 3 Student Resource* Book: Walch Education**<br>• 1.1 The Central Limit Theorem<br>• 1.2 Determining Margins of Error and Confidence Intervals<br>• 1.3 Making Inferences Using Margins of Error and Confidence Intervals<br><br>***Functions, Statistics, and Trigonometry; Integrated Mathematics*: Follett Educational Services**<br>• 7.7 Designing Simulations<br>• 7.8 Simulations with Technology<br>• 10.7 Sampling Distributions and the Central Limit Theorem<br>• 10.8 Confidence and Cautions in Statistical Reasoning |

| Unit 2: Sequences and Series | | | |
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| **3 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3A9. Students will use sequences and series**<br>a. Use and find recursive and explicit formulae for the terms of sequences.<br>b. Recognize and use simple arithmetic and geometric sequences.<br>c. Investigate limits of sequences.<br>d. Use mathematical induction to find and prove formulae for sums of finite series.<br>e. Find and apply the sums of finite and, where appropriate, infinite arithmetic and geometric series.<br>f. Use summation notation to explore series.<br>g. Determine geometric series and their limits. | • **Arithmetic sequence**<br>• **Common difference**<br>• **Common ratio**<br>• **Converge**<br>• **Diverge**<br>• **Explicit formula**<br>• **Geometric sequence**<br>• **Limit of a sequence**<br>• **Recursive formula**<br>• **Sequence**<br>• **Series**<br>• **Term**<br>• **Summation notation** | **Mandatory Tasks**<br>• **Renaissance Festival Learning Task**<br>• **Fascinating Fractals Learning Task**<br><br>**Optional Tasks**<br>• **Diving into Diversions Learning Task**<br>• **Culminating Task: Interior Design Interview** | ***Accelerated Math 3; Student Resource Book*: Walch Education**<br>• 2.1 Sequences<br>• 2.2 Series<br><br>***Pre-Calculus; Graphing and Data Analysis*: Prentice Hall**<br>• 12.1 Sequences<br>• 12.2 Arithmetic Sequences<br>• 12.3 Geometric Sequences; Geometric Series<br>• 12.4 Mathematical Induction<br><br>***Functions, Statistics, and Trigonometry; Integrated Mathematics*: Follett Educational Services**<br>• 8.1 Formulas for Sequences<br>• 8.2 Limits of Sequences<br>• 8.3 Arithmetic Series<br>• 8.4 Geometric Series<br>• 8.5 Infinite Series |

| Unit 3: Rational Functions | | | |
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| **5 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3A1. Students will explore rational functions.**<br>a. Investigate and explain characteristics of rational functions, including domain, range, zeros, points of discontinuity, intervals of increase and decrease, rates of change, local and absolute extrema, symmetry, asymptotes, and end behavior.<br>b. Find inverses of rational functions, discussing domain and range, symmetry, and function composition.<br>c. Solve rational equations and inequalities analytically, graphically, and by using appropriate technology. | • **Absolute extrema**<br>• **Domain**<br>• **End behavior**<br>• **Horizontal asymptote**<br>• **Interval of decrease**<br>• **Interval of increase**<br>• **Local extrema**<br>• **Oblique asymptote**<br>• **Point of discontinuity**<br>• **Range**<br>• **Rate of change**<br>• **Rational function**<br>• **Symmetric with respect to the origin**<br>• **Symmetric with respect to the x-axis**<br>• **Symmetric with respect to the y-axis**<br>• **Vertical asymptote**<br>• **Zero**<br>• **Composition of functions**<br>• **Inverse function**<br>• **Extraneous solution** | **Mandatory Tasks**<br>• **Rational Function Characteristics Learning Task**<br>• **Graphing Rational Functions Learning Task**<br>• **Finding Horizontal Asymptote Learning Task**<br>• **Inverse of a Rational Function Learning Task**<br><br>**Optional Tasks**<br>• **Partial Fraction Decomposition Learning Task**<br>• **NFL Passer Rating Culminating Task**<br>• **Create a Coffee Can Culminating Task** | ***Accelerated Math 3 Student Resource Book*: Walch Education**<br>• 3.1 Characteristics of Rational Functions<br>• 3.2 Inverses<br>• 3.3 Solving<br><br>***PreCalculus; Graphing and Data Analysis*: Prentice Hall**<br>• 3.4 Rational Functions I<br>• 3.5 Rational Functions II: Analyzing Graphs<br><br>***Functions, Statistics, and Trigonometry; Integrated Mathematics*: Follett Educational Services**<br>• 6.2 Rational Power Functions |

