Scope & Sequence GUIDE
AND Instructional GUIDE

Core: Grade 9 through Grade 12 Mathematics
The Grades 9-12 Scope and Sequence document provides an outline of the standards and a recommended teaching order. This document is broken down by quarters and includes three crucial learning criteria:

- Grade level academic standards that make up one or more units as part of instruction in the grading cycle.
- The suggested order for teaching the content and skills on a nine to ten week cycle.
- The recommended number of lessons and amount of time for instruction.

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ALGEBRA I

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INTERPRETING FUNCTIONS

1. Understand the concept of a function and use function notation
   1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).
   2. Use function notation, evaluate functions from inputs in their domains, and interpret statements that use function notation in terms of a context.
   3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

2. Represent and solve equations and inequalities graphically
   3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
   4. Represent and solve equations and inequalities graphically

3. Build new functions from existing functions
   4. Understand solving equations as a process of reasoning and explain the reasoning

4. Construct and compare linear, quadratic, and exponential models and solve problems
   5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
   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.

5. Analyze functions using different representations
   7. Find the value of f(g(x)) for specific values of x and g(x)

6. Build new functions from existing functions
   8. Given 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 and periodicity.

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 linear and quadratic functions and show intercepts, maxima, and minima.
   b. Graph exponential functions, showing intercepts and end behavior.

FUNCTIONS: BUILDING FUNCTIONS

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. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations and translate between the two forms.

2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations and translate between the two forms.
   a. Build functions by replacing the function notation f(x) by f(kx) or 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.

3. Build new functions from existing functions
   b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
   c. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship or two input-output pairs (include reading these from a table).
## INSTRUCTIONAL ALIGNMENT

### Unit 1: Equations and Inequalities (Lessons 1-1 to 4-2)
- **EA1: Patterns and Equations, Of Music and Money (p. 33)**
  - Identify patterns
  - Model patterns with expressions
  - Use patterns to make predictions
  - Write, solve and interpret multi-step equations
  - Solve literal equations for a variable
- **EA2: Inequalities and Absolute Value-Diet and Exercise (p. 61)**
  - Writing, solving, and graphing inequalities
  - Writing and graphing compound inequalities
  - Solving and graphing absolute value inequalities

### Unit 2: Functions (Lessons 5-1 to 13-3)
- **EA1 Representations of Functions Bryce Canyon Hiking (p. 121)**
  - Functions, range and domain
  - Graphs of functions and their key features
  - Writing and using equations of functions
  - Transforming functions
- **EA2 Linear Functions and Equations, Text Message Plans (p.173)**
  - Model with, write, and use linear functions
  - Identify a direct variation

### PREREQUISITE SKILLS
- **Unit 1**
  - Perform operations with decimals
  - Interpret Venn diagrams
  - Simplify expressions by combining like terms
  - Identify and extend patterns
  - Represent data using an equation
  - Solve one-step equations
  - Solve and interpret inequalities
  - Solve linear equations mixed numbers
  - Evaluate algebraic expressions

- **Unit 2**
  - Perform operations with fractions
  - Solve one-step equations
  - Compare & perform operations with integers
  - Solve and interpret inequalities
  - Solve linear equations mixed numbers
  - Evaluate algebraic expressions
  - Graph points on the coordinate plane

### VOCABULARY
- **Unit 1:** sequence, common difference, expression, variable, equilateral, equation, solution, formula, literal equation, compound inequality, conjunction, disjunction, absolute value, absolute value notation, absolute value equation, absolute value inequality
- **Unit 2:** mapping, relation, vertical line test, independent variable, dependent variable, continuous, discrete, y-intercept, parent function, translation, direct variation, constant of variation, indirect variation, inverse function, one-to-one, arithmetic sequence, explicit formula, recursive formula, slope-intercept form, point-slope form, standard form, scatter plot, trend line, correlation, line of best fit, linear regression, quadratic regression, exponential regression

### ASSESSMENTS
- SpringBoard Digital Online Assessments Unit 1 and Unit 2

### ACADEMIC CONNECTIONS
- **ELA:** Writing: Research to Build and Present Knowledge
  - Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
  - Draw evidence from informational texts to support analysis, reflection, and research.

- **SEL - Relationship Skills:** communication, social engagement, working cooperatively, resolving conflicts, helping-seeking help;
  - Self-Management: goal setting, organizational skills;
  - Responsible Decision Making: problem-solving, evaluation, reflection

### ADDITIONAL RESOURCES
- Springboard Online: [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons (instructional support for concepts related to lesson content)

### ESL

### NOTES:
FUNCTIONS: INTERPRETING FUNCTIONS
Understand the concept of a function and use function notation
1. Use function notation, evaluate functions from inputs in their domains, and interpret statements that use function notation in terms of a context.
2. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
3. Interpret functions that arise in applications in terms of the context
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; and periodicity.*
5. 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.
6. Analyze functions using different representations
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 linear and 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 exponential functions, showing intercepts and end behavior.
8. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

FUNCTIONS: BUILDING FUNCTIONS
Build a function that models a relationship between two quantities
1. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*

FUNCTIONS: LINEAR, QUADRATIC, AND EXPONENTIAL MODELS
Construct and compare linear, quadratic, and exponential models and solve problems.
1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
   a. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another
   b. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another

ALGEBRA: REASONING WITH EQUATIONS AND INEQUALITIES
Solve systems of equations
5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
6. Solve systems of linear equations exactly and approximately focusing on pairs of linear equations in two variables
Represent and solve equations and inequalities graphically
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.
12. Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

ALGEBRA: CREATING EQUATIONS
Create equations that describe numbers or relationships
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.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS
Interpret the structure of expressions
2. Use the structure of an expression to identify ways to rewrite it.
3. Choose & produce in equivalent forms an expression to reveal & explain properties of the quantity represented by the expression.
   a. Use the properties of exponents to transform expressions for exponential functions.

NUMBER AND QUANTITY: THE REAL NUMBER SYSTEM
Extend the properties of exponents to rational exponents
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.
2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.
# GRADE 9: ALGEBRA I

## 2ND QUARTER

### INSTRUCTIONAL ALIGNMENT

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| **Essential Questions:** Text: SpringBoard Algebra I | **Unit 4**
- **EA1:** Exponents, Radicals, & Geometric Sequences, Taking Stock (p. 323)
  - Properties of exponents
  - Integer exponents
  - Simplifying expressions involving exponents
  - Simplifying radical expressions
  - Performing operations with radical expressions
  - Distinguishing rational and irrational numbers
  - Identifying geometric sequences
  - Recursive & explicit formulas for geometric sequences
  - Finding a given term of a geometric sequence
- **EA2:** Exponential Functions-Family Bonds (p. 285)
  - Exponential functions
  - Compound interest | Suggested SpringBoard Strategies to Use:
  - See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
  - SpringBoard Text pages 618-620 for Learning Strategies
  - SpringBoard Text TE Individual Instruction Boxes for each lesson

### PREREQUISITE SKILLS

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<th>Unit 3</th>
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<td><em>Represent linear relationships using tables, equations, &amp; graphs</em></td>
<td><em>Graph compound inequalities</em></td>
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<tr>
<td><em>Identify solutions of linear inequalities in two variables</em></td>
<td><em>Graph a linear equation in two variables</em></td>
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<tr>
<td><em>Recognize rational and irrational numbers</em></td>
<td><em>Graph linear functions</em></td>
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### VOCABULARY

<table>
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<tr>
<th>Unit 3</th>
<th>Unit 4</th>
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<tr>
<td><em>Piecewise-defined function, linear inequality, solutions of a linear inequality, boundary line, half-plane, closed half-plane, system of linear equations, substitution method, elimination method, parallel, coincident, independent, dependent, inconsistent, consistent, system of linear inequalities, solution region</em></td>
<td><em>Radical expression, principal square root, negative square root, rationalize, tree diagram, geometric sequence, common ratio, recursive formula, exponential growth, exponential function, exponential decay, compound interest, exponential regression, polynomial, degree of a term, degree of a polynomial, standard form of a polynomial, descending order, leading coefficient, monomial, binomial, trinomial, difference of two squares, square of a binomial perfect square trinomial, rational expression</em></td>
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### ASSESSMENTS

- SpringBoard Digital Online Assessments Unit 2, Unit 3 and Unit 4

### ACADEMIC CONNECTIONS

- **ELA:** Writing: Research to Build and Present Knowledge
  - Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
  - Draw evidence from informational texts to support analysis, reflection, and research.

