Course Information

Grade(s):	**8**
Discipline/Course:	**Mathematics / Pre-Algebra 8**
Course Title:	**Pre-Algebra 8**
Prerequisite(s):	**Math 7**
Course Description: *Program of Studies*	In the Pre-Algebra 8 course, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem: 1. Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m \cdot A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation. Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems

	of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems. 2. Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations. 3. Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.
Course Essential Questions:	● How do patterns and functions help us describe data and physical phenomena and solve a variety of problems? ● How are quantitative relationships represented by numbers? ● How do geometric relationships and measurements help us to solve problems and make sense of our world? ● How can collecting, organizing and displaying data help us analyze information and make reasonable and informed decisions?
Course Enduring Understandings:	Insights learned from exploring generalizations through the essential questions. (Students will understand that…) ● Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools, and technologies. ● Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

	● Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools, and technologies. ● Data can be analyzed to make informed decisions using a variety of strategies, tools, and technologies.
Duration:	One Year
Course Materials/Resources:	EdGems Course 3

Grade Eight Standards for Mathematical Practice The K-12 Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. This page gives examples of what the practice standards look like at the specified grade level. Students are expected to:	
Standards	Explanations and Examples
1. Make sense of problems and persevere in solving them.	In grade 8, students solve real world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"
2. Reason abstractly and quantitatively.	In grade 8, students represent a wide variety of real world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.
3. Construct viable arguments and critique the reasoning of others.	In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking.
4. Model with mathematics.	In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.

5. Use appropriate tools strategically.	Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.
6. Attend to precision.	In grade 8, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays.
7. Look for and make use of structure.	Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity
8. Look for and express regularity in repeated reasoning.	In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. During multiple opportunities to solve and model problems, they notice that the slope of a line and rate of change are the same value. Students flexibly make connections between covariance, rates, and representations showing the relationships between quantities.

Academic Expectations The Fairfield Public Schools describe a variety of cross curricular expectations that all students should exemplify during their time within the schooling experience. This page gives examples of what the practice standards look like at the specified grade level. Students are expected to:		
Standards	Explanations	Example
1. Exploring and Understanding [MP1]	When students engage in problem solving situations, they should be able to understand the problem, determine relevant information, and ask relevant additional questions.	Students should be able to answer the following questions when approaching a problem: 1. Do you understand all the words used in stating the problem? 2. What are you asked to find or show? 3. Can you restate the problem in your own words? 4. Can you think of a picture or diagram that might help you understand the problem?
2. Synthesizing and Evaluating	Engaging in a problem solving situation, students should be able to analyze the most efficient approach, and reflect on the process used to solve the problem.	Students should be able to answer the following questions when analyzing how to approach a problem, and also reflect on the result: 1. Is there enough information to enable you to find a solution? If not, what additional information is needed? 2. Are there multiple ways to complete the task? Which approach do you think is most efficient, and why? 3. Do you know a related problem? Look at the unknown and try to think of a familiar problem having the same or similar unknown. Can you use it? 4. Was your strategy effective? What worked? What didn't? 5. Was there another approach that could have been more efficient? 6. Is your answer reasonable? How do you know? 7. Was your presentation approach effective? If not, what would you change? 8. How did the communication tools allow you to get the message across to the intended audience?

3. Creating and Constructing	Engaged in a problem solving situation, students should implement a plan.	Students should be able to answer the following question to implementing their plan to solve a problem: 1. What strategy will you use to complete the task?
4. Conveying Ideas	Students should be able to use correct mathematical language, logically display their work for the desired problem.	Students should be able to answer the following questions to convey their mathematical thinking to solve a problem: 1. How will you present your information to your intended audience? 2. Does your response illustrate the correct terms and work to the problem?
5. Using Communicatio n Tools	Students should be able to choose the correct tools to illustrate their mathematical work to solve a specific problem.	Students should be able to answer the following question to use specific communication tools to solve a problem: 1. If applicable, what communication tools will you use to convey your ideas and solution?
6. Collaborating Strategically	Students should be able to work collaboratively to solve problems.	Students should be able to answer the following question to collaboratively solve problems: 1. In what ways did you work together to help solve the desired problem?

Unit Number and Title:	**Unit 1: Equations**
Resource(s):	Ed Gems Course 3 Unit 1
Learning Goals	
Standard(s):	8.NS.1 (Supporting Standard) Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers, show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. 8.NS.2 (Supporting Standard) Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). 8.EE.2 (Major Standard) Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. 8.EE.7 (Major Standard) Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers). 8.EE.7b (Major Standard) Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
Essential Question(s):	● How can you use mathematical properties to solve one-variable equations? ● How can you identify or create a one-variable equation that has no solution, one solution, or infinitely many solutions?