| Unit 4: Introduction to Trigonometry | | | |
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| **5 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3A2. Students will use the circle to define the trigonometric functions**.<br>a. Define and understand angles measured in degrees and radians, including but not limited to 0°, 30°, 45°, 60°, 90°, their multiples, and equivalences.<br>b. Understand and apply the six trigonometric functions as functions of general angles in standard position.<br>c. Find values of trigonometric functions using points on the terminal sides of angles in the standard position.<br>d. Understand and apply the six trigonometric functions as functions of arc length on the unit circle.<br>e. Find values of trigonometric functions using the unit circle. | • **Angle**<br>• **Angular velocity**<br>• **Arc**<br>• **Arc length**<br>• **Central angle**<br>• **Clockwise**<br>• **Complementary angles**<br>• **Counter-clockwise**<br>• **Co-terminal angles**<br>• **Degree**<br>• **Initial side**<br>• **Negative degree measure**<br>• **Positive degree measure**<br>• **Quadrant**<br>• **Quadrantal angle**<br>• **Radian**<br>• **Sector** | **Mandatory Tasks**<br>• **Polynomial Root Suitcase Design**<br><br>**Optional Tasks**<br>• **Historical Relevance and Overview of Properties Formal Definition and Theorem Approach to Exponents and Logarithm Laws**<br>• **Potato Lab** | ***Accelerated Math 3 Student Resource* Book: Walch Education**<br>• 4.1 Angles in Radians and Degrees<br>• 4.2 Trigonometric Functions<br>• 4.3 The Unit Circle<br><br>***Pre-Calculus, Graphing and Data Analysis*: Prentice Hall**<br>• 6.1 Angles and Their Measures<br>• 6.2 Trigonometric Functions: Unit Circle Approach<br>• 6.3 Properties of the Trigonometric Functions |

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| | • **Special angle**<br>• **Standard position**<br>• **Supplementary angles**<br>• **Terminal side**<br>• **Unit circle**<br>• **Vertex**<br>• **Cosecant function**<br>• **Cosine function**<br>• **Cotangent function**<br>• **Pythagorean theorem**<br>• **Reference angle**<br>• **Secant function**<br>• **Sine function**<br>• **Tangent function**<br>• **Trigonometric function** | | ***Functions, Statistics, and Trigonometry; Integrated Mathematics*:**<br>**Follett Educational Services**<br>• 4.1 Measures of Angles and Rotations<br>• 4.2 Lengths of Arcs and Areas of Circles<br>• 4.3 Sines, Cosines, and Tangents<br>• 4.5 Exact Values of Sines, Cosines, and Tangents<br>• 4.6 The Sine, Cosine, and Tangent Function<br>• 13.1 The Secant, Cosecant, and Cotangent Functions |

| Unit 5: Graphs and Inverses of Trigonometric Functions | | | |
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| **4 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3A3. Students will investigate and use the graphs of the six trigonometric functions.**<br>a. Understand and apply the six basic trigonometric functions as functions of real numbers.<br>b. Determine the characteristics of the graphs of the six basic trigonometric functions.<br>c. Graph transformations of trigonometric functions including changing period, amplitude, phase shift, and vertical shift.<br>d. Apply graphs of trigonometric functions in realistic contexts involving periodic phenomena.<br><br>**MA3A8. Students will investigate and use inverse sine, inverse cosine, and inverse tangent functions.**<br>a. Find values of the above functions using technology as appropriate.<br>**b.** Determine characteristics of the above functions and their graphs. | • **Amplitude**<br>• **Asymptote**<br>• **Cosecant function**<br>• **Cosine function**<br>• **Cotangent function**<br>• **Coterminal angles**<br>• **Degree**<br>• **Domain**<br>• **Negative angle measure**<br>• **Period**<br>• **Periodic function**<br>• **Positive angle measure**<br>• **Radian**<br>• **Real numbers**<br>• **Secant function**<br>• **Sine function**<br>• **Tangent function**<br>• **Trigonometric function** | **Mandatory Tasks**<br>• **Getting to Know Conic Sections**<br>• **Circles Radio Station**<br><br>**Optional Tasks**<br>• **Parabolas**<br>• **Ellipses**<br>• **Hyperbolas**<br>• **Let's Go Fishing** | ***Accelerated Math 3 Student Resource* Book; Walch Education**<br>5.1 Trigonometric Functions<br>5.2 Graphs of Transformations and Periodic Phenomena<br>5.3 Inverse Trigonometric Functions<br><br>***Pre-Calculus; Graphing and Data Analysis*: Prentice Hall**<br>6.4 Graphs of the Sine and Cosine Functions<br>6.5 Graphs of the Tangent, Cotangent, Cosecant, and Secant Functions<br>6.6 Sinusoidal Graphs; Sinusoidal Curve Fitting<br>7.5 The Inverse Trigonometric Functions (I)<br>7.6 The Inverse Trigonometric Functions (II) |

