TRUMBULL PUBLIC SCHOOLS

Trumbull, Connecticut

PRE-ALGEBRA

Grades 6-10
Mathematics Department

2016

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Pre-Algebra
Table of Contents

The Trumbull Board of Education will continue to take Affirmative Action to ensure that no persons are discriminated against in its employment.

CORE VALUES AND BELIEFS

The Trumbull School Community engages in an environment conducive to learning which believes that all students will **read** and **write effectively**, therefore communicating in an articulate and coherent manner. All students will participate in activities **that present problem-solving through critical thinking**. Students will use technology as a tool applying it to decision making. We believe that by fostering self-confidence, self-directed and student-centered activities, we will promote **independent thinkers and learners**. We believe **ethical conduct** to be paramount in sustaining the welcoming school climate that we presently enjoy.

Approved 8/26/2011

INTRODUCTION & PHILOSOPHY

Pre-Algebra is a prerequisite for Algebra I. The course objective is for students to master the mathematical skills and understanding to be prepared for both Algebra I and higher-level mathematics. In Pre-Algebra, students will reason and think analytically to make and investigate mathematical conjectures, as well as to be able to express their understandings orally, in writing, and with models. The focus areas of Pre-Algebra are designed to help students gain a strong mathematical foundation, a high degree of procedural skill and fluency, and a deepening understanding of the connections of mathematical ideas to one another and to real-world applications of those ideas.

The textbook *Math Accelerated: A Pre-Algebra Program* offers students problems at varying levels of complexity in order to introduce, reinforce, and extend upon topics necessary for student success. This curriculum guide has been updated to reflect new textbook and online resources available for pre-algebra support.

Pre-Algebra is offered at both Hillcrest and Madison Middle Schools for students whose performance suggests that they are cognitively ready to attain the standards.

COURSE GOALS

Pre-Algebra takes a balanced instructional approach to promote the understanding of important mathematical concepts, skills, procedures, and ways of thinking and reasoning.

The following course goals derive from the 2010 Connecticut Core Standards for Mathematical Content.

7.RP Ratios and Proportional Relationships
Analyze proportional relationships and use them to solve real-world and mathematical problems.

7.NS The Number System
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

7.EE Expressions and Equations

Use properties of operations to generate equivalent expressions. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

7.G Geometry

Draw, construct, and describe geometrical figures and describe the relationships between them. Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

7.SP Statistics and Probability

Use random sampling to draw inferences about a population. Draw informal comparative inferences about two populations. Investigate chance processes and develop, use, and evaluate probability models.

8.NS The Number System

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

8.EE Expressions and Equations

Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations. Analyze and solve linear equations and pairs of simultaneous linear equations.

8.G Geometry

Understand congruence and similarity using physical models, transparencies, or geometry software. Understand and apply the Pythagorean Theorem. Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

The following course goals derive from the 2010 Connecticut Core Standards for Mathematical Practices, which describe varieties of expertise that all teachers of mathematics will develop in their students. These practices rest on important "processes and proficiencies" that have long been valued in mathematics education.

1. Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary.

2. Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is.

4. Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.

Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and the tools' limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, expressing numerical answers with a degree of precision appropriate for the problem context. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects.

8. Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

The following course goals derive from the 2014 International Society for Technology in Education Standards.

1. Creativity and Innovation – Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
2. Communication and Collaboration – Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
3. Research and Information Fluency – Students apply digital tools to gather, evaluate, and use information.
4. Critical Thinking, Problem Solving, and Decision Making – Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
5. Digital Citizenship – Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

COURSE ENDURING UNDERSTANDINGS

Students will understand that . . .

- mathematics is a language consisting of symbols and rules.
- rules of arithmetic and algebra can be used together, with the concept of equivalence, to transform equations and inequalities so solutions to problems can be found.
- proportional relationships express how quantities change in relation to each other.
- data analysis and probability skills can help one make more informed decisions about real-life problems.

COURSE ESSENTIAL QUESTIONS

- How can I use numbers and symbols to represent mathematical ideas?
- What happens when I add, subtract, multiply, and divide rational numbers?
- How are equations and inequalities used to describe and solve multi-step problems?
- How can I identify, represent, and use proportional relationships to solve real-world problems?
- How are statistics used to draw inferences about and compare populations?