- **SEL:** Relationship Skills: communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help; Self-Management: goal setting, organizational skills; Responsible Decision Making: problem-solving, evaluation, reflection

#### ADDITIONAL RESOURCES

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- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following:
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<td>Unit 4: 16 days</td>
<td>Unit 5: 24 Days</td>
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<td>(Extra days allotted for review and various state mandated assessments)</td>
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<td><strong>ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS</strong></td>
<td><strong>INTERPRET the structure of expressions</strong></td>
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<td>1. Interpret expressions that represent a quantity in terms of its context</td>
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<td>a. Interpret parts of an expression, such as terms, factors, and coefficients</td>
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<td>b. Interpret complicated parts of expressions by viewing one or more of their parts as a single entity</td>
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<td>2. Use the structure of an expression to identify ways to rewrite it</td>
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<td>Write expressions in equivalent forms to solve problems</td>
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<td>3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression</td>
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<td>a. Factor a quadratic expression to reveal the zeros of the function it defines</td>
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<td>b. Complete the square in a quadratic expression to reveal the max or minimum value of the function it defines</td>
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<td><strong>ALGEBRA: ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS</strong></td>
<td><strong>PERFORM arithmetic operations on polynomials</strong></td>
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<td>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</td>
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<td>Rewrite rational expressions</td>
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<td>6. Rewrite simple rational expressions in different forms; write ( \frac{f(x)}{g(x)} ) in the form of ( a(x) + \frac{b(x)}{g(x)} ), where ( a(x), b(x), ) and ( r(x) ) are polynomials with the degree of ( r(x) ) less than the degree of ( b(x) ), using inspection, long division, or, for the more complicated examples, a computer algebra system</td>
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<td>7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions</td>
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<td><strong>ALGEBRA: CREATING EQUATIONS</strong></td>
<td><strong>CREATE equations that describe numbers or relationships</strong></td>
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<td></td>
<td>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</td>
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<tr>
<td><strong>ALGEBRA: REASONING WITH EQUATIONS AND INEQUALITIES</strong></td>
<td><strong>SOLVE equations and inequalities in one variable</strong></td>
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<td>4. Solve quadratic equations in one variable</td>
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<td>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</td>
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<td>Solve systems of equations</td>
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<td>7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically</td>
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<td><strong>FUNCTIONS: INTERPRETING FUNCTIONS</strong></td>
<td><strong>INTERPRET functions that arise in applications in terms of the context</strong></td>
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<td>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; and periodicity.*</td>
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<td>5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes</td>
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<tr>
<td><strong>FUNCTIONS: BUILDING FUNCTIONS</strong></td>
<td><strong>BUILD a function that models a relationship between two quantities</strong></td>
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<td>1. Write a function that describes a relationship between two quantities.*</td>
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<td>a. Graph linear and quadratic functions and show intercepts, maxima, and minima</td>
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<td>b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions</td>
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<td></td>
<td>e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude</td>
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<td>9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)</td>
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<td><strong>NUMBER AND QUANTITY: QUANTITIES</strong></td>
<td><strong>REASON quantitatively and use units to solve problems</strong></td>
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<td>3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</td>
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**GRADE 9: ALGEBRA I**

### INSTRUCTIONAL ALIGNMENT

**DIGITAL / PRINT TEXT**

**Essential Questions:**
- Text: *SpringBoard Algebra I*
- Unit 4: Exponents, Radicals, and Polynomials (Lessons 24-1 to 28-4)
  - How do multiplicative and exponential patterns model the physical world?
  - How are adding and multiplying polynomial expressions different from each other?

**Unit 5: Quadratic Function (Lessons 29-1 to 35-2)**
- How are quadratic functions used to model, analyze, and interpret mathematical relationships?
- Why is it advantageous to know a variety of ways to solve and graph quadratic functions?

### PERFORMANCE TASKS

**Unit 4**
- EA3: Polynomial Operations-Measuring Up (p. 383)
  - Adding polynomials
  - Multiplying polynomials
  - Factoring trinomials and Dividing polynomials
- EA4: Factoring and Simplifying Rational Expressions, Rock Star Demands (p. 419)
  - Rational expressions

**Unit 5**
- EA1: Graphing Quadratic Functions, Parabolic Paths (p. 453)
  - Writing, Analyzing, Graphing, and Transforming quadratic functions
- EA2: Solving Quadratic Equations, Egg Drop (p. 493)
  - Solving quadratic equations
  - Writing the equation of a quadratic function to fit data
  - Using a quadratic model to solve problems

### DIFFERENTIATION

**Suggested SpringBoard Strategies to Use:**
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Text pages 618-620 for Learning Strategies
- SpringBoard Text TE Individual Instruction Boxes for each lesson

**Digital Resources:**

### PREREQUISITE SKILLS

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<th><em>Evaluating functions</em></th>
<th><em>Solving equations</em></th>
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<td><em>Solving inequalities</em></td>
<td><em>Graphing linear functions</em></td>
<td><em>Interpreting graphs of linear functions</em></td>
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</table>

**VOCABULARY**

**Unit 4:** radical expression, principal square root, negative square root, rationalize, tree diagram, geometric sequence, common ratio, recursive formula, exponential growth, exponential function, exponential decay, compound interest, exponential regression, polynomial, degree of a term, degree of a polynomial, standard form of a polynomial, descending order, leading coefficient, monomial, binomial, trinomial, difference of two squares, square of a binomial perfect square trinomial, rational expression

**Unit 5:** quadratic function, standard form of a quadratic function, parabola, vertex of a parabola, maximum, minimum, parent function, axis of symmetry, translation, vertical stretch, vertical shrink, transformation, reflection, factored form, zeros of a function, roots, completing the square, discriminant, imaginary numbers, imaginary unit, complex numbers, piecewise-defined function, nonlinear system of equations

### ASSESSMENTS

SpringBoard Digital Online Assessments Unit 4 and Unit 5

### ACADEMIC CONNECTIONS

**ELA:** Writing: Research to Build and Present Knowledge
- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL - Relationship Skills:**
- Communication: social engagement, working cooperatively, resolving conflicts, helping/seeking help.
- Self-Management: goal setting, organizational skills;
  - Responsible Decision Making: problem-solving, evaluation, reflection

### ADDITIONAL RESOURCES

**additional resources**
- Springboard Online: [https://clevelandmetropolitanoah.springboardonline.org](https://clevelandmetropolitanoah.springboardonline.org)
- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity);
  - 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills);
  - 3. Mini-Lessons (instructional support for concepts related to lesson content)

### ESL

**NOTES:**
## STATISTICS AND PROBABILITY: INTERPRETING CATEGORICAL AND QUANTITATIVE DATA

**Summarize, represent, and interpret data on a single count or measurement variable**

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

**Summarize, represent and data on two categorical and quantitative variables**

5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related: a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
   b. Informally assess the fit of a function by plotting and analyzing residuals.
   c. Fit a linear function for a scatter plot that suggests a linear association.

**Interpret linear models**

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.
### Essential Questions:
- How are dot plots, histograms, and box plots used to learn about distributions of numerical data?
- How can the scatter plot, best-fit line, and correlation coefficient be used to learn about linear relationships in bivariate numerical data?
- How can a two-way table be used to learn about associations between two categorical variables?
- When is it reasonable to interpret associations as evidence for causations?

### Unit 6:
**Comparing Univariate Distributions, Splitting the Bill** (p. 557)
- Visual comparison of univariate graphical displays
- Computational comparisons of center and spread
- Determining outliers and creating modified box plots
- Determining appropriate measures of variability

**Bivariate Distributions, Dear Traveling Tooth** (p. 609)
- Describing a bivariate numerical relationship and associating that description with a correlation coefficient
- Developing a linear model, interpreting its components, using the model for prediction, and recognizing its limitations
- Analyzing row percentages and segmented bar graphs to investigate association

### PREREQUISITE SKILLS
- Developing a trend line
- Interpreting slope in context
- Computing summary measures of center for univariate data
- Developing a graph for univariate data
- Determining missing values in a two-way table
- Developing row percentages from two-way tables
- Describing the shape of a univariate distribution

### VOCABULARY
- sample, sampling error, measurement error, standard deviation, outlier, normal distribution, z score, correlate, correlation coefficient, residual, best-fit-line, segmented bar graph, row percentages

### ASSESSMENTS
- SpringBoard Digital Online Assessments Unit 6

### ACADEMIC CONNECTIONS
**ELA:** Writing; Research to Build and Present Knowledge
- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL - Relationship Skills:** communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help; **Self-Management:** goal setting, organizational skills; **Responsible Decision Making:** problem-solving, evaluation, reflection

### ADDITIONAL RESOURCES
- Springboard Online: [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons (instructional support for concepts related to lesson content)

### ESL

### NOTES:
# GEOMETRY

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<tr>
<td><strong>GEOMETRY (G): CONGRUENCE</strong>&lt;br&gt;Experiment with transformations in the plane.&lt;br&gt;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.&lt;br&gt;Prove geometric theorems.&lt;br&gt;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. <strong>GEOMETRY (G): EXPRESSIONS GEOMETRIC PROPERTIES WITH EQUATIONS</strong>&lt;br&gt;Use coordinates to prove simple geometric theorems algebraically.&lt;br&gt;5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).&lt;br&gt;6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</td>
<td><strong>GEOMETRY (G): CONGRUENCE</strong>&lt;br&gt;Experiment with transformations in the plane.&lt;br&gt;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).&lt;br&gt;3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.&lt;br&gt;4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.&lt;br&gt;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. <strong>Understand congruence in terms of rigid motions.</strong>&lt;br&gt;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. <strong>Prove geometric theorems.</strong>&lt;br&gt;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.</td>
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</tbody>
</table>
# MATHEMATICS
## GRADE 10: GEOMETRY
### 1ST QUARTER

## INSTRUCTIONAL ALIGNMENT

### ESSENTIAL QUESTIONS:
- How can you represent patterns from everyday life by using tables, expressions and graphs?
- How can you write and solve equations and inequalities?