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| | • **Unit circle**<br>• **Midline**<br>• **Model**<br>• **Phase shift**<br>• **Simple harmonic motion**<br>• **Vertical shift**<br>• **Angle of repose**<br>• **Arccos** $(\cos^{-1})$<br>• **Arcsin** $(\sin^{-1})$<br>• **Arctan** $(\tan^{-1})$<br>• **Function**<br>• **Interval notation**<br>• **Inverse function**<br>• **Inverse relation**<br>• **Range**<br>• **Relation**<br>• **Vertical line test** | | ***Functions, Statistics, and Trigonometry; Integrated Mathematics*: Follett Educational Services**<br><br>4.8 Translation Images of Circular Functions<br>4.9 The Graph-Standardization Theorem<br>5.3 The Inverse Cosine Function<br>5.5 The Inverse Sine Function<br>5.6 The Inverse Tangent Function |

| Unit 6: Trigonometric Identities | | | |
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| **4 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3A5. Students will establish the identities below and use them to simplify trigonometric expressions and verify equivalence statements.**<br>$\tan\theta = \frac{\sin\theta}{\cos\theta}$<br>$\cot\theta = \frac{\cos\theta}{\sin\theta}$<br>$\sec\theta = \frac{1}{\cos\theta}$<br>$\csc\theta = \frac{1}{\sin\theta}$<br>$\sin^2\theta + \cos^2\theta = 1$<br>$\tan^2\theta + 1 = \sec^2\theta$<br>$1 + \cot^2\theta = \csc^2\theta$<br>$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta$<br>$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$ | • **Cosecant of an angle**<br>• **Cosine of an angle**<br>• **Cotangent of an angle**<br>• **Hypotenuse**<br>• **Identity**<br>• **Legs of a right triangle**<br>• **Pythagorean theorem**<br>• **Right triangle**<br>• **Secant of an angle**<br>• **Sine of an angle**<br>• **Tangent of an angle**<br>• **Double angle** | **Mandatory Tasks**<br>• **And You Believed That?!**<br>• **Please Be Discrete**<br>• **Let's Be Normal**<br>**Optional Tasks**<br>• **We're Watching You**<br>• **One Way or the Other**<br>• **Class Project** | ***Accelerated Math 3 Student Resource* Book; Walch Education**<br>• 6.1 Identities<br>• 6.2 Trigonometric Sum and Difference Formulae<br>• 6.3 Trigonometric Double Angle Formulae<br>***Pre-Calculus; Graphing and Data Analysis*: Prentice Hall**<br>• 7.1 Trigonometric Identities<br>• 7.2 Sum and Difference Formulas<br>• 7.3 Double-Angle and Half Angle Formulas<br>• 8.2 The Law of Sines<br>• 8.3 The Law of Cosines<br>• 8.4 The Area of a Triangle |

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| $\sin(2\theta) = 2\sin\theta\cos\theta$<br>$\cos(2\theta) = \cos^2\theta - \sin^2\theta$<br><br>**MA3A6. Students will solve trigonometric equations both graphically and algebraically.**<br>a. Solve trigonometric equations over a variety of domains, using technology as appropriate.<br>b. Use the coordinates of a point on the terminal side of an angle to express *x* as *r*cosθ and *y* as *rsinθ.*<br>c. Apply the law of sines and the law of cosines.<br><br>**MA3A7. Students will verify and apply ½ *ab*sinC to find the area of a triangle.** | | | ***Functions, Statistics, and Trigonometry; Integrated Mathematics*: Follett Educational Services**<br><br>• 4.4 Basic Identities Involving Sines, Cosines, and Tangents<br>• 5.2 The Law of Cosines<br>• 5.4 The Law of Sines<br>• 13.2 Proving Trigonometric Identities<br>• 13.3 Restrictions on Identities |

