



# Bedford Public Schools

## Grade 8 – Pre-Algebra

In Grade 8 Pre-Algebra, 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.

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.



### Learning Expectations

[The Number System](#)

[Functions](#)

[Geometry](#)

[Statistics and Probability](#)

[Expressions and Equations](#)

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.

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.



### **Learning Expectations**

[The Number System](#)

[Functions](#)

[Geometry](#)

[Statistics and Probability](#)

[Expressions and Equations](#)

The Number System

<p><b>Enduring Understandings</b> In order to meet the standards, the students will need to understand that . . .</p>	<p><b>Essential Questions</b> In order to understand, students will need to consider questions such as . . .</p>	<p><b>Knowledge and Skills</b> Learning this material will require students to . . .</p>	<p><b>Standards and Assessments</b></p>
<p><b>Know that there are numbers that are not rational, and approximate them by rational numbers.</b></p> <ul style="list-style-type: none"> <li>Mathematicians look for patterns and represent them with rules.</li> <li>In order to evaluate numerical expressions, you must use order of operations.</li> <li>Integers represent real world situations involving gains and losses.</li> <li>You can use the Commutative, Associative, and Distributive properties to evaluate expressions</li> <li>Variables are representations of unknown values.</li> <li>An estimation can be as useful as an exact number</li> <li>Rational numbers can be written in different forms</li> </ul>	<ul style="list-style-type: none"> <li>How does the number system apply to algebra?</li> <li>How can rational numbers be written in different forms?</li> <li>How can we estimate the value of expressions?</li> <li>Why do I need order of operations?</li> <li>What are the properties of real numbers?</li> <li>How can you use integers to represent real world situations?</li> <li>What sort of real-world situations can be represented by mathematical equations?</li> <li>What are the benefits of writing large numbers using scientific notation?</li> </ul>	<p><i>Chapter 1</i></p> <ul style="list-style-type: none"> <li>Use Order of Operations to simplify</li> <li>Evaluate expressions with powers</li> <li>Write and solve equations using mental math</li> <li>Use formulas to find unknown values</li> </ul> <p><i>Chapter 2</i></p> <ul style="list-style-type: none"> <li>Find absolute value</li> <li>Add, subtract, multiply, and divide integers</li> <li>Use properties to evaluate expressions</li> <li>Use the distributive property</li> <li>Identify and plot points in a coordinate plane</li> </ul> <p><i>Chapter 9</i></p> <ul style="list-style-type: none"> <li>Understand and simplify square root</li> <li>Classify real numbers</li> <li>Define irrational numbers</li> <li>Use rational approximations to describe irrational numbers</li> <li>Compare and order real numbers</li> <li>Apply square roots to solving problems using the Pythagorean Theorem</li> <li>Understand and simplify cube roots</li> </ul>	<ul style="list-style-type: none"> <li><i>Chapter 1 (Variables and Equations) Test (support for future lessons)</i></li> <li><i>Chapter 2 (Integers) Test (support for future lessons)</i></li> <li><i>Chapter 9 (Real Numbers and Right Triangles, Cube Roots) Test 8.NS.1, 8.NS.2</i></li> </ul>

## Functions

Enduring Understandings In order to meet the standards, the students will need to understand that . . .	Essential Questions In order to understand, students will need to consider questions such as . . .	Knowledge and Skills Learning this material will require students to . . .	Standards and Assessments
<p><b>Use functions to model relationships between quantities.</b></p> <p><b>Define, evaluate, and compare functions.</b></p> <ul style="list-style-type: none"> <li>• A function is a relationship pairing each input value with exactly one output value.</li> <li>• Relations and functions can be numerically, graphically, algebraically and verbally.</li> <li>• The value of one variable may be uniquely determined by the value of another variable.</li> <li>• Linear functions represent situations with a constant rate of change.</li> <li>• Non-linear functions have a graph that is not a line or part of a line.</li> <li>• Many real-world functional relationships can be represented by equations.</li> </ul>	<ul style="list-style-type: none"> <li>• Why are relations and functions represented in multiple ways?</li> <li>• How do the application of patterns and functions support algebraic thinking?</li> <li>• How are the properties of functions useful?</li> <li>• How can you use functions to model real-world situations?</li> </ul>	<p><i>Chapter 11</i></p> <ul style="list-style-type: none"> <li>• Understand that a function is a rule that assigns to each input exactly one output.</li> <li>• A graph of a function is the set of ordered pairs</li> <li>• Represent functions algebraically, graphically, numerically and with a verbal description</li> <li>• Understand how to find and use the x- and y-intercepts of a linear function</li> <li>• Interpret and use <math>y = mx + b</math></li> <li>• Determine rate of change using two points, a graph or an equation</li> <li>• Understand what values the slope and y-intercept represent in the real world</li> <li>• Be able to distinguish between linear and nonlinear functions by looking at graphs, equations or tables</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Chapter 11 [11.1-11.7] (Linear Equations and Graphs) Test</i> 8.F.1, 8.F.2, 8.F.3, 8.F.4, 8.F.5</li> </ul>

