Readington Township Public Schools

Pre-Algebra

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I. OVERVIEW

This Pre-Algebra course is the mathematics class for eighth graders working on grade level. It is also the course for the Advanced 7th grade students, placed into the course by district criteria. This course is directly aligned with the Common Core State Standards ("CCSS") for grade 8. Through their work in this course, students will understand and apply their knowledge in real world applications. Focus will be on the content as specified in the CCSS, as well as the CCSS Practice Standards. The Practice Standards focus on the development of competencies used by mathematicians in all grades and throughout life.

Students in this course will understand slope of a linear relationship and relate linear equations to lines in the coordinate plane. They will write and solve linear equations, including pairs of linear equations. Students will understand that functions are rules that assign a unique output number to each input number. They will then use linear functions to model relationships. Students will analyze statistical relationships and use lines of best-fit to determine future outcomes in real-life situations. Students will work with positive and negative exponents, square root and cube root symbols, and scientific notation. They will understand congruence and similarity of geometric figures.

II. STUDENT OUTCOMES (Link to New Jersey Core Curriculum Standards/Common Core Mathematics)

THE NUMBER SYSTEM (8.NS)

Know that there are numbers that are not rational, and approximate them by rational numbers.

1. 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.

2. 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).

EXPRESSIONS AN EQUATIONS (8.EE)

Work with radicals and integer exponents.

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions.

2. 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.

3. 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.

4. 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.

Understand the connections between proportional relationships, lines, and linear equations.

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
6. 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*.

Analyze and solve linear equations and pairs of simultaneous linear equations.

7. Solve linear equations in one variable.
   a. 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).
   b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8. Analyze and solve pairs of simultaneous linear equations.
   a. 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.
   b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.
   c. Solve real-world and mathematical problems leading to two linear equations in two variables.

FUNCTIONS (8.F)

Define, evaluate, and compare functions.

1. 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.

2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

3. 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.

Use functions to model relationships between quantities.

4. 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.

5. 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.

GEOMETRY (8.G)

Understand congruence and similarity using physical models, transparencies, or geometry software.

1. 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.

2. 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.

3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

4. 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.

5. 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.

Understand and apply the Pythagorean Theorem.

6. Explain a proof of the Pythagorean Theorem and its converse.

7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

STATISTICS AND PROBABILITY (8.SP)

Investigate patterns of association in bivariate data.

1. 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.

2. 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.

3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

4. 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 two variables.

III. ESSENTIAL QUESTIONS AND CONTENT

Unit 1 Linear Equations

What are the characteristics of a linear equation, and how is a linear equation graph constructed using a table of values?
How can I write different types of equations to represent different equations or systems of equations?
How do I solve problems involving linear equations?

Unit 2 Functions, Exponents, and Scientific Notation

What are the different ways you can represent a function?
How can a pattern in real life be recognized as linear or non-linear?

How can graphs be used to represent relationships between quantities without using numbers?
How can exponents be used to write numbers?
How can operations be performed on numbers in scientific notation?

Unit 3 Transformations, Angles, and Triangles
What are the three basic ways to move an object in a plane?
How can proportions be used to make decisions in art, design, and magazine layouts?
How does changing the dimensions of similar geometric figures affect the perimeters and areas of the similar figures?
How can I use what I know about geometry to create, describe, or measure geometric figures?

Unit 4 Data Analysis and Volume of Solid Figures
How can data be used to predict an event?
What is the best way to display data to aid in decision making?
How can I solve real-life problems related to finding the volume of a three-dimensional shape?

IV. STRATEGIES

The curriculum will be instructed through a variety of strategies, based in research on middle school learning and educational best practices. Students will be engaged in meaningful lessons and activities using guided and independent practice and cooperative learning. Students will participate in hands-on activities, use manipulatives or technology where appropriate, and participate actively in class discussions.

Teachers will encourage students to employ a number of problem solving strategies, relevant to the situations they are in. They will demonstrate evidence of understanding through modeling, verbal descriptions and oral presentations. Students may also use tools of technology where needed to better enhance their ability to complete and defend their mathematical reasoning.

V. EVALUATION

Teacher observations
Homework assignments
Notebooks
Student projects
Unit tests and quizzes
Benchmark unit assessments
Performance based assessments

VI. REQUIRED RESOURCES

Big Ideas Math 7 textbook (Ron Larson and Laurie Boswell; published by Big Ideas Learning)
Record and Practice Journal

The following resources can also be used as reference, or may be used by the course instructor.
Project Based Assignment Resources – Including:
Illustrative Mathematics (www.illustratviemathematics.org)
The MAP Project (www.map.mathshell.org/materials/index.php)

VII. SCOPE AND SEQUENCE

Unit 1 Linear Equations
Equations (15 days)

1. Solving Simple Equations
2. Solving Multi-Step Equations

3. Solving Equations with Variables on Both Sides
4. Rewriting Equations and Formulas

Graphing and Writing Linear Equations (20 days)
1. Graphing Linear Equations
2. Slope of a Line
3. Graphing Proportional Relationships
4. Graphing Linear Equations in Slope-Intercept Form
5. Graphing Linear Equations in Standard Form
6. Writing Equations in Slope-Intercept Form
7. Writing Equations in Point-Slope Form

Systems of Linear Equations (20 days)
1. Solving Systems of Linear Equations by Graphing
2. Solving Systems of Linear Equations by Substitution
3. Solving Systems of Linear Equations by Elimination
4. Solving Special Systems of Linear Equations

Unit 2 Functions, Exponents, and Scientific Notation

Functions (15 days)
1. Relations and Functions
2. Representations of Functions
3. Linear Functions
4. Comparing Linear and Nonlinear Functions
5. Analyzing and Sketching Graphs

Exponents and Scientific Notation (20 days)
1. Exponents
2. Product of Powers Property
3. Quotient of Powers Property
4. Zero and Negative Exponents
5. Reading Scientific Notation
6. Writing Scientific Notation
7. Operations in Scientific Notation

Unit 3 Transformations, Angles, and Triangles

Transformations (15 days)
1. Congruent Figures
2. Translations
3. Reflections
4. Rotations
5. Similar Figures
6. Perimeters and Areas of Similar Figures
7. Dilations

Angles and Triangles (15 days)
1. Parallel Lines and Transversals
2. Angles of Triangles
3. Angles of Polygons
4. Using Similar Triangles

Real Numbers and the Pythagorean Theorem (15 days)

1. Finding Square Roots
2. Finding Cube Roots
3. The Pythagorean Theorem
4. Approximating Square Roots/Repeating Decimals
5. Using the Pythagorean Theorem

Unit 4 Data Analysis and volume of Solid Figures

Data Analysis and Displays (10 days)

1. Scatter Plots
2. Lines of Fit
3. Two-Way Tables
4. Choosing a Data Display

Volume and Similar Solids (15 days)

1. Volumes of Cylinders
2. Volumes of Cones
3. Volumes of Spheres
4. Surface Areas and Volumes of Similar Solids

Unit 5 Project Based Learning

Students will complete a number of projects to review and/or extend topics covered in this course and/or preview topics in the course which follows. Projects will vary in duration and form, and will be based on real-world situations and examples. Students will be required to apply and extend learning through their responses, calculations and/or presentations.