### UNIT 1:
**Proof, Parallel and Perpendicular Lines**
- Lessons: 1 to 8

- **EA1:** Geometric Figures and Basic Reasoning: The Art and Math of Folding Paper (p. 37)
  - Geometric figures
  - Logical reasoning
  - Axiomatic system of geometry

- **EA2:** Distance, Midpoint, and Angle Measurement: A Walk in the Park (p. 61)
  - Segment and angle measurement
  - Distance and midpoint formulas

### UNIT 2:
**Transformations, Triangles, and Quadrilaterals**
- Lessons: 9-10

- **EA1:** Transformations: Designing the Plaza (p. 141)
  - Compositions of transformations
  - Congruent triangles

### SUGGESTED SPRINGBOARD STRATEGIES TO USE:
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Text pages 618-620 for Learning Strategies
- SpringBoard Text TE Individual Instruction Boxes for each lesson

### DIGITAL RESOURCES:
- [www.clevelandmetropolitanoh.springboard.org](http://www.clevelandmetropolitanoh.springboard.org)

### PREREQUISITE SKILLS:
- Unit 1: solving a linear equation, graphing a linear equation, finding the measure of an angle, describing the pattern of a sequence
- Unit 2: simplifying the square-root of an expression, solving a quadratic equation, finding slope and writing an equation for the graph of a line

### VOCABULARY:
- Unit 1: inductive reasoning, conjecture, deductive reasoning, proof, theorem, axiomatic system, undefined terms, two-column proof, conditional statement, hypothesis, conclusion, counterexample, converse, inverse, contrapositive, truth value, biconditional statement, postulates, midpoint, congruent, bisect, bisector of an angle, parallel, transversal, same-side interior angles, alternate interior angles, corresponding angles, perpendicular, perpendicular bisector
- Unit 2: transformation, pre-image, image, rigid motion, translation, directed line segment, rhombus, reflection, line of reflection, reflectional symmetry, line of symmetry, rotation, rotational symmetry, angle of rotational symmetry, composition of transformations, congruent, corresponding parts, triangle congruence criteria, flow chart proof, auxiliary line, interior angle, exterior angle, remote interior angle, Exterior Angle Theorem, altitude of a triangle, point of concurrency, orthocenter, median, centroid, circumcenter, circumscribed circle, inscribed circle, midsegment, median of a trapezoid, parallelogram, corollary, rectangle, indirect proof

### ASSESSMENTS:
- SpringBoard Digital Online Assessments Unit 1 and Unit 2

### ACADEMIC CONNECTIONS:
- **ELA:** Writing; Research to Build and Present Knowledge
  - Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
  - Draw evidence from informational texts to support analysis, reflection, and research.

- **SEL - Relationship Skills:** communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help; **Self-Management:** goal setting, organizational skills; **Responsible Decision Making:** problem-solving, evaluation, reflection

### ADDITIONAL RESOURCES:
- Springboard Online: [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons (instructional support for concepts related to lesson content)

### ESL:

### NOTES:
### Unit 2: GEOMETRY (G): CONGRUENCE

#### Understand congruence in terms of rigid motions.

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.

8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

#### Prove geometric theorems.

10. Prove theorems about triangles.

11. Prove theorems about parallelograms.

#### Make geometric constructions.

12. Make formal geometric constructions with a variety of tools and methods (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.

### Unit 3: GEOMETRY (G): SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY

#### Prove theorems involving similarity.

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.

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

#### Define trigonometric ratios and solve problems involving right triangles.

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

### Scope & Sequence

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<thead>
<tr>
<th>UNIT</th>
<th>SUGGESTED PACING</th>
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<tbody>
<tr>
<td>Unit 2</td>
<td>24 days</td>
</tr>
<tr>
<td>Unit 3</td>
<td>16 days</td>
</tr>
</tbody>
</table>

(Extra days allotted for review and various state mandated assessments)
### INSTRUCTIONAL ALIGNMENT

#### Digital / Print Text

**Essential Questions:**
- Text: SpringBoard 2014

**Unit 2: Transformations, Triangles, and Quadrilaterals**
- Lessons: 11-1 to 16-4
  - How are transformations related to congruence?
  - How do proving theorems extend your understanding of geometry?

**Unit 3: Similarity and Trigonometry**
- Lessons: 17-1 to 21-2
  - How are similar triangles used in solving problems in everyday life?
  - What mathematical tools do I have to solve right triangles?

#### Performance Tasks

**Unit 2**
- **EA2:** Congruence, Triangles, and Proofs: Building a Fitness Center (p. 179)
  - Writing proofs
  - Making conjectures

**EA3:** Properties of Triangles: Where Does the Fountain Go? (p. 203)
  - Properties of triangles
  - Point of concurrency

**EA4:** Quadrilaterals: Lucy Latimer’s Logo (p. 237)
  - Properties of special quadrilaterals
  - Identifying special quadrilaterals

**Unit 3**
- **EA1:** Similarity in Polygons: Monitoring Progress (p. 273)
  - Properties of similar figures
  - Similarity Transformations

- **EA2:** Right Triangles: Powered by the Wind (p. 301)
  - Altitudes of right triangles and geometric means
  - Proving and applying the Pythagorean Theorem
  - Relationships in special right triangles

#### Differentiation

**Suggested SpringBoard Strategies to Use:**
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Text pages 618-620 for Learning Strategies
- SpringBoard Text TE Individual Instruction Boxes for each lesson

**Digital Resources:**
- www.clevelandmetropolitanoh.springboard.org
- Online Book, Additional Practice Pages, Common Core Correlation, Standards for Mathematical Practices, Mini-Lessons, Additional Getting Ready Practice

#### Prerequisite Skills

**Unit 2**
- *Simplifying the square-root of an expression*
- *Writing the equation of a line given two points*

**Unit 3**
- *Translating a figure*
- *Solving a multi-step problem using proportional relationships*

#### Vocabulary

**Unit 2:** transformation, pre-image, image, rigid motion, translation, directed line segment, rhombus, reflection, line of reflection, reflectional symmetry, line of symmetry, rotation, rotational symmetry, angle of rotational symmetry, composition of transformations, congruent, corresponding parts, triangle congruence criteria, flow chart proof, auxiliary line, interior angle, exterior angle, remote interior angle, exterior angle theorem, altitude of a triangle, point of concurrency, orthocenter, median, centroid, circumcenter, circumscribed circle, inscribed circle, midsegment, median of a trapezoid, parallelogram, corollary, rectangle, indirect proof

**Unit 3:** dilation, center of dilation, similarity transformation, similar, indirect measurement, triangle proportionality theorem, parallel proportionality theorem, right angle altitude theorem, geometric mean, pythagorean theorem, pythagorean triple, opposite leg, adjacent leg, trigonometric ratio, sine, cosine, tangent, inverse trigonometric function, solving a right triangle, law of sines, law of cosines

#### Assessments

**Digital Resources**
- SpringBoard Digital Online Assessments Unit 2 and Unit 3

**Academic Connections**
- **ELA:** Writing: Research to Build and Present Knowledge
- **SEL:** Relationship Skills
- **Additional Resources**
  - SpringBoard Online: [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
  - Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons ( instructional support for concepts related to lesson content)

**ESL**
- [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
<table>
<thead>
<tr>
<th>UNIT</th>
<th>SCOPE &amp; SEQUENCE</th>
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</thead>
</table>
| Unit 3 | GEOMETRY: SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY  
Define trigonometric ratios and solve problems involving right triangles.  
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.
   7. Explain and use the relationship between the sine and cosine of complementary angles.
   8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
   Apply trigonometry to general triangles.  
10. Prove the Laws of Sines and Cosines and use them to solve problems.  
11. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles. (e.g., surveying problems, resultant forces) |
| Unit 4 | GEOMETRY: CONGRUENCE  
Experiment with transformations in the plane.  
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.  
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.  
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. |
| Unit 5 | GEOMETRY: SIMILARITY, RIGHT TRIANGLES, AND TRIGONOMETRY  
Apply trigonometry to general triangles.  
9. Derive the formula \( A = \frac{1}{2} ab \sin(C) \) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. |
| Unit 4 cont. | GEOMETRY: CIRCLES  
Understand and apply theorems about circles.  
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.  
3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. |
| Unit 6 | GEOMETRY: EXPRESSION OF GEOMETRIC PROPERTIES WITH EQUATIONS  
Use coordinates to prove simple geometric theorems algebraically.  
7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.  
GEOMETRY: MODELING WITH GEOMETRY  
1. Use geometric shapes, their measures, and their properties to describe objects.  
2. Apply concepts of density based on area and volume in modeling situations.  
GEOMETRY: CIRCLES  
1. Prove that all circles are similar.  
Find arc lengths and areas of sectors of circles.  
5. Derive using similarity the fact that length of the arc intercepted by an angle is proportional to radius, & define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.  
GEOMETRY: GEOMETRIC MEASUREMENT AND DIMENSION  
Explain volume formulas and use them to solve problems.  
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. |

**PACING**

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<td>Unit 4</td>
<td>25 days</td>
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<tr>
<td>Unit 5</td>
<td>5 days</td>
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(Extra days allotted for review and various state mandated assessments)
### INSTRUCTIONAL ALIGNMENT

#### DIGITAL / PRINT TEXT

**Essential Questions:**
- Text: *SpringBoard 2014*

**Unit 3: Trigonometry**

<table>
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<th>Lesson</th>
<th>Topic</th>
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<tr>
<td>EA3</td>
<td>Trigonometry: Zipping Along (p. 331)</td>
</tr>
<tr>
<td></td>
<td>- Trigonometric functions</td>
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<tr>
<td></td>
<td>- Laws of Sines</td>
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<td></td>
<td>- Laws of Cosines</td>
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<td></td>
<td>- Solving triangles</td>
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**Unit 4: Circles**

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<th>Lesson</th>
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<tr>
<td>EA1</td>
<td>Circles: Vertigo Round (p. 371)</td>
</tr>
<tr>
<td></td>
<td>- Central angles, inscribed angles, &amp; intercepted arcs</td>
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<td></td>
<td>- Angles formed by 2 chords, tangents, &amp; secants</td>
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<td>- Lengths of chord, tangent, &amp; secant segments</td>
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#### PERFORMANCE TASKS