## Geometry

<b>Enduring Understandings</b> In order to meet the standards, the students will need to understand that . . .	<b>Essential Questions</b> In order to understand, students will need to consider questions such as . . .	<b>Knowledge and Skills</b> Learning this material will require students to . . .	<b>Standards and Assessment</b>
<p><b>Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.</b></p> <p><b>Understand and apply the Pythagorean Theorem.</b></p> <p><b>Understand congruence and similarity using physical models, transparencies, or geometry software.</b></p> <ul style="list-style-type: none"> <li>• All constructions are based on properties of geometric figures</li> <li>• Two and three dimensional objects can be described, classified, and analyzed by their attributes</li> <li>• Geometry and spatial sense offer ways to visualize, to interpret, and to reflect on our physical environment</li> <li>• You can indirectly measure a distance using the Pythagorean</li> <li>• The Pythagorean Theorem has extensive real-world applications, many involving distance</li> <li>• Similarity is an instance of proportionality</li> <li>• Mathematicians use algebra to explore geometric concepts</li> </ul>	<ul style="list-style-type: none"> <li>• What are characteristics and applications of symmetry?</li> <li>• How do we describe, sort, and classify shapes?</li> <li>• How are shapes related to one another?</li> <li>• How do we recognize and apply transformations of shapes to solve problems?</li> <li>• When does a figure have a line of symmetry?</li> </ul>	<p><i>Chapter 8</i></p> <ul style="list-style-type: none"> <li>• Establish facts about and identify the angles created when parallel lines are cut by a transversal</li> <li>• Classify angles</li> <li>• Classify triangles</li> <li>• Classify quadrilaterals</li> <li>• Calculate angles measures in polygons</li> <li>• Identify and name congruent polygons</li> <li>• Reflect figures</li> <li>• Identify lines of symmetry</li> <li>• Translate figures in a coordinate plane</li> <li>• Rotate figures in a coordinate plane</li> <li>• Use similar polygons to find missing measures</li> </ul> <p><i>Chapter 9</i></p> <ul style="list-style-type: none"> <li>• Find square roots of numbers</li> <li>• Approximate square roots of numbers</li> <li>• Work with irrational numbers</li> <li>• Use the Pythagorean Theorem to solve problems</li> <li>• Solve real-world problems using</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Chapter 8 (Polygons and Transformations) Test</i> 8.G.1, 8.G.2, 8.G.3, 8.G.4, 8.G.5</li> <li>• <i>Chapter 9 (Real Numbers and Right Triangles) Test</i> 8.G.6, 8.G.7, 8.G.8, 8.G.9</li> <li>• <i>Formula Sheet Test (lessons 3.5 &amp; 6.4)</i> 8.G.9</li> <li>• <i>Chapter 10 (Measurement, Area, and Volume) Test*</i></li> </ul>

<p><b>Enduring Understandings</b> In order to meet the standards, the students will need to understand that . . .</p>	<p><b>Essential Questions</b> In order to understand, students will need to consider questions such as . . .</p>	<p><b>Knowledge and Skills</b> Learning this material will require students to . . .</p>	<p><b>Standards and Assessment</b></p>
		<p>the Pythagorean Theorem</p> <ul style="list-style-type: none"> <li>• Use special right triangles to solve real-life problems</li> </ul> <p><i>Chapter 10</i></p> <ul style="list-style-type: none"> <li>• Find areas of parallelograms and trapezoids</li> <li>• Find areas of circles</li> <li>• Classify and sketch solids</li> <li>• Find surface areas of prisms and cylinders</li> <li>• Find surface areas of pyramids and cones</li> <li>• Find volumes of prisms and cylinders</li> <li>• Find volumes of pyramids and cones</li> </ul>	