| Unit 7: Extended Trigonometry | | | |
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| **6 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MM4A10. Students will understand and use vectors.**<br>a. Represent vectors algebraically and geometrically.<br>b. Convert between vectors expressed using rectangular coordinates and vectors expressed using magnitude and direction.<br>c. Add, subtract, and compute scalar multiples of vectors.<br>d. Use vectors to solve realistic problems.<br>**MA3A11. Students will use complex numbers in trigonometric form.**<br>a. Represent complex numbers in trigonometric form.<br>b. Find products, quotients, powers, and roots of complex numbers in trigonometric form.<br>**MA3A12. Students will explore parametric representations of plane curves.**<br>a. Convert between Cartesian and parametric | • **One-to-one function**<br>• **Periodic function**<br>• **Trigonometric function**<br>• **Ambivalent case**<br>• **Law of sines**<br>• **Law of cosines**<br>• **Pole**<br>• **Polar axis**<br>• **Polar coordinate system**<br>• **Rectangular coordinate system**<br>• **Argument**<br>• **Complex plane**<br>• **Complex number**<br>• **Imaginary number**<br>• **Modulus**<br>• **Real number**<br>• **Rectangular form of a complex number** | **Mandatory Tasks**<br>• **And You Believed That?!**<br>• **Please Be Discrete**<br>• **Let's Be Normal**<br><br>**Optional Tasks**<br>• **We're Watching You**<br>• **One Way or the Other**<br>• **Class Project** | ***Accelerated Math 3 Student Resource* Book: Walch Education**<br>7.1 Solving Trigonometric Equations<br>7.2 Applications of Trigonometric Equations<br>7.3 Vectors<br>7.4 Complex Trigonometry<br>7.5 Parametric Forms<br>7.6 Polar Equations<br><br>***Pre-Calculus, Graphing and Data Analysis*: Prentice Hall**<br>7.7 Trigonometric Equations (I)<br>7.8 Trigonometric Equations (II)<br>8.1 Right Triangle Trigonometry<br>9.1 Polar Coordinates<br>9.2 Polar Equations and Graphs<br>9.3 The Complex Plan; DeMoivre's Theorem<br>9.4 Vectors |

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| form.<br>b. Graph equations in parametric form showing direction and beginning and ending points where appropriate.<br><br>**MA3A13. Students will explore polar equations.**<br>a. Express coordinates of points in rectangular and polar form.<br>b. Graph and identify characteristics of simple polar equations including lines, circles, cardioids, limacons, and roses. | • **Trigonometric form of a complex number**<br>• **Cartesian equation**<br>• **Parameter**<br>• **Parametric equations**<br>• **Plane curve**<br>• **Polar equation**<br>• **Rectangular equation** | | ***Functions, Statistics, and Trigonometry; Integrated Mathematics*: Follett Educational Services**<br><br>13.4 Polar Coordinates<br>13.5 Polar Graphs<br>13.7 Trigonometric Form of Complex Numbers |

| Unit 8: Investigations of Functions | | | |
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| **2 Weeks** | | | |
| **Key Standards** | **Key Vocabulary** | **GPS Learning Tasks and Culminating Task** | **Textbook Resources** |
| **MA3A4. Students will investigate functions.**<br>a. Compare and contrast properties of functions within and across the following types: linear, quadratic, polynomial, power, rational, exponential, logarithmic, trigonometric, and piecewise.<br>b. Investigate transformations of functions.<br>c. Investigate characteristics of functions built through sum, difference, product, quotient, and composition. | • **Absolute extrema**<br>• **Asymptote**<br>• **Domain**<br>• **Exponential function**<br>• **Independent value**<br>• **Interval of decrease**<br>• **Interval of increase**<br>• **Linear function**<br>• **Local extrema**<br>• **Logarithmic function**<br>• **Period**<br>• **Periodic function**<br>• **Piecewise function**<br>• **Point of discontinuity**<br>• **Polynomial function**<br>• **Power function**<br>• **Quadratic function**<br>• **Range** | **Mandatory Tasks**<br>• **Combining Functions Learning Task: Part I-Per Capita Crime Rate**<br>• **Composition of Functions Learning Task: Part I-Is Your Heart Rate Normal For That Medication?**<br>**Optional Tasks**<br>• **Combining Functions Learning Task: Part II-Per Capita Food Supply**<br>• **Combining Functions Learning Task: Part III-Interpreting Tables**<br>• **Composition of Function Learning Task: Part II-Interpreting Tables** | ***Accelerated Math 3 Student Resource Book*: Walch Education**<br>• 8.1 Comparing and Contrasting Functions<br>• 8.2 Transforming Functions<br>• 8.3 Operating with Functions and the Resulting Function<br><br>***PreCalculus, Graphing and Data Analysis*: Prentice Hall**<br>• 2.2 Characteristics of Functions<br>• 2.3 Library of Functions; Piecewise-defined Functions<br>• 2.4 Graphing Techniques: Transformations<br>• 2.5 Operations of Functions; Composite Functions |

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| | • **Rate of change**<br>• **Rational function**<br>• **Trigonometric function**<br>• **Zero**<br>• **Reflection of a function**<br>• **Shrink of a function**<br>• **Stretch of a function**<br>• **Transformation of a function**<br>• **Translation of a function**<br>• **Composition of functions**<br>• **Difference of functions**<br>• **Product of functions**<br>• **Quotient of functions**<br>• **Sum of functions** | | |