**Unit 4 cont.**

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<td>EA2</td>
<td>Coordinates &amp; Constructions: Location Matters (p. 429)</td>
</tr>
<tr>
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<td>- Coordinate proofs</td>
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<td></td>
<td>- Writing equations of circles</td>
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<tr>
<td></td>
<td>- Finding the center &amp; radius of a circle from its equation</td>
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<td></td>
<td>- Writing equations of parabolas</td>
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<td>- Geometric constructions</td>
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**Unit 5: Area & Perimeter**

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<tr>
<td>EA1</td>
<td>Area &amp; Perimeter: Play Planning (p. 477)</td>
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<tr>
<td></td>
<td>- Finding perimeters and areas of composite figures</td>
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<tr>
<td></td>
<td>- Finding perimeters and areas of regular polygons</td>
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<td></td>
<td>- Converting between radian and degree measures</td>
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<tr>
<td></td>
<td>- Showing that all circles are similar</td>
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#### DIFFERENTIATION

**Suggested SpringBoard Strategies to Use:**
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Text pages 618-620 for Learning Strategies
- SpringBoard Text TE Individual Instruction Boxes for each lesson

**Digital Resources:**
- https://clevelandmetropolitanoh.springboardonline.org

**ASSESSMENTS**
- SpringBoard Digital Online Assessments Unit 4 and Unit 5

#### ACADEMIC CONNECTIONS

**ELA: Writing: Research to Build and Present Knowledge**
- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL - Relationship Skills**
- Communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help;
- Self-Management: goal setting, organizational skills;
- Responsible Decision Making: problem-solving, evaluation, reflection

#### ADDITIONAL RESOURCES

- **Springboard Online:** [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
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<td><strong>Unit 5</strong></td>
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<tr>
<td><strong>GEOMETRY: GEOMETRIC MEASUREMENT AND DIMENSION</strong></td>
</tr>
<tr>
<td><em>Explain volume formulas and use them to solve problems.</em></td>
</tr>
<tr>
<td>1. Give an informal argument for the formulas for the volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri’s principle, and informal limit arguments.</td>
</tr>
<tr>
<td>2. Give an informal argument using Cavalieri’s principle for the formulas for the volume of a sphere and other solid figures.</td>
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<tr>
<td>3. Use volume formulas for cylinders, pyramid, cones, and spheres to solve problems.</td>
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<th><strong>APPLICATION OF GEOMETRIC CONCEPTS</strong></th>
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<td><strong>Visualize relationships between two-dimensional and three dimensional objects.</strong></td>
<td><strong>Apply geometric concepts in modeling situations.</strong></td>
</tr>
<tr>
<td>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.</td>
<td>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).</td>
</tr>
<tr>
<td><strong>GEOMETRY: MODELING WITH GEOMETRY</strong></td>
<td><strong>2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).</strong></td>
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<table>
<thead>
<tr>
<th><strong>PROGRESS MONITORING</strong></th>
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<tr>
<td><strong>Unit 5</strong></td>
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<tr>
<td><strong>40 DAYS</strong></td>
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<tr>
<td><strong>Unit 5: 15 days</strong></td>
</tr>
<tr>
<td><em>(Extra days allotted for review and various state mandated assessments)</em></td>
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</tbody>
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Unit 6:

**STATISTICS AND PROBABILITY: CONDITIONAL PROBABILITY AND THE RULES OF PROBABILITY**

- Understand independence and conditional probability and use them to interpret data.
  - 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”).
  - 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.
  - Understand the conditional probability of A given B as $P(A \cap B)/P(B)$, 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 $B$.
  - 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.
  - Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

**Use the rules of probability to compute probabilities of compound events in a uniform probability model.**

- 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 model.
  - Use probabilities to make fair decisions.
  - Apply the Addition Rule, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, and interpret the answer in terms of the model.
  - Apply the general Multiplication Rule in a uniform probability model, $P(A \cap B) = P(A)P(B \mid A) = P(B)P(A \mid B)$, and interpret the answer in terms of the model.
  - Use permutations and combinations to compute probabilities of compound events and solve problems.

**STATISTICS AND PROBABILITY: USING PROBABILITY TO MAKE DECISIONS**

- Use probability to evaluate outcomes of decisions.
  - 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 model.
  - Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
# MATHEMATICS

## GRADE 10: GEOMETRY

## 4TH QUARTER

### INSTRUCTIONAL ALIGNMENT

**Digital / Print Text**

**Text:** SpringBoard 2014

**Unit 5:** Extending Two Dimensions to Three Dimensions (Lessons 30-1 to 32-3)
- How do two-dimensional figures help you visualize three-dimensional figures?
- Why are geometric formulas useful in solving real-world problems?

**Unit 6:** Probability (Lessons 38-1 to 42-3)
- How does knowing that one event has happened change the probability of another event happening?
- How do such changes in probability influence the decisions we make?

### Performance Tasks

**Unit 5**
- **EA2:** Surface Area and Volume: Action-Packed Measurements (p. 523)
  - Surface areas of prisms, cylinders and cones
  - Volumes of prisms, cylinders and cones
  - Solve design problems using applications of geometric concepts, including density based on area and volume
  - Solving triangles

**Unit 6**
- **EA1:** Probability and the Addition Rule: Diane’s Books (p. 593)
  - Sample spaces
  - Venn diagram and probability notation
  - The Addition Rule and mutually exclusive events

**Unit 5**
- **EA3:** Changing Dimensions of Spheres: Spherical Storage (p. 549)
  - Surface area of spheres
  - Volumes of spheres
  - Applications of geometric concepts, including changing dimensions of 3-D figures, to solve problems

**Unit 6**
- **EA2:** Conditional Probability and Independent Events: Diane’s Books (p. 633)
  - Independent events
  - Conditional probability
  - Multiplication Rule
  - Geometric probability
  - Permutations and combinations

### Differentiation

**Suggested SpringBoard Strategies to Use:**
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Text pages 618-620 for Learning Strategies
- SpringBoard Text TE Individual Instruction Boxes for each lesson

**Digital Resources:**
- www.clevelandmetropolitanoh.springboard.org
- Online Book, Additional Practice Pages, Common Core Correlation, Standards for Mathematical Practices, Mini-Lessons, Additional Getting Ready Practice

### Prerequisite Skills

**Unit 5**
- *Solving a literal equation for a given variable*
- *Identifying two- and three-dimensional figures*
- *Finding area of a composite figure*
- *Solving an area problem involving a circle*
- *Analyzing similar triangles*

**Unit 6**
- *Express percentages as decimals*
- *Express a fraction in simplest form*
- *Add fractions*
- *Express decimals rounded to a given number of decimal places*

### Vocabulary

**Unit 5:** sphere, composite figure, density, polygon, interior angle, discrete domain, regular polygon, equilateral, equiangular, exterior angle, convex polygon, apothem, circumference, sector, concentric circles, net, face, edge, vertex, oblique prism, right prism, pyramid, polyhedron, vertices of the polyhedron, cylinder, cone, height of a cone, sphere, great circle, solid of rotation, lateral area, total surface area, base, Cavalieri’s Principle, slant height, oblique pyramid, hemisphere, antipodal points, lune

**Unit 6:** probability experiment, outcome, sample space, event, complement, intersection, union, mutually exclusive events, two-way frequency table, conditional probability, tree diagram, dependent events, independent events, n factorial, permutation, combination

### Assessments

**Digital Online Assessments Unit 6**

### Academic Connections

**ELA:** Writing: Research to Build and Present Knowledge
- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL:** Relationship Skills: communication, social engagement, working cooperatively, resolving conflicts, helpingSeeking help; Self-Management: goal setting, organizational skills; Responsible Decision Making: problem-solving, evaluation, reflection

### Additional Resources

**Springboard Online:**
- https://clevelandmetropolitanoh.springboardonline.org

**Source:** eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. **Unit Practice** (additional problems for each activity); 2. **Getting Ready Practice** (additional lessons & practice problems for prerequisite skills); 3. **Mini-Lessons** (instructional support for concepts related to lesson content)

### ESL

**NOTES:**
### TEACHER WORKSHEET

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| ADDITIONAL ASSESSMENTS / ACADEMIC CONNECTIONS |
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<td><strong>Unit 2:</strong> 20 days*</td>
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<td>(Extra days allotted for review and various state mandated assessments)</td>
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<td><strong>Note:</strong> Unit 2 will be 27 days total and will continue into second quarter</td>
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</tbody>
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**ALGEBRA: CREATING EQUATIONS**
Create equations that describe numbers or relationships
1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear functions and quadratic functions, and simple rational and exponential functions.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

**ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS**
Interpret the structure of expressions
1. Interpret parts of an expression, such as terms, factors, and coefficients.

**ALGEBRA: REASONING WITH EQUATIONS AND INEQUALITIES**
Represent and solve equations and inequalities graphically
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, absolute value.

**FUNCTIONS: BUILDING FUNCTIONS**
Build a function that models a relationship between two quantities
1. Write a function that describes a relationship between two quantities.
2. Combine standard function types using arithmetic operations.
3. Identify the effect on the graph of replacing \( f(x) \) by \( f(x) + k \), \( kf(x) \), \( f(kx) \), and \( f(x + k) \) for specific values of \( k \) (both positive and negative); find the value of \( k \) given the graphs.
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.