### Statistics and Probability

Enduring Understandings In order to meet the standards, the students will need to understand that . . .	Essential Questions In order to understand, students will need to consider questions such as . . .	Knowledge and Skills Learning this material will require students to . . .	Standards and Assessments
<p><b>Investigate patterns of association in bivariate data.</b></p> <ul style="list-style-type: none"> <li>The way that data is collected, organized, and displayed influences interpretation.</li> <li>Patterns and relationships can be represented numerically, graphically, symbolically, and verbally.</li> <li>Data representations can give information on data.</li> <li>All data and statistics are biased. Data can be biased by many different elements, including questions and sampling methods. Bias comes from many different sources, and is inherent in human work.</li> <li>Some ways of representing data are more effective than others for different data and/or results.</li> <li>Actual outcomes may not match mathematically predicted outcomes.</li> <li>Probability explains how things will tend to act over many trials.</li> <li>Events can be dependent or independent of each other. Some will</li> </ul>	<ul style="list-style-type: none"> <li>How can graphs be used to examine data?</li> <li>What is strength of association between two variables?</li> <li>What are different methods by which data can be displayed?</li> <li>Why does the world not conform to probability all of the time?</li> <li>What does it mean for a game to be fair?</li> <li>How are measures of central tendency used?</li> <li>How do people use data to influence others?</li> </ul>	<p><i>Chapter 11</i></p> <ul style="list-style-type: none"> <li>Construct and Interpret Scatter Plots</li> <li>Describe patterns using linear relationships</li> <li>Describe Positive and Negative Correlation</li> <li>Describe nonlinear association</li> <li>Know that straight lines are used to model relationships</li> <li>Use linear equations to solve problems</li> <li>Interpret slope and intercept</li> </ul> <p><i>Chapter 12</i></p> <ul style="list-style-type: none"> <li>Interpret stem-and-leaf plots</li> <li>Interpret Box-and-Whisker plots</li> <li>Understand Outliers</li> <li>Use Data Displays to organize information</li> <li>Identify and analyze misleading graphs</li> </ul> <p><i>What Do You Expect?</i></p> <ul style="list-style-type: none"> <li>Use measures of central tendency to describe data</li> </ul>	<ul style="list-style-type: none"> <li><i>Chapter 11 (Linear Equations and Graphs) Test</i> 8.SP.1, 8.SP.2, 8.SP.3</li> <li><i>Chapter 12 (Data Analysis) Test</i> 8.SP.4</li> <li><i>What do You Expect (Probability) Test</i> 8.SP.1</li> </ul>

<b>Enduring Understandings</b> In order to meet the standards, the students will need to understand that . . .	<b>Essential Questions</b> In order to understand, students will need to consider questions such as . . .	<b>Knowledge and Skills</b> Learning this material will require students to . . .	<b>Standards and Assessments</b>
<p>only happen if another happens first.</p> <p>Some may happen anyway.</p> <ul style="list-style-type: none"> <li>• Events can be equally likely or not equally likely, but with appropriate data the probability of each type can be found.</li> <li>• Probability can be represented in many ways.</li> <li>• Not all games are fair.</li> </ul>			