COURSE KNOWLEDGE & SKILLS

Students will understand . . .

- the key vocabulary of pre-algebraic mathematics:
    - four-step plan, numerical expression, evaluate, order of operations, algebra, variable, algebraic expression, defining a variable, substitution property of equality, properties, simplify, deductive reasoning, inductive reasoning, counterexample, coordinate plane, ordered pair, x-coordinate, y-coordinate, origin, quadrant, equation, integer, opposites, inequality, absolute value, additive inverse, repeating decimal, terminating decimal, rational numbers, multiplicative inverse, reciprocal, exponent, power, base, monomial, standard form, scientific notation, square root, perfect square, radical sign, cube root, perfect cube, irrational number, real numbers, equivalent expressions, distributive property, term, coefficient, like terms, constant, simplest form, linear expression, factor, solution, inverse operations, equivalent equations, two-step equation, identity, null or empty set (Unit 1);
    - ratio, rate, unit rate, complex fraction, proportional, constant of proportionality, nonproportional, proportion, cross products, scale, scale drawing, scale model, scale factor, similar figures, congruent, corresponding parts, indirect measurement, percent proportion, percent equation, percent of change, percent of increase/decrease, percent error, markup, selling price, discount, interest, simple interest, principal, compound interest (Unit 2);
    - vertical angles, adjacent angles, complementary angles, supplementary angles, perpendicular lines, parallel lines, transversal, alternate interior angles, alternate exterior angles, corresponding angles, line segment, vertex, interior angle, exterior angle, congruent, polygon, diagonal, regular polygon, tessellation, transformation, image, translation, reflection, line of reflection, rotation, center of rotation, rotational symmetry, dilation, circle, center, diameter, radius, circumference, pi (π), composite figure, edge, vertex, face, prism, bases, pyramid, cylinder, cross section, volume, lateral faces, lateral area, surface area (Unit 3);
    - statistics, measures of center, measures of variability, range, quartile, interquartile range, outlier, mean absolute deviation, box plot, sample, population, unbiased sample, biased sample, simple random sample, convenience sample, outcome, simple event, probability, theoretical probability, experimental probability, compound event, tree diagram (Unit 4);
    - function, independent variable, dependent variable, vertical line test, function rule, function notation, linear equation, linear function, function table, x-intercept, y-intercept, rate of change, linear relationship, slope, direct variation, constant of variation (Unit 5); and
    - the Pythagorean Theorem (Unit 6).

Students will be able to . . .

- add, subtract, multiply, and divide rational numbers.
- simplify numerical and algebraic expressions.
- graph points on a coordinate plane.
- evaluate expressions containing positive and negative exponents.
- multiply and divide monomials.
- express numbers in standard form and in scientific notation.
- find square roots and cube roots.

- simplify radical expressions.
- solve real-world and mathematical problems using numerical and algebraic expressions and equations.
- solve linear equations in one variable (one-step, two-step, and variables on both sides).
- solve inequalities in one variable (one-step, two-step, and variables on both sides).
- compute unit rates.
- decide whether two quantities are in a proportional relationship.
- identify the constant of proportionality.
- represent proportional relationships by equations.
- graph proportional relationships.
- solve problems involving discount, markup, and interest.
- find percent of change and percent error.
- solve problems involving scale drawings of geometric figures.
- solve problems involving indirect measurement.
- use data from a random sample to draw inferences about a population.
- determine the theoretical and experimental probability of an event.
- use organized lists, tables, and tree diagrams to find the probability of compound events.
- utilize the formula for finding area of a circle and of a semi-circle.
- identify angle relationships such as complementary, supplementary, and vertical.
- solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects.
- describe the effects of dilations, translations, rotations, and reflections.

UNIT 1
Expressions and Equations and The Number System

Unit Goals

At the completion of this unit, students will:

7.NS The Number System

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

1. Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.
    a. Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.*
    b. Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
    c. Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.
    d. Apply properties of operations as strategies to add and subtract rational numbers.
2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
    a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
    b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts.
    c. Apply properties of operations as strategies to multiply and divide rational numbers.
    d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.
3. Solve real-world and mathematical problems involving the four operations with rational numbers.

7.EE Expressions and Equations

Use properties of operations to generate equivalent expressions.