**NUMBER AND QUANTITY: THE COMPLEX NUMBER SYSTEM**
Perform arithmetic operations with complex numbers
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.
2. Use the relation \( i^2 = -1 \) and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

**FUNCTIONS: INTERPRETING FUNCTIONS**
Interpret functions that arise in applications in terms of the context
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.
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

**FUNCTIONS: INTERPRETING FUNCTIONS**
Interpret functions that arise in applications in terms of the context
8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

**FUNCTIONS: INTERPRETING FUNCTIONS**
Interpret functions that arise in applications in terms of the context
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 piecewise-defined functions, including step functions and absolute value functions.
# INSTRUCTIONAL ALIGNMENT

## DIGITAL / PRINT TEXT

**Text:** SpringBoard 2014

**Unit 1 Equations, Inequalities, Functions (Lessons: 1.1-6.2)**
- How are linear equations and systems of equations and inequalities used to model and solve real-world problems?
- How are composite and inverse functions useful in problem solving?

**Unit 2 Applications of Quadratic Equations (Lessons: 7.1-9.2)**
- How can you determine key attributes of a quadratic function from an equation or graph?
- How do graphic, symbolic, and numeric methods of solving quadratic equations compare to one another?

## PERFORMANCE TASKS

**Unit 1**
- **EA1: Gaming Systems (p. 55-56)**
  - Systems of equations and systems of inequalities
  - Absolute value equations
- **EA2: Currency Conversions (p. 99-100)**
  - Piecewise-defined functions
  - Composition of functions
  - Inverse functions

**Unit 2**
- **EA1: No Horsing Around (p. 151-152)**
  - Quadratic functions and quadratic equations
  - Discriminants
  - Complex numbers
- **EA2: The Safari Experience (p. 191-192)**
  - Standard form and Vertex form of a parabola
  - Transformations
  - Directrix
  - Focus
  - Axis of symmetry
- **EA3: The Green Monster (p. 223-224)**
  - Graph of a parabola
  - Maximum of a parabola
  - Domain and range of quadratic functions
  - System of equations with a linear equation and quadratic equation

## DIFFERENTIATION

**Suggested SpringBoard Strategies to Use:**
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Algebra 2 text in the Resources section and see TE Differentiation Instruction boxes for each lesson

**Digital Resources:**
- www.clevelandmetropolitanoh.springboard.org
- Online Book, Additional Practice Pages, Common Core Correlation, Standards for Mathematical Practices, Mini-Lessons, Additional Getting Ready Practice

## PREREQUISITE SKILLS

**Unit 1**
- Evaluating functions
- Finding slope and intercepts
- Finding additive and multiplicative inverses
- Solving linear and literal equations
- Finding additive and multiplicative inverses
- Graphing functions
- Understanding absolute value
- Finding domain and range

**Unit 2**
- Factoring polynomials
- Finding slope and intercepts
- Solving absolute value equations
- Writing linear equations
- Finding domain and range

## VOCABULARY

**Unit 1:**
- Absolute value equation
- Absolute value inequality
- Constraints
- Consistent
- Inconsistent
- Independent
- Dependent
- Ordered triple
- Gaussian elimination
- Matrix
- Dimensions of a matrix
- Square matrix
- Multiplicative identity matrix
- Multiplicative inverse matrix
- Matrix equation
- Coefficient matrix
- Variable matrix
- Constant matrix
- Piecewise-defined function
- Step function
- Parent function
- Composition
- Composite function
- Inverse function

**Unit 2:**
- Quadratic equation
- Standard form of a quadratic equation
- Imaginary number
- Complex number
- Complex conjugate
- Completing the square
- Discriminant
- Root
- Zero
- Parabola
- Focus
- Directrix
- Axis of symmetry
- Vertex
- Quadratic regression
- Vertex form

## ASSESSMENTS

SpringBoard Digital Online Assessments Unit 1 and Unit 2

## ACADEMIC CONNECTIONS

**ELA:** Writing: Research to Build and Present Knowledge
- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL - Relationship Skills:**
- Communication, social engagement, working cooperatively, resolving conflicts, helpingseeking help;
- Self-Management: goal setting, organizational skills;
- Responsible Decision Making: problem-solving, evaluation, reflection

## ADDITIONAL RESOURCES

**Springboard Online:** [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)

**Source:** eBook Teacher Resources - Additional resources that may be helpful for instruction include the following:
1. **Unit Practice** (additional problems for each activity);
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3. **Mini-Lessons** (instructional support for concepts related to lesson content)

## ESL

**NOTES:**
### FUNCTIONS: INTERPRETING FUNCTIONS

Interpret functions that arise in application in terms of the context

1. Interpret functions as representations of relationships between quantities.
2. Use functions to model relationships between quantities.
3. Analyze functions in terms of context and model situations with them.
4. Use functions to make predictions and decisions.
5. Understand the relationship between the domain and range of a function.

### FUNCTIONS: BUILDING FUNCTIONS

Build new functions from existing functions

1. Use operations on functions as expressions for new functions.
2. Write a function that models a relationship between two quantities.
3. Use the structure of an expression to identify ways to rewrite it.
4. Build new functions from existing functions.

### ALGEBRA: ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS

Perform arithmetic operations on polynomials

1. Add, subtract, and multiply polynomials.
2. Use the Remainder and Factor Theorems to find factors of polynomials.
3. Use polynomial identities to solve problems.

### ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS

Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.
2. Use the structure of an expression to identify ways to rewrite it.
3. Use polynomial and rational expressions to model situations.

### ALGEBRA: REASONING WITH EQUATIONS AND INEQUALITIES

Represent and solve equations and inequalities graphically

1. Understand the relationship between zeros and factors of polynomials.
2. Know and apply the Remainder Theorem.
3. Use polynomial identities to solve problems.
4. Prove polynomial identities and use them to describe numerical relationships.
5. Compare properties of functions.
6. Graph exponential and logarithmic functions.

### NUMBER AND QUANTITY: THE COMPLEX NUMBER SYSTEM

Use complex numbers in polynomial identities and equations

1. Use complex numbers in polynomial identities and equations.
2. Know the Fundamental Theorem of Algebra.

### SCOPE & SEQUENCE

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<th>SUGGESTED PACING</th>
<th>40 DAYS</th>
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<td>Unit 2: 7 days</td>
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<td>Unit 3: 21 days</td>
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<td>Unit 4: 12 days*</td>
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*Note: Unit 4 will be 21 days total and will continue into third quarter

(Extra days allotted for review and various state mandated assessments)
# INSTRUCTIONAL ALIGNMENT

## DIGITAL / PRINT TEXT

### Essential Questions:
- Text: SpringBoard 2014

**Unit 2: Applications of Quadratic Equations (Lessons 12.1-13.2)**
- How can you determine key attributes of a quadratic function from an equation or graph?
- How do graphic, symbolic, and numeric methods of solving quadratic equations compare to one another?

**Unit 3: Polynomials (Lessons 14.1-18.3)**
- How do polynomial functions help to model real-world behavior?
- How do you determine the graph of a polynomial function?

**Unit 4: Series, Exponential, & Logarithmic Functions (Lessons 19.1-23.3)**
- How are functions that grow at a constant rate distinguished from those that do not grow at a constant rate?
- How are logarithmic & exponential equations used to model real-world problems?

## PERFORMANCE TASKS

### Unit 3
**EA1: This Test is Square (p. 265-266)**
- Polynomial functions
- Operations with polynomials
- Graphs of polynomials
- Binomial expansion
- Binomial Theorem

**EA2: Test Artist (p. 291-292)**
- Factoring polynomials
- Graphing polynomial functions

### Unit 4
**EA1: The Chessboard Problem (p. 321-322)**
- Identifying terms in arithmetic and geometric sequences
- Identifying common differences and common ratios
- Writing implicit & explicit rules for arithmetic & geometric sequences
- Identifying and analyzing exponential graphs
- Transforming exponential functions
- Graphing and transforming natural base exponential functions
- Examining common logarithmic functions
- Understanding properties of logarithms

**EA2: Whether or Not (p. 357-358)**
- Examining exponential patterns and functions
- Identifying and analyzing exponential graphs
- Transforming exponential functions
- Graphing and transforming natural base exponential functions
- Examining common logarithmic functions
- Understanding properties of logarithms

**EA3: Evaluating Your Interest (p. 383-384)**
- Solving exponential and logarithmic equations
- Solving real-world applications of exponential & logarithmic functions

## DIFFERENTIATION

### Suggested SpringBoard Strategies to Use:
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Algebra 2 text in the Resources section and see TE Differentiation Instruction boxes for each lesson

### Digital Resources:
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## PREREQUISITE SKILLS

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<th><em>Properties of exponents</em></th>
<th><em>Solving equations</em></th>
<th><em>Writing and graphing functions</em></th>
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## VOCABULARY

### Unit 3:
- Polynomial function, degree, standard form of a polynomial, relative maximum, relative minimum, end behavior, even function, odd function, synthetic division, combination, factorial, summation notation, Fundamental Theorem of Algebra, extrema, relative extrema, global extrema

### Unit 4:
- Sequence, arithmetic sequence, common difference, recursive formula, explicit formula, series, partial sum, sigma notation, geometric sequence, common ratio, geometric series, finite series, infinite series, sum of the infinite geometric series, exponential function, exponential decay factor, exponential growth factor, asymptote, logarithm, common logarithm, logarithmic function, natural logarithm, change of base formula, exponential equation, compound interest, logarithmic equation, extraneous solution

## ASSESSMENTS

- SpringBoard Digital Online Assessments Unit 2, Unit 3 and Unit 4

## ACADEMIC CONNECTIONS

### ELA: Writing; Research to Build and Present Knowledge
- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

### SEL - Relationship Skills: communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help
- Self-Management: goal setting, organizational skills
- Responsible Decision Making: problem-solving, evaluation, reflection

## ADDITIONAL RESOURCES

### Springboard Online:
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### ESL
FUNCTIONS: INTERPRETING FUNCTIONS
Interpret functions that arise in applications in terms of the context
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; and periodicity.
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS
Interpret the structure of expressions
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.
2. Use the structure of an expression to identify ways to rewrite it.