Enduring Understanding(s):	● One variable equations are the foundation for Algebra and solving them is rooted in mathematical properties (distributive, addition property of equality, multiplication property of equality). ● Linear functions are characterized by a constant rate of change. Reasoning about the similarity of "slope" triangles allows deducing that linear functions have a constant rate of change and a formula of the type $f(x) = mx + b$. ● Exponential functions connect multiplication through addition through the equation $(a^m)(a^n) = a^{m+n}$
Learning Goal(s): *Students will be able to use their learning to:*	1. Solve one- and two-step equations and verify the answer is correct. 2. Simplify and solve multi-step equations. 3. Determine if a linear equation in one variable has no solution, one solution or infinitely many solutions. 4. Recognize perfect squares and perfect cubes and find the values of square roots and cube roots. 5. Use roots to solve equations with exponents. 6. Simplify square roots and cube roots.

Unit Number and Title:	**Unit 2: Pythagorean Theorem**
Resource(s):	Ed Gems Course 3: Unit 2
Learning Goals	
Standard(s):	8.G.6 (Major Standard) Explain a proof of the Pythagorean Theorem and its converse. 8.G.7 (Major Standard) Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. 8.G.8 (Major Standard) Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
Essential Question(s):	● What is the Pythagorean Theorem? ● How do you find the value of a missing side in a right triangle? ● How do you find the distance between two points on a coordinate plane when they dont share the same x or y coordinate?
Enduring Understanding(s):	● The Pythagorean Theorem holds for any right triangle and the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.
Learning Goal(s): *Students will be able to use their learning to:*	1. Use the Pythagorean Theorem to find missing side lengths in right triangles. 2. Apply the Pythagorean Theorem to solve problems in two and three dimensions. 3. Find the distance between two points on a coordinate plane using the Pythagorean Theorem.

Unit Number and Title:	**Unit 3: Proportional Relationships and Slope**
Resource(s):	Edgems Course 3: Unit 3
Learning Goals	
Standard(s):	8.EE.5 (Major Standard) Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. 8.EE.6 (Major Standard) Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b. 8.F.1 (Major Standard) Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
Essential Question(s):	● What is a linear function? ● How can you identify a function from a graph, equation, and table? ● Linear functions are characterized by a constant rate of change. Reasoning about the similarity of "slope" triangles allows deducing that linear functions have a constant rate of change and a formula of the type f(x) = mx + b.
Enduring Understanding(s):	● Functions can be represented in various ways, including through algebraic means (e.g., equations), graphs, word descriptions, and tables. ● Functions are single-valued mappings from one set-the domain of the function- to another- its range. ● A function's rate of change is one of the main characteristics that determine what kinds of real-world phenomena the function can model.
Learning Goal(s):	1. Determine if a given set of data is a function.

Students will be able to use their learning to:	2. Recognize and represent proportional relationships. 3. Use slope triangles to find the slope of lines. 4. Find the slope of a line using the slope formula.

Unit Number and Title:	**Unit 4: Functions**
Resource(s):	Ed Gems Course 3 Unit 4
Learning Goals	
Standard(s):	8.F.2 (Major Standard) Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions) 8.F.3 (Major Standard) Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. 8.F.4 (Major Standard) Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. 8.F.5 (Major Standard) Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. 8.EE.6 (Major Standard) Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y =mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.
Essential Question(s):	● What are features of linear and nonlinear functions? ● How can we graph and write linear functions? ● What are different forms of linear equations?

Enduring Understanding(s):	● Functions are single-valued mappings from one set-the domain of the function- to another- its range. ● A function's rate of change is one of the main characteristics that determine what kinds of real-world phenomena the function can model. ● Linear functions are characterized by a constant rate of change. Reasoning about the similarity of "slope" triangles allows deducing that linear functions have a constant rate of change and a formula of the type $f(x) = mx + b$. ● Functions can be represented in various ways, including through algebraic means (e.g., equations), graphs, word descriptions, and tables.
Learning Goal(s): *Students will be able to use their learning to:*	1. Graph linear equations in slope-intercept form. 2. Write a linear equation for a given graph. 3. Write a linear equation in slope-intercept form when given information about the line. 4. Convert different forms of linear equations to slope-intercept form. 5. Determine if a function is linear or nonlinear. 6. Interpret graphs representing real-world situations.

Unit Number and Title:	**Unit 5: Systems of Equations**
Resource(s):	EdGems Course 3 Unit 5
Learning Goals	
Standard(s):	8.EE.8a (Major Standard) Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. 8.EE.8b (Major Standard) Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. 8.EE.8c (Major Standard) Solve real-world and mathematical problems leading to two linear equations in two variables 8.NS.1 (Major Standard) Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers, show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.
Essential Question(s):	● What do parallel and intersecting lines look like? ● What are the three methods of solving a system of equations? ● How can we utilize systems of equations to solve real world problems?
Enduring Understanding(s):	● Solving a system equation can be done with tables, graphs and equations. ● The different methods to solve a system of equations can be more efficient than others, based on the situation and context.
Learning Goal(s): *Students will be able*	1. Algebraically determine if two lines are parallel, intersecting or the same line. 2. Determine the solution to a system of equations by graphing.

to use their learning to:	3. Determine the solution to a system of equations by using the substitution method. 4. Determine the solution to a system of equations using the elimination method. 5. Set up and solve systems of equations for a real-world situation. 6. Convert repeating decimals to fractions.