1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, $a + 0.05a = 1.05a$ means that "increase by 5%" is the same as "multiply by 1.05."*

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: if a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9¾ inches long in the center of a door that is 27½ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.*
4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
   a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?*
   b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.*

8.NS The Number System

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). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*

8.EE Expressions and Equations

Work with radicals and integer exponents.

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
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 √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. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.*
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.

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.

Unit Essential Questions

- How can I use numbers and symbols to represent mathematical ideas?
- What happens when I add, subtract, multiply, and divide integers?
- What happens when I add, subtract, multiply, and divide rational numbers?
- Why is it useful to write numbers in different ways?
- How are linear functions used to model proportional relationships?
- Why are algebraic rules useful?
- How are equations and inequalities used to describe and solve multi-step problems?

Scope and Sequence

- The language of algebra
- Operations with integers
- Operations with rational numbers
- Powers and roots
- Algebraic expressions
- Equations and inequalities

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Pre-Algebra teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

<u>Core</u>

- Carter, John A., et al. *Math Accelerated: A Pre-Algebra Program*. New York: Glencoe, 2014. Print. Chps. 1-4 & 7-8.
- Grade 7 i-Ready Teacher Toolbox Lessons 14-15, with Unit Assessment and Performance Task.
- Hockey Project.
- Grade 7 i-Ready Teacher Toolbox Lessons 1-4.
- *Big Ideas* Lesson 2.7 Performance Task – Gasoline Prices.
- "Rational Number Riddles" – p. 69 McDougal Resource Book.
- Grade 7 i-Ready Teacher Toolbox Lessons 5-8, with Unit Assessment and Performance Task.
- The Solar System Project (Scientific Notation).
- Grade 8 i-Ready Teacher Toolbox Lessons 1-5, with Unit Assessment, Performance Task, and Unit Game ("Triple E").
- Grade 7 i-Ready Teacher Toolbox Lessons 16-17.

Time Allotment

- Approximately 16 weeks

UNIT 2
Ratios and Proportional Relationships

Unit Goals

At the completion of this unit, students will:

7.RP <u>Ratios and Proportional Relationships</u>

Analyze proportional relationships and use them to solve real-world and mathematical problems.

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. *For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction* $^{1/2}/_{1/4}$ *miles per hour, equivalently 2 miles per hour.*
2. Recognize and represent proportional relationships between quantities.
    a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
    b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
    c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.*
    d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.
3. Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

7.NS <u>The Number System</u>

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

3. Solve real-world and mathematical problems involving the four operations with rational numbers.

7.EE <u>Expressions and Equations</u>

Use properties of operations to generate equivalent expressions.

2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: if a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9¾ inches long in the center of a door that is 27½ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.*

7.G Geometry

Draw, construct, and describe geometrical figures and describe the relationships between them.

1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

8.EE Expressions and Equations

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. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*

Unit Essential Questions

- How can I identify and represent proportional relationships?
- How can I use proportional relationships to solve real-world percent problems?

Scope and Sequence

- Ratio, proportion, and similar figures
- Percents

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Pre-Algebra teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Carter, John A., et al. *Math Accelerated: A Pre-Algebra Program*. New York: Glencoe, 2014. Print. Chps. 5-6.
- Grade 7 i-Ready Teacher Toolbox Lessons 9-11.
- Grade 7 i-Ready Teacher Toolbox Lessons 12-13, with Unit Assessment and Performance Task.

Time Allotment

- Approximately 6 weeks

UNIT 3
Statistics & Probability

Unit Goals

At the completion of this unit, students will:

7.SP Statistics and Probability

Use random sampling to draw inferences about a population.

1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of the population. Understand that random sampling tends to produce representative samples and support valid inferences.
2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*

Draw informal comparative inferences about two populations.

3. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.*
4. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.*

Investigate chance processes and develop, use, and evaluate probability models.

5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.
6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*

7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.
    a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.*
    b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?*
8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
    a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
    b. Represent sample spaces for compound events using methods such as organized lists, tables, and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
    c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

Unit Essential Questions

- Why is it useful to collect multiple samples of data to make an inference about a population?
- How is probability related to relative frequency?
- How can I use a simulation to find the probability of a compound event?