FUNCTIONS: BUILDING FUNCTIONS
Build a function that models a relationship between two quantities
1. Write a function that describes a relationship between two quantities.
   a. Combine standard function types using arithmetic operations.
   b. Compose functions.

ALGEBRA: ARITHMETIC WITH POLYNOMIAL AND RATIONAL EXPRESSIONS
Rewrite rational expressions
6. Rewrite simple rational expressions in different forms; write in the form , where a(x), b(x), g(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
7. Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

FUNCTIONS: LINEAR, QUADRATIC, AND EXPONENTIAL MODELS
Construct and compare linear, quadratic, and exponential models and solve problems
4. For exponential models, express as a logarithm the solution to ab^x = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

ALGEBRA: CREATING EQUATIONS
Create equations that describe numbers or relationships
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.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V=IR to highlight resistance R.

ALGEBRA: REASONING WITH EQUATIONS AND INEQUALITIES
Understand solving equations as a process of reasoning and explain the reasoning
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

FUNCTIONS: ARITHMETIC WITH POLYNOMIAL AND RATIONAL EXPRESSIONS
Rewrite rational expressions
6. Rewrite simple rational expressions in different forms; write in the form , where a(x), b(x), g(x), and r(x) are functions, including step functions and absolute value functions.
7. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

ALGEBRA: INTERPRETING FUNCTIONS
Interpret functions that arise in applications in terms of the context
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; and periodicity.
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

ALGEBRA: SEEING STRUCTURE IN EXPRESSIONS
Interpret the structure of expressions
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.
2. Use the structure of an expression to identify ways to rewrite it.

FUNCTIONS: BUILDING FUNCTIONS
Build a function that models a relationship between two quantities
1. Write a function that describes a relationship between two quantities.
   a. Combine standard function types using arithmetic operations.
   b. Compose functions.

ALGEBRA: ARITHMETIC WITH POLYNOMIAL AND RATIONAL EXPRESSIONS
Rewrite rational expressions
6. Rewrite simple rational expressions in different forms; write in the form , where a(x), b(x), g(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
7. Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

FUNCTIONS: LINEAR, QUADRATIC, AND EXPONENTIAL MODELS
Construct and compare linear, quadratic, and exponential models and solve problems
4. For exponential models, express as a logarithm the solution to ab^x = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
### INSTRUCTIONAL ALIGNMENT

#### Essential Questions:

**Text:** SpringBoard 2014

**Unit 4: Series, Exponential, & Logarithmic Functions** (Lessons 19.1-23.3)

- How are functions that grow at a constant rate distinguished from those that do not grow at a constant rate?
- How are logarithmic and exponential equations used to model real-world problems?

**Unit 5: Radical and Rational Functions** (Lessons 26.1-30.2)

- Why is it important to consider the domain and range of a function?
- How are rational functions useful in everyday life?

**Unit 4 EA2: Whether or Not (p. 357-358)**

- Solving exponential equations
- Solving logarithmic equations
- Solving real-world applications of exponential and logarithmic functions

**Unit 5 EA1: How Big is that Ball (p. 415-416)**

- Square root functions
- Cube roots functions
- Transformations of square root and cube root functions
- Inverses of square root and cube root functions

**Unit 5 EA2: A Condo for my Cat (p. 443-444)**

- Rational functions
- Inverse variation

**Unit 5 EA3: Evaluating Your Interest (p. 383-384)**

- Solving exponential equations
- Solving logarithmic equations
- Solving real-world applications of exponential and logarithmic functions

**Unit 5 EA3: Evaluating Your Interest (p. 383-384)**

- Solving exponential equations
- Solving logarithmic equations
- Solving real-world applications of exponential and logarithmic functions

**Suggested SpringBoard Strategies to Use:**

- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies
- SpringBoard Algebra 2 text in the Resources section and see TE Differentiation Instruction boxes for each lesson

**Digital Resources:**

- www.clevelandmetropolitanoh.springboard.org
- Online Book, Additional Practice Pages, Common Core Correlation, Standards for Mathematical Practices, Mini-Lessons, Additional Getting Ready Practice

### PREREQUISITE SKILLS

**Unit 4:**

- Rewriting radical expressions in equivalent forms
- Finding inverses of functions
- Identifying and analyzing exponential graphs
- Graphing and transforming natural base exponential functions
- Examining common logarithmic functions
- Understanding properties of logarithms

**Unit 5:**

- Simplifying rational expressions
- Writing interval notation
- Determining asymptotic restrictions
- Factoring trinomials and difference of squares binomials

### VOCABULARY

**Unit 4:** sequence, arithmetic sequence, common difference, recursive formula, explicit formula, series, partial sum, sigma notation, geometric sequence, common ratio, geometric series, finite series, infinite series, sum of the infinite geometric series, exponential function, exponential decay factor, exponential growth factor, asymptote, logarithm, common logarithm, logarithmic function, natural logarithm, change of base formula, exponential equation, compound interest, logarithmic equation, extraneous solution

**Unit 5:** square root regression, one-to-one function, rational function, horizontal asymptote, vertical asymptote, inverse variation, constant of variation, combined variation, joint variation, complex fraction, discontinuity, removable point of discontinuity

### ASSESSMENTS

SpringBoard Digital Online Assessments Unit 4 and Unit 5

### ACADEMIC CONNECTIONS

**ELA:** Writing; Research to Build and Present Knowledge

- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL - Relationship Skills:** communication, social engagement, working cooperatively, resolving conflicts, helping seeking help; Self-Management: goal setting, organizational skills; Responsible Decision Making: problem-solving, evaluation, reflection

### ADDITIONAL RESOURCES

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<td>Unit 6: 20 days</td>
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<tr>
<td>Unit 7: 20 Days</td>
<td></td>
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<tr>
<td>(Extra days allotted for review and various state mandated assessments)</td>
<td></td>
</tr>
</tbody>
</table>

**FUNCTIONS: TRIGONOMETRIC FUNCTIONS**

Extend the domain of trigonometric functions using the unit circle
1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

Model periodic phenomena with trigonometric functions
5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

Prove and apply trigonometric identities
8. Prove the Pythagorean identity \( \sin^2(\theta) + \cos^2(\theta) = 1 \) and use it to find \( \sin(\theta) \), \( \cos(\theta) \), or \( \tan(\theta) \), given \( \sin(\theta) \), \( \cos(\theta) \), or \( \tan(\theta) \), and the quadrant of the angle.

**FUNCTIONS: INTERPRETING FUNCTIONS**

Build new functions from existing functions
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.

Analyze functions using different representations
7. Graph functions expressed symbolically and show key features of the graph; by hand in simple cases and using technology for more complicated cases.*

    e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

**FUNCTIONS: BUILDING FUNCTIONS**

Build new functions from existing functions
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.

**STATISTICS AND PROBABILITY: MAKING INFERENCES AND JUSTIFYING CONCLUSIONS**

Understand and evaluate random processes underlying statistical experiments
2. Decide if a specified model is consistent with results from a given data-generating process using simulation.

    For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?

Make inferences and justify conclusions from sample surveys, experiments, and observational studies
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
### Essential Questions:

- What types of real-world problems can be modeled and solved using trigonometry?
- How are trigonometric functions used to model real-world problems?
- What role does a random process play when conducting: 1) a survey; 2) an experiment with two treatments?
- How can a simulation help you decide if a set of data is consistent or inconsistent with a conjecture about the world?

### Unit 6: Trigonometry (Lessons: 31.1-35.1)

- Radian measure
- Unit circle on the coordinate plane
- Special right triangles and the unit circle
- Trigonometric identities

**EA1: A Floral Clock (p. 509-510)**
- Arc length
- Unit circle on the coordinate plane
- Special right triangles and the unit circle
- Trigonometric identities

**EA2: Totally Tires (p. 549-550)**
- Sine and cosine functions
- Translating trigonometric functions
- Trigonometric models of periodic phenomena

### Unit 7: Probability and Statistics (Lessons: 36.1-40.2)

- What are the properties of normal distributions?
- What are the sampling techniques in studies?
- How are the characteristics of experimental studies?
- How are the characteristics of observational studies?