Unit Number and Title:	**Unit 6: Angle Relationships**
Resource(s):	EdGems Course 3 Unit 6
Learning Goals	
Standard(s):	8.G.5 (Major Standard) Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. 8.EE.6 (Major Standard) Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.
Essential Question(s):	● What relationships do angles form? ● What is the sum of three interior angles of a triangle? ● What is the relationship between interior and exterior angles of triangles?
Enduring Understanding(s):	● Geometric thinking involves developing, attending to, and learning how to work with imagery.
Learning Goal(s): *Students will be able to use their learning to:*	1. Apply properties of angle pairs including alternate exterior and alternate interior angles 2. Apply properties of corresponding and same-side interior angles 3. Classify triangles and find angle measures in a triangle 4. Determine if triangles are similar or congruent and find missing measures 5. Special angle relationships to find angle measures

Unit Number and Title:	**Unit 7: Transformations**
Resource(s):	EdGems Course 3 Unit 7
Learning Goals	
Standard(s):	8.G.1 (Major Standard) Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines. 8.G.2 (Major Standard) Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. 8.G.3 (Major Standard) Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. 8.G.4 (Major Standard) Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
Essential Question(s):	● What are different ways you can transform a shape? ● How can you describe transformations? ● How can you prove when shapes are congruent? Similar ?
Enduring Understanding(s):	● Geometric thinking involves developing, attending to, and learning how to work with imagery. ● Decomposing and rearranging provide a geometric way of both seeing that a measurement formula is the right one and seeing why it is the right one. ● Symmetry provides a powerful way of working geometrically.

Learning Goal(s): *Students will be able to use their learning to:*	1. Reflect an image on a coordinate plane. 2. Translate an image on a coordinate plane. 3. Rotate an image on a coordinate plane 4. Dilate an image on a coordinate plane 5. Perform multiple transformations on a figure and prove if figures are congruent or similar using transformation

Unit Number and Title:	**Unit 8: Exponent Properties**
Resource(s):	EdGems Course 3 Unit 8
Learning Goals	
Standard(s):	8.EE.1 (Major Standard) Know and apply the properties of integer exponents to generate equivalent numerical expressions 8.EE.3 (Major Standard) Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. 8.EE.4 (Major Standard) Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology
Essential Question(s):	● What are properties of exponents? ● How do 0 or negative exponents affect an expression? ● How do we write numbers in scientific notation form? ● How can we perform operations with numbers expressed in scientific notation?
Enduring Understanding(s):	● Rational numbers can be represented in multiple ways and are useful when examining situations involving numbers that are not whole.
Learning Goal(s): *Students will be able to use their learning to:*	● Use properties of exponents to simplify expressions involving multiplication ● Use properties of exponents to simplify expressions involving division. ● Express numbers in scientific notation and standard notation ● Compute with numbers in scientific notation

Unit Number and Title:	**Unit 9: Volume**
Resource(s):	EdGems Course 3 Unit 9
Learning Goals	
Standard(s):	8.G.9 (Additional Standard) Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
Essential Question(s):	● Which formulas can be used to find volume? ● How can we find missing dimensions of a 3D shape when given the volume?
Enduring Understanding(s):	● Spatial sense and geometric relationships are a means to solve problems and make sense of a variety of phenomena.
Learning Goal(s): *Students will be able to use their learning to:*	1. Find the volume of cylinders and solve real-world problems involving cylinders. 2. Find the volume of cones and solve real-world problems involving cones 3. Find the volume of spheres and solve real-world problems involving spheres.

Unit Number and Title:	**Unit 10: Bivariate Data**
Resource(s):	EdGems Course 3 Unit 10
Learning Goals	
Standard(s):	8.SP.1 (Supporting Standard) Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. 8.SP.2 (Supporting Standard) Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. 8.SP.3 (Supporting Standard) Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. 8.SP.4 (Supporting Standard) Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.
Essential Question(s):	● How do you create a scatter plot? ● Can data be associated with linear or nonlinear equations? ● Can we make predictions from data associations?
Enduring Understanding(s):	● Reading, understanding, interpreting, and communicating data are critical in modeling a variety of real-world situations, drawing appropriate inferences, making informed decisions, and justifying those decisions.

	● The message conveyed by the data depends on how the data is collected, represented, and summarized. ● The results of a statistical investigation can be used to support or refute an argument.
Learning Goal(s): *Students will be able to use their learning to:*	1. Read, create and describe the associations in scatter plots. 2. Draw a line of best fit for a set of data and use the line of best fit to make predictions. 3. Write an equation for a line of best fit and use the equation to make predictions. 4. Describe associations between two sets of data using relative and conditional frequencies