Scope and Sequence

- Statistics and probability

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Pre-Algebra teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Carter, John A., et al. *Math Accelerated: A Pre-Algebra Program*. New York: Glencoe, 2014. Print. Chp. 10.
- Grade 7 i-Ready Teacher Toolbox Lessons 26-33, with Unit Assessment and Performance Task.

Time Allotment

- Approximately 2-3 weeks

UNIT 4
Geometry

Unit Goals

At the completion of this unit, students will:

7.G Geometry

Draw, construct, and describe geometrical figures and describe the relationships between them.

2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.
6. Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

8.G Geometry

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. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*

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.

Unit Essential Questions

- How can I determine congruence and similarity?
- How are two-dimensional figures used to solve problems involving three-dimensional figures?

Scope and Sequence

- Congruence, similarity, and transformations
- Volume and surface area

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Pre-Algebra teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Carter, John A., et al. *Math Accelerated: A Pre-Algebra Program*. New York: Glencoe, 2014. Print. Chps. 11-12.
- Grade 8 i-Ready Teacher Toolbox Lessons 18-20.
- *Big Ideas* blue book Lessons 2.2-2.4.
- Grade 7 i-Ready Teacher Toolbox Lessons 23-25, with Unit Assessment and Performance Task.
- Grade 8 i-Ready Teacher Toolbox Lessons 26-27.

Time Allotment

- Approximately 6-7 weeks

Units 5-6 follow a "Draft for Pilot 2016" structure for the 2016-17 school year. Based on the draft Unit Goals, Assured Assessments, Resources, and Time Allotment for each Unit, teachers will collaborate on an ongoing basis during the school year under the leadership of the middle schools' Mathematics Team Leaders and the Director of Curriculum, Instruction, and Assessments to develop each Unit based on articulated essential questions, scope and sequence, and best practices for mathematics.

UNIT 5
Linear Functions

Unit Goals

At the completion of this unit, students will:

7.RP Ratios and Proportional Relationships

Analyze proportional relationships and use them to solve real-world and mathematical problems.

2. Recognize and represent proportional relationships between quantities.
    a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
    b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
    c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.*
    d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and $(1, r)$ where r is the unit rate.

7.EE Expressions and Equations

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
    a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?*

b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.*

8.EE Expressions and Equations

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. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*
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.

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. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.*
   c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Pre-Algebra teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- Carter, John A., et al. *Math Accelerated: A Pre-Algebra Program*. New York: Glencoe, 2014. Print. Chp. 9 (lessons 1-4 only).

Time Allotment

- Supplemental; if time, teach for exposure. Algebra I will include these concepts.

UNIT 6
The Pythagorean Theorem

Unit Goals

At the completion of this unit, students will:

8.G Geometry

Understand and apply the Pythagorean Theorem.

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

Assured Assessments

Formative Assessment:
Each student will participate in at least one reflection/journal entry, exit slip, or formative performance task common to all Pre-Algebra teachers and assessed via a common scoring guide or rubric.

Summative Assessment:
Each student will take an end-of-unit assessment common to all teachers at the grade level and assessed via a common scoring guide.

Resources

Core

- *Big Ideas* blue book Lessons 7.3-7.5.
- Pythagorean Theorem Project.
- Grade 8 i-Ready Teacher Toolbox Lessons 23-24.

Time Allotment

- Approximately 1-2 weeks

TEACHER GUIDE

Unit One: Expressions and Equations and The Number Systems (approximately 16 weeks)