**EA1: Researching Readers (p. 591-592)**
- Properties of normal distributions
- Sampling techniques in studies
- Characteristics of experimental studies
- Characteristics of observational studies

**EA2: Psychic or Just Hot Air (p. 631-632)**
- Simulation of random processes
- Testing the truth of a conjecture
- Statistical significance
- Margin of error

### PREREQUISITE SKILLS

**Unit 6**
- Finding the length of the sides of special right triangles
- Identifying the coordinates of a point
- Determining the circumference of a circle
- Writing a linear function to model a real-world scenario

**Unit 7**
- Constructing data displays
- Shape of data distribution
- Association in bivariate data

### VOCABULARY

**Unit 6**
- Arc length
- Trigonometric identities
- Special right triangles

**Unit 7**
- Density curve
- Z-score
- Normal distribution

### ASSESSMENTS

SpringBoard Digital Online Assessments: Unit 6 and Unit 7

### ACADEMIC CONNECTIONS

**ELA:** Writing; Research to Build and Present Knowledge

- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL:** Relationship Skills: communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help; Self-Management: goal setting, organizational skills; Responsible Decision Making: problem-solving, evaluation, reflection

### ADDITIONAL RESOURCES

- Springboard Online: [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons (instructional support for concepts related to lesson content)

### ESL

### NOTES:
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<th>ADDITIONAL NOTES</th>
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| ADDITIONAL ASSESSMENTS / ACADEMIC CONNECTIONS |
PRE-CALCULUS

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<th>SUGGESTED PACING</th>
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<td>Unit 1: 25 days</td>
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<td>Unit 2: 15 days</td>
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<tr>
<td>(Extra days allotted for review and various state mandated assessments)</td>
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</table>

**NUMBER AND QUANTITY: THE COMPLEX NUMBER SYSTEM**
- Perform arithmetic operations with complex numbers
- 3. Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

**NUMBER AND QUANTITY: VECTOR AND MATRIX QUANTITIES**
- Perform operations on vectors
  - 5a. Multiply a vector by a scalar. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(vx, vy) = (cvx, cvy)$.

**FUNCTIONS: INTERPRETING FUNCTIONS**
- Analyze functions using different representations
  - 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
  - d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

**FUNCTIONS: BUILDING FUNCTIONS**
- Build a function that models a relationship between two quantities
  - 1. Write a function that describes a relationship between two quantities.
  - 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.
- Build new functions from existing functions
  - 4. Find inverse functions.
    - b. Verify by composition that one function is the inverse of another.
    - d. Produce an invertible function from a non-invertible function by restricting the domain.

**PROGRESS MONITORING**
- 25
### Essential Questions:

1. How are recursive relationships used to model and investigate long-term behavior involving sequential change?
2. How are exponential, logarithmic, and power functions used to model real-world problems?
3. How are rational functions used to model real-world problems?

### Performance Tasks

#### Unit 1: Sequences, Series, Exponential, and Logarithmic Functions (Lessons 1.1 – 8.2)

- **EA1: Sequences, The Old Square Craft (p. 45)**
  - Arithmetic sequences and geometric sequences
  - Sums of sequences
- **EA2: Exponential and Logarithmic Functions, Population Explosion (p. 75)**
  - Exponential functions and exponential equations
  - Logarithmic equations
- **EA3: Mathematical Transformations, Compositions, and Inverses, Feeding Frenzy (p. 115)**
  - Transformations
  - Power functions
  - Composition of functions and inverses of functions

#### Unit 2: Polynomial Functions, Coffee Time (p. 155)

- **EA1: Polynomial Functions**
  - Polynomial functions
  - Complex polynomial roots
  - Zeros of polynomial functions
  - Polynomial inequalities
- **EA2: Rational Functions, Taneytown Reunion (p. 183)**
  - Rational functions
  - Graphing rational functions
  - Asymptotes

### Prerequisite Skills

- Calculating simple interest
- Describing and extending patterns
- Factoring quadratic expressions
- Graphing linear equations
- Multiplying and dividing polynomials
- Predicting with scatter plots
- Simplifying monomial expressions
- Simplifying radical expressions
- Solving systems of equations
- Simplifying radical expressions
- Solving quadratic expressions

### Vocabulary

**Unit 1:**
- Sigma notation
- Sequence of partial sums
- Mathematical induction
- Polar grid
- Common ratio
- Series
- nth partial sum
- Infinite sequence
- Infinite series
- Iteration
- Recursive
- Explicit form
- Exponential function
- Interest rate
- Exponential growth factor
- Exponential decay factor
- Half-life
- Logarithm
- Common logarithm
- Strictly monotonic
- Parent function
- Even function
- Odd function
- Composition
- Inverse function

**Unit 2:**
- Relative maximum
- Relative minimum
- Turning points
- Polynomial function
- End behavior
- Increasing
- Decreasing
- Multiplicity
- Multiple root
- Fundamental Theorem of Algebra
- Linear Factorization Theorem
- Rational Root Theorem
- Factor Theorem
- Remainder Theorem
- Descartes’ Rule of Signs
- Complex Conjugate Theorem
- Bounded
- Horizontal asymptote
- Vertical asymptote
- Parameter
- Hole
- Oblique asymptote

### Assessments

- SpringBoard Digital Online Assessments Unit 1 and Unit 2

### Academic Connections

**ELA:** Writing

- Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
- Draw evidence from informational texts to support analysis, reflection, and research.

**SEL:**

- Relationship Skills: communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help
- Self-Management: goal setting, organizational skills
- Responsible Decision Making: problem-solving, evaluation, reflection

### Additional Resources

- Springboard Online: [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)
- Source: eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons (instructional support for concepts related to lesson content)

### ESL

- **NOTES:**
<table>
<thead>
<tr>
<th>FUNCTIONS: BUILDING FUNCTIONS</th>
<th>Build new functions from existing functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Find inverse functions</td>
<td></td>
</tr>
<tr>
<td>c. Read values of an inverse function from a graph or a table, given that the function has an inverse.</td>
<td></td>
</tr>
<tr>
<td>d. Produce an invertible function from a non-invertible function by restricting the domain.</td>
<td></td>
</tr>
</tbody>
</table>

| Unit 3: 26 days               |                                           |
| Unit 4: 19 days              |                                           |
| (Extra days allotted for review and various state mandated assessments) |                                           |

<table>
<thead>
<tr>
<th>FUNCTIONS: TRIGONOMETRIC FUNCTIONS</th>
<th>Extend the domain of trigonometric functions using the unit circle</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–x, π+x, and 2π–x in terms of their values for x, where x is any real number.</td>
<td></td>
</tr>
<tr>
<td>4. Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model periodic phenomena with trigonometric functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.</td>
</tr>
<tr>
<td>7. Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prove and apply trigonometric identities</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.</td>
</tr>
</tbody>
</table>
## Essential Questions:
- What type of real-world problems are modeled and solved using trigonometry?
- How are graphic representations of trigonometric functions useful in understanding real-life phenomena?
- How are algebraic and geometric concepts related to trigonometric identities and formulas?
- How is trigonometry used to solve real-world problems involving measure?

## Performance Tasks

### Unit 3: Angles, the Unit Circle, and Trigonometric Graphs, Orbiting Spacecraft (p. 245)
- Reference angles
- Trigonometric functions

### Unit 4: Trigonometric Identities and Equations, A Quick-Start Guide for Trig (p. 319)
- Trigonometric identities
- Trigonometric equations

## Differentiation

Suggested SpringBoard Strategies to Use:
- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies or SpringBoard Pre-Calculus Text in the Resources Section and SpringBoard Teacher Edition (TE) Individual Instruction Boxes for each lesson

Digital Resources:
- [www.clevelandmetropolitianoh.springboard.org](http://www.clevelandmetropolitianoh.springboard.org)

## Prerequisite Skills

- Explaining functions and their inverses
- Factoring polynomials
- Transformations of functions
- Using right triangle trigonometry
- Using trigonometry
- Writing equations for trigonometric graphs
- Simplifying rational expressions
- Using special right triangle relationships
- Solving for measures in right triangles
- Using trigonometric functions

## Vocabulary

### Unit 3:
- Initial side, terminal side, standard position, coterminal angles, subtend, radian, angular velocity, linear velocity, reference triangle, periodic function, period, amplitude, phase shift, trigonometric functions, sine, unit circle, tangent, cosecant, secant, cotangent, concentric circles, one-to-one function, inverse trigonometric function, reference angle

### Unit 4:
- Identity, Pythagorean identity, trigonometric identity, cofunction identity, sum and difference identities, Law of Cosines, oblique triangle, Law of Sines, ambiguous case (SSA)

## Assessments

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<td>Unit 3: initial side, terminal side, standard position, coterminal angles, subtend, radian, angular velocity, linear velocity, reference triangle, periodic function, period, amplitude, phase shift, trigonometric functions, sine, unit circle, tangent, cosecant, secant, cotangent, concentric circles, one-to-one function, inverse trigonometric function, reference angle</td>
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## Academic Connections

<table>
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<tr>
<th>ELA: Writing; Research to Build and Present Knowledge</th>
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<td>Produce clear &amp; coherent writing in which development, organization, &amp; style are appropriate to task, purpose, &amp; audience. Draw evidence from informational texts to support analysis, reflection, and research.</td>
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## Additional Resources

### Springboard Online:
- [https://clevelandmetropolitianoh.springboardonline.org](https://clevelandmetropolitianoh.springboardonline.org)

### Source:
- eBook Teacher Resources - Additional resources that may be helpful for instruction include the following: 1. Unit Practice (additional problems for each activity); 2. Getting Ready Practice (additional lessons & practice problems for prerequisite skills); 3. Mini-Lessons (instructional support for concepts related to lesson content)

## ESL

## Notes:
### FUNCTIONS: TRIGONOMETRIC FUNCTIONS
- Extend the domain of trigonometric functions using the unit circle.
- Use special triangles to determine geometrically the values of sine, cosine, tangent for \( \pi/3, \pi/4 \) and \( \pi/6 \), and use the unit circle to express the values of sine, cosine, and tangent for \( \pi-x \), \( \pi+x \), and \( 2\pi-x \) in terms of their values for \( x \), where \( x \) is any real number.
- Prove and apply trigonometric identities.
- Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

### NUMBER AND QUANTITY: THE COMPLEX NUMBER SYSTEM
- Represent complex numbers and their operations on the complex plane.
- Represent complex numbers on the complex plane in rectangular and polar form (including real & imaginary numbers), and explain why the rectangular & polar forms of a given complex number represent the same number.
- Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.
- Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

### NUMBER AND QUANTITY: VECTOR AND MATRIX QUANTITIES
- Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., \( \mathbf{v}, |\mathbf{v}|, ||\mathbf{v}||, \mathbf{v} \)).
- Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
- Solve problems involving velocity and other quantities that can be represented by vectors.
- Add and subtract vectors.
  a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
  b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
  c. Understand vector subtraction \( v - w \) as \( v + (-w) \), where \(-w\) is the additive inverse of \( w \), with the same magnitude as \( w \) and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.
- Multiply a vector by a scalar.
  a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as \( c(v_1, v_2) = (cv_1, cv_2) \).
  b. Compute the magnitude of a scalar multiple \( cv \) using \( |cv| = |c| |v| \). Compute the direction of \( cv \) knowing that when \( |v| \neq 0 \), the direction of \( cv \) is either along \( v \) (for \( c > 0 \)) or against \( v \) (for \( c < 0 \)).

### GEOMETRY: EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS
- Translate between the geometric description and the equation for the conic section.
- Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
**Essential Questions:**

- How are algebraic and geometric concepts related to trigonometric identities and formulas?
- How is trigonometry used to solve real-world problems involving measure?

**Unit 5: Conics, Parametric Equations, and Vectors (Lessons 26.1-33.2)**

- How are multiple representations of conic sections related and used to model real-world situations?
- How are parametric equations and vectors used to solve real-world problems involving motion?

**Suggested SpringBoard Strategies to Use:**

- See SpringBoard Digital Online Teacher Resource Link under Learning Strategies or SpringBoard Pre-Calculus Text in the Resources Section and SpringBoard Teacher Edition (TE) Individual Instruction Boxes for each lesson

**PREREQUISITE SKILLS**

- Factoring polynomials
- Solving quadratic equations
- Graphing inverse trigonometric functions
- Writing equations for trigonometric graphs
- Simplifying rational expressions

**VOCABULARY**


**ASSESSMENTS**

- SpringBoard Digital Online Assessments Unit 4 and Unit 5

**ACADEMIC CONNECTIONS**

- ELA: Writing: Research to Build and Present Knowledge: Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience. Draw evidence from informational texts to support analysis, reflection, and research.

**ADDITIONAL RESOURCES**

- Springboard Online: [https://clevelandmetropolitannot.springboardonline.org](https://clevelandmetropolitannot.springboardonline.org)

**ESL NOTES:**

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**INSTRUCTIONAL ALIGNMENT**

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<td></td>
<td>- Law of Cosines</td>
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<td>- Law of Sines/</td>
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<tr>
<td><strong>Unit 5</strong></td>
<td><strong>EA1: Conic Sections and Polar Graphs, Make a Beeline (or a Bee Curve) (p. 409)</strong></td>
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<tr>
<td></td>
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<td>- Conic sections</td>
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<td></td>
<td><strong>EA2: Parametric Equations, A Pirate’s Life (p. 441)</strong></td>
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<td>- Converting with parametric equations</td>
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<td></td>
<td>- Modeling and solving parametric equations</td>
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**Digital Resources:**

- [www.clevelandmetropolitannot.springboard.org](http://www.clevelandmetropolitannot.springboard.org)

Online Book, Additional Practice Pages, Common Core Correlation, Standards for Mathematical Practices, Mini-Lessons, Additional Getting Ready Practice

**NOTES:**
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<th>NUMBER AND QUANTITY: THE COMPLEX NUMBER SYSTEM</th>
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<tbody>
<tr>
<td>40 DAYS</td>
<td>Represent and model with vector quantities.</td>
<td>Represent complex numbers and their operations on the complex plane.</td>
</tr>
<tr>
<td></td>
<td>1. Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., ( \mathbf{v} ), (</td>
<td>\mathbf{v}</td>
</tr>
<tr>
<td></td>
<td>2. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.</td>
<td>5. Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.</td>
</tr>
<tr>
<td></td>
<td>3. Solve problems involving velocity and other quantities that can be represented by vectors.</td>
<td>6. Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.</td>
</tr>
<tr>
<td></td>
<td><strong>Perform operations on vectors.</strong></td>
<td><strong>FUNCTIONS: TRIGONOMETRIC FUNCTIONS</strong></td>
</tr>
<tr>
<td></td>
<td>4. Add and subtract vectors.</td>
<td><strong>Extend the domain of trigonometric functions using the unit circle.</strong></td>
</tr>
<tr>
<td></td>
<td>a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.</td>
<td>3. Use special triangles to determine geometrically the values of sine, cosine, tangent for ( \pi/3 ), ( \pi/4 ) and ( \pi/6 ), and use the unit circle to express the values of sine, cosine, and tangent for ( \pi-x ), ( \pi+x ) and ( 2\pi-x ) in terms of their values for ( x ), where ( x ) is any real number.</td>
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<tr>
<td></td>
<td>b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.</td>
<td><strong>GEOMETRY: EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS</strong></td>
</tr>
<tr>
<td></td>
<td>c. Understand vector subtraction ( \mathbf{v} - \mathbf{w} ) as ( \mathbf{v} + (-\mathbf{w}) ), where (-\mathbf{w}) is the additive inverse of ( \mathbf{w} ), with the same magnitude as ( \mathbf{w} ) and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.</td>
<td><strong>Translate between the geometric description and the equation for a conic section.</strong></td>
</tr>
<tr>
<td></td>
<td>5. Multiply a vector by a scalar.</td>
<td>3. Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.</td>
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<tr>
<td></td>
<td>a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as ( c(\mathbf{v}_x, \mathbf{v}_y) = (cv_x, cv_y) ).</td>
<td><strong>Explain volume formulas and use them to solve problems.</strong></td>
</tr>
<tr>
<td></td>
<td>b. Compute the magnitude of a scalar multiple ( \mathbf{c} ) using (</td>
<td>\mathbf{c}\mathbf{v}</td>
</tr>
<tr>
<td></td>
<td>6. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.</td>
<td><strong>ALGEBRA: REASONING WITH EQUATIONS AND INEQUALITIES</strong></td>
</tr>
<tr>
<td></td>
<td>7. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.</td>
<td>8. Represent a system of linear equations as a single matrix equation in a vector variable.</td>
</tr>
<tr>
<td></td>
<td>8. Add, subtract, and multiply matrices of appropriate dimensions.</td>
<td>9. Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension ( 3 \times 3 ) or greater).</td>
</tr>
<tr>
<td></td>
<td>9. Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.</td>
<td></td>
</tr>
</tbody>
</table>
### Essential Questions:

- How are multiple representations of conic sections related and used to model real-world situations?
- How are parametric equations and vectors used to solve real-world problems involving motion?
- How are matrices used to represent real-world problems in business?
- How can systems of equations be solved using matrix equations and technology?
- How are matrices used to model real-world problems in business?
- How can systems of equations be solved using matrix equations and technology?

### Performance Tasks

#### Unit 5: Conics, Parametric Equations, and Vectors (Lessons 26.1-33.2)

- **EA3:** Complex Numbers and Vectors, Electrifying (p. 481)
  - Complex numbers
  - Vectors

#### Unit 6: Matrices, Systems of Equations, and Volume (Lessons 34.1-37.3)

- **EA1:** Matrices, A Tale of Two Orchards (p. 515)
  - Matrix operations
  - Transformations with matrices

- **EA2:** Matrices and Systems, Let it Snow, Man! (p. 545)
  - Matrices and systems of equations
  - Volume of spheres

### Prerequisite Skills

- Finding volume
- Solving systems of equations in two variables
- Writing equations of lines
- Graphing inverse trigonometric functions
- Solving systems of equations in three variables
- Understanding transformations in the coordinate plane
- Solving quadratic equations
- Using trigonometric functions

### Vocabulary

- Unit 5: identity, Pythagorean identity, trigonometric identity, cofunction identity, sum and difference identities, Law of Cosines, oblique triangle, Law of Sines, ambiguous case (SSA)
- Unit 6: matrix, elements, entries, dimension, order, scalar, determinant, multiplicative inverse, column matrix, row matrix, perpendicular, dilation, matrix equation, coefficient matrix, variable matrix, constant matrix, Cavalieri’s Principle, converse, sphere, annulus, limit

### Assessments

- SpringBoard Digital Online Assessments Unit 5 and Unit 6

### Academic Connections

- **ELA:** Writing: Research to Build and Present Knowledge
  - Produce clear & coherent writing in which development, organization, & style are appropriate to task, purpose, & audience.
  - Draw evidence from informational texts to support analysis, reflection, and research.

- **SEL - Relationship Skills:** communication, social engagement, working cooperatively, resolving conflicts, helping/seeking help;

- **SEL - Self-Management:** goal setting, organizational skills;

- **SEL - Responsible Decision Making:** problem-solving, evaluation, reflection

### Additional Resources

- **Springboard Online:** [https://clevelandmetropolitanoh.springboardonline.org](https://clevelandmetropolitanoh.springboardonline.org)

### Notes:

- SpringBoard Online: Additional resources that may be helpful for instruction include the following: 1. **Unit Practice** (additional problems for each activity); 2. **Getting Ready Practice** (additional lessons & practice problems for prerequisite skills); 3. **Mini-Lessons** (instructional support for concepts related to lesson content)