## Expressions and Equations

<b>Enduring Understandings</b> In order to meet the standards, the students will need to understand that . . .	<b>Essential Questions</b> In order to understand, students will need to consider questions such as . . .	<b>Knowledge and Skills</b> Learning this material will require students to . . .	<b>Standards and Assessments</b>
<p><b>Analyze and solve linear equations and pairs of simultaneous linear equations.</b></p> <p><b>Understand the connections between proportional relationships, lines, and linear equations.</b></p> <ul style="list-style-type: none"> <li>• Inverse operations are used to simplify equations.</li> <li>• Rules of exponents are applied to simplify expressions and equations.</li> <li>• Equivalent expressions and equations can be generated.</li> <li>• Very large and very small numbers can be expressed as a product of a power of 10.</li> <li>• Two proportional relationships can be compared using a system of equations.</li> <li>• Equations can have no solution, one solution or multiple solutions.</li> <li>• Real world problems can be analyzed or solved using an expression or equation.</li> <li>• Expressions and equations can be represented in an infinite number of ways and have the same value.</li> </ul>	<ul style="list-style-type: none"> <li>• How does a pattern and its graph relate?</li> <li>• What does it mean when a graph of a real world situation is a line?</li> <li>• How do lines convey information?</li> <li>• What is the most efficient or effective way to solve equations with one or more variables?</li> <li>• How does a linear equation represent real-life and mathematical information?</li> <li>• Why are we able to use multiple methods to solve equations?</li> <li>• What is the meaning of rate of change?</li> <li>• What are the laws of exponents and how can we prove them?</li> <li>• How do you translate verbal sentences into Algebraic expressions?</li> <li>• How is math a language?</li> <li>• How do you represent</li> </ul>	<p><i>Chapter 1</i></p> <ul style="list-style-type: none"> <li>• Use order of operations to simplify expressions</li> <li>• Evaluate algebraic expressions using substitution</li> </ul> <p><i>Chapter 3 &amp; 6.1-6.4</i></p> <ul style="list-style-type: none"> <li>• Use inverse operations to solve one-, two- and multi-step equations</li> <li>• Apply Properties such as Associative, Commutative and Distributive to simplify equations</li> <li>• Rewrite equations into equivalent forms</li> <li>• Recognize equations can have one solution, infinite solutions or no solutions</li> </ul> <p><i>Chapter 4</i></p> <ul style="list-style-type: none"> <li>• Use Properties of integer exponents to simplify expressions</li> <li>• Perform operations with numbers written in scientific notation</li> </ul> <p><i>Chapter 7</i></p> <ul style="list-style-type: none"> <li>• Calculate unit rates</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Chapter 1 (Variables and Equations) Test</i> 8.EE.1, 8.EE.7</li> <li>• <i>Chapter 3 &amp; 6.1-6.4 (Solving Equations) Test</i> 8.EE.7</li> <li>• <i>Chapter 4 (Exponents) Test</i> 8.EE.1, 8.EE.3, 8.EE.4</li> <li>• <i>Chapter 7 (Ratio, Proportion, Percent) Test</i> 8.EE.5</li> <li>• <i>Chapter 9 (Real Numbers and Right Triangles) Test</i> 8.EE.1, 8.EE.2</li> <li>• <i>Chapter 11 (Linear Equations and Graphs) Test and Systems of Linear Equations Test</i> 8.EE.6, 8.EE.7, 8.EE.8</li> </ul>

<b>Enduring Understandings</b> In order to meet the standards, the students will need to understand that . . .	<b>Essential Questions</b> In order to understand, students will need to consider questions such as . . .	<b>Knowledge and Skills</b> Learning this material will require students to . . .	<b>Standards and Assessments</b>
<ul style="list-style-type: none"> <li>Many different real-world situations can be represented using linear models.</li> </ul>	<p>numbers and their relationships to each other?</p> <ul style="list-style-type: none"> <li>How are variables and constants in equations reflected in real life problems?</li> </ul>	<ul style="list-style-type: none"> <li>Calculate a missing side length using proportional relationships</li> </ul> <p><i>Chapter 9</i></p> <ul style="list-style-type: none"> <li>Know and apply the properties of integer exponents to generate equivalent expressions.</li> <li>Use square root and cube root symbols to represent solutions to equations.</li> </ul> <p><i>Chapter 11</i></p> <ul style="list-style-type: none"> <li>Know linear equations can have one solution, infinite solutions, or no solutions</li> <li>Transform equations into simpler forms</li> <li>Derive the equation <math>y = mx + b</math></li> <li>Graph proportional relationships</li> <li>Interpret unit rate as slope</li> <li>Compare two different proportional relationships represented in different ways</li> <li>Understand the point of intersection is the solution to a linear system</li> <li>Solve systems of equations algebraically and by graphing</li> </ul>	