Text Chapter	**Suggested Time Allotment**	**Topic**	**CCS Standards**	**Activities and Supplements**
1	1-2 weeks	Language of Algebra	7.NS.3 7.EE.1 7.EE.2 7.EE.3 7.EE.4	• Grade 7 i-Ready Teacher Toolbox Lessons 14-15 • Hockey Project
2	2 weeks	Operations with Integers	7.NS.1a-d 7.NS.2a-c 7.NS.3 7.EE.3	• Grade 7 i-Ready Teacher Toolbox Lessons 1-4 • *Big Ideas* Lesson 2.7 Performance Task – Gasoline Prices
3	2-3 weeks	Operations with Rational Numbers	7.NS.1d 7.NS.2a,c,d 7.NS.3 7.EE.3 8.NS.1	• "Rational Number Riddles" – p. 69 McDougal Resource Book • Grade 7 i-Ready Teacher Toolbox Lessons 5-8, with Unit Assessment and Performance Task
4	3 weeks	Powers and Roots	8.NS.1 8.NS.2 8.EE.1 8.EE.2 8.EE.3 8.EE.4	• The Solar System Project (Scientific Notation) • Grade 8 i-Ready Teacher Toolbox Lessons 1-5, with Unit Assessment, Performance Task, and Unit Game ("Triple E")
7	3 weeks	Algebraic Expressions	7.NS.2c 7.EE.1 7.EE.2	• Grade 7 I – Ready Teacher Toolbox Lessons 14-15, with Unit Assessment and Performance Task
8	3-4 weeks	Equations and Inequalities	7.EE.4a-b 8.EE.7a-b	• Grade 7 i – Ready Teacher Toolbox Lessons 16-17

Unit Two: Ratios and Proportional Relationships (approximately 6 weeks)

Text Chapter	**Suggested Time Allotment**	**Topic**	**CCS Standards**	**Activities and Supplements**
5 (Lessons 1 & 2 should be very quick review)	3-4 weeks	Ratio, Proportion, & Similar Figures	7.RP.1 7.RP.2a-d 7.RP.3 7.NS.3 7.G.1 8.EE.5	• Grade 7 i-Ready Teacher Toolbox Lessons 9-11
6	2 weeks	Percents	7.RP.2c 7.RP.3 7.EE.2 7.EE.3	• Grade 7 i-Ready Teacher Toolbox Lessons 12-13, with Unit Assessment and Performance Task

Unit Three: Statistics & Probability (approximately 2-3 weeks)

Text Chapter	Suggested Time Allotment	Topic	CCS Standards	Activities and Supplements
10	2-3 weeks	Statistics and Probability	7.SP.1 7.SP.2 7.SP.3 7.SP.4 7.SP.5 7.SP.6 7.SP.7 7.SP.8a-c	• Grade 7 i-Ready Teacher Toolbox Lessons 26-33, with Unit Assessment and Performance Task

Unit Four: Geometry (approximately 6-7 weeks)

Text Chapter	Suggested Time Allotment	Topic	CCS Standards	Activities and Supplements
11	3 weeks	Congruence, Similarity, and Transformations	7.G.2 7.G.5 8.G.1 8.G.1a-c 8.G.2 8.G.3 8.G.4 8.G.5	• Grade 8 i-Ready Teacher Toolbox Lessons 18-20 • *Big Ideas* blue book Lessons 2.2-2.4
12	3-4 weeks	Volume and Surface Area	7.G.3 7.G.4 7.G.6 8.G.9	• Grade 7 i-Ready Teacher Toolbox Lessons 23-25, with Unit Assessment and Performance Task • Grade 8 i-Ready Teacher Toolbox Lessons 26-27

SMARTER BALANCED ASSESSMENT

Unit Five: Linear Functions (supplemental; if time, teach for exposure)

Text Chapter	Suggested Time Allotment	Topic	CCS Standards	Activities and Supplements
9 (Lessons 1-4 only)	*supplemental; if time, teach for exposure*	Linear Functions	7.RP.2 7.RP.2a-d 7.EE.4 8.EE.5 8.EE.6 8.EE.8a-c	---

Unit Six: The Pythagorean Theorem (approximately 1-2 weeks)

Text Chapter	Suggested Time Allotment	Topic	CCS Standards	Activities and Supplements
---	1-2 weeks	Pythagorean Theorem	8.G.6b 8.G.7b	• *Big Ideas* blue book Lessons 7.3-7.5 • Pythagorean Theorem Project • Grade 8 i-Ready Teacher Toolbox Lessons 23-24

COURSE CREDIT

One credit in Mathematics

One class period daily for a full year

PREREQUISITES

for Grade 6: attainment of District criteria for advanced mathematics placement.

TEXT

Carter, John A., et al. *Math Accelerated: A Pre-Algebra Program*. New York: Glencoe, 2014. Print.

SUPPLEMENTARY MATERIALS/RESOURCES/TECHNOLOGY

Department- and teacher-prepared materials

CURRENT REFERENCES

2010 Connecticut Core Standards for Mathematics

http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf