TOWNSHIP OF UNION PUBLIC SCHOOLS

Grade 8 Mathematics

Curriculum Guide 2017

Mission Statement

The mission of the Township of Union Public Schools is to build on the foundations of honesty, excellence, integrity, strong family, and community partnerships. We promote a supportive learning environment where every student is challenged, inspired, empowered, and respected as diverse learners. Through cultivation of students' intellectual curiosity, skills and knowledge, our students can achieve academically and socially, and contribute as responsible and productive citizens of our global community.

Philosophy Statement

The Township of Union Public School District, as a societal agency, reflects democratic ideals and concepts through its educational practices. It is the belief of the Board of Education that a primary function of the Township of Union Public School System is to formulate a learning climate conducive to the needs of all students in general, providing therein for individual differences. The school operates as a partner with the home and community.

Course Description

Eighth grade mathematics is about (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.

Recommended Textbooks:

Eureka Math – EngageNY Grade 8

Overview	Standards for Mathematical Content	Unit Focus	Standards for Mathematical Practice
Unit 1	• 8.EE.A.1 • 8.EE.A.3 • 8.EE.A.4 • 8.G.A.1 • 8.G.A.2 • 8.G.A.5 • 8.G.B.6 • 8.G.B.7 • 8.EE.A.2	**Module 1** Lesson 1: Exponential Notation (S)1 Lesson 2: Multiplication and Division of Numbers in Exponential Form (S) Lesson 3: Numbers in Exponential Form Raised to a Power (S) Lesson 4: Numbers Raised to the Zeroth Power (E) Lesson 5: Negative Exponents and the Laws of Exponents (S) Lesson 6: Proofs of Laws of Exponents (S) Lesson 7: Magnitude (P)1 Lesson 8: Estimating Quantities (P) Lesson 9: Scientific Notation (P) Lesson 10: Operations with Numbers in Scientific Notation (P) Lesson 11: Efficacy of Scientific Notation (S) Lesson 12: Choice of Unit (E) Lesson 13: Comparison of Numbers Written in Scientific Notation and Interpreting Scientific Notation Using Technology (E) **Module 2** Lesson 1: Why Move Things Around? (E)1 Lesson 2: Definition of Translation and Three Basic Properties (P) Lesson 3: Translating Lines (S) Lesson 4: Definition of Reflection and Basic Properties (P) Lesson 5: Definition of Rotation and Basic Properties (S) Lesson 6: Rotations of 180 Degrees (P) Lesson 7: Sequencing Translations (E)1 Lesson 8: Sequencing Reflections and Translations (S) Lesson 9: Sequencing Rotations (E) Lesson 10: Sequences of Rigid Motions (P) Lesson 11: Definition of Congruence and Some Basic Properties (S)1 Lesson 12: Angles Associated with Parallel Lines (E) Lesson 13: Angle Sum of a Triangle (E) Lesson 14: More on the Angles of a Triangle (S) Lesson 15: Informal Proof of the Pythagorean Theorem (S)1 Lesson 16: Applications of the Pythagorean Theorem (P)	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.

Unit 1: ***Suggested Educational Resources***	8.EE.A.1 Extending the Definitions of Exponents 8.G.C.9 A Canister of Tennis Balls 8.EE.A.3 Ant and Elephant 8.EE.A.4 Giantburgers 8.NS.A.1 Converting Decimal Representations of Rational Numbers to Fraction Representations 8.NS.A.2 Irrational Numbers on the Number Line 8.G.A.1 Reflections, Rotations, and Translations 8.G.A.2 Congruent Triangles 8.G.A.5 Street Intersections 8.G.A.5 Triangle's Interior Angles		
Unit 2	• 8.G.A.3 • 8.G.A.4 • 8.G.A.5 • 8.G.B.6 • 8.G.B.7 • 8.EE.B.5 • 8.EE.B.6	**Module 3** Lesson 1: What Lies Behind "Same Shape"? (E)1 Lesson 2: Properties of Dilations (P) Lesson 3: Examples of Dilations (P) Lesson 4: Fundamental Theorem of Similarity (FTS) (S) Lesson 5: First Consequences of FTS (P) Lesson 6: Dilations on the Coordinate Plane (P) Lesson 7: Informal Proofs of Properties of Dilations (Optional) (S) Lesson 8: Similarity (P)1 Lesson 9: Basic Properties of Similarity (E) Lesson 10: Informal Proof of AA Criterion for Similarity (S) Lesson 11: More About Similar Triangles (P) Lesson 12: Modeling Using Similarity (M) Lesson 13: Proof of the Pythagorean Theorem (S)1 Lesson 14: The Converse of the Pythagorean Theorem (P) **Module 4** Lesson 1: Writing Equations Using Symbols (P)1 Lesson 2: Linear and Nonlinear Expressions in x (P) Lesson 3: Linear Equations in x (P) Lesson 4: Solving a Linear Equation (P) Lesson 5: Writing and Solving Linear Equations (P) Lesson 6: Solutions of a Linear Equation (P) Lesson 7: Classification of Solutions (S) Lesson 8: Linear Equations in Disguise (P) Lesson 9: An Application of Linear Equations (S)	

		Lesson 10: A Critical Look at Proportional Relationships (S)1 Lesson 11: Constant Rate (P) Lesson 12: Linear Equations in Two Variables (E) Lesson 13: The Graph of a Linear Equation in Two Variables (S) Lesson 14: The Graph of a Linear Equation—Horizontal and Vertical Lines (S)	
Unit 2: ***Suggested Educational Resources***	8.G.A.3 Effects of Dilations on Length, Area, and Angles 8.G.A.4 Are They Similar 8.G.A.5 Similar Triangles II 8.G.B.6 Converse of the Pythagorean Theorem 8.G.B.7 Running on the Football Field 8.EE.B.5 Who Has the Best Job? 8.EE.B.6 Slopes Between Points on a Line		
Unit 3	• 8..EE.B.5 • 8.EE.B.6 • 8.EE.C.8 • 8.G.B.7 • 8.F.A.1 • 8.F.A.2 • 8.F.A.3 • 8.G.C.9 • 8.F.B.4 • 8.F.B.5	**Module 4 (Continued)** Lesson 15: The Slope of a Non-Vertical Line (P)1 Lesson 16: The Computation of the Slope of a Non-Vertical Line (S) Lesson 17: The Line Joining Two Distinct Points of the Graph $y = mx + b$ Has Slope m (S) Lesson 18: There Is Only One Line Passing Through a Given Point with a Given Slope (P) Lesson 19: The Graph of a Linear Equation in Two Variables Is a Line (S) Lesson 20: Every Line Is a Graph of a Linear Equation (P) Lesson 21: Some Facts About Graphs of Linear Equations in Two Variables (P) Lesson 22: Constant Rates Revisited (P) Lesson 23: The Defining Equation of a Line (E) Lesson 24: Introduction to Simultaneous Equations (P)1 Lesson 25: Geometric Interpretation of the Solutions of a Linear System (E) Lesson 26: Characterization of Parallel Lines (S) Lesson 27: Nature of Solutions of a System of Linear Equations (P) Lesson 28: Another Computational Method of Solving a Linear System (P) Lesson 29: Word Problems (P)	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.

		Lesson 30: Conversion Between Celsius and Fahrenheit (M) Lesson 31: System of Equations Leading to Pythagorean Triples (S)1 **Module 5** Lesson 1: The Concept of a Function (P)1 Lesson 2: Formal Definition of a Function (S) Lesson 3: Linear Functions and Proportionality (P) Lesson 4: More Examples of Functions (P) Lesson 5: Graphs of Functions and Equations (E) Lesson 6: Graphs of Linear Functions and Rate of Change (S) Lesson 7: Comparing Linear Functions and Graphs (E) Lesson 8: Graphs of Simple Nonlinear Functions (E) Lesson 9: Examples of Functions from Geometry (E)1 Lesson 10: Volumes of Familiar Solids—Cones and Cylinders (S) Lesson 11: Volume of a Sphere (P) **Module 6** Lesson 1: Modeling Linear Relationships (P)1 Lesson 2: Interpreting Rate of Change and Initial Value (P) Lesson 3: Representations of a Line (P) Lessons 4–5: Increasing and Decreasing Functions (P, P)	
Unit 3: Suggested Educational Resources	8.G.B.7 Running on the Football Field 8.F.B.4 Delivering the Mail 8.EE.C.8 Kimi and Jordan		
Unit 4	• 8.SP.A.1 • 8.SP.A.2 • 8.SP.A.3 • 8. SP.A.4 • 8.NS.A.1 • 8.NS.A.2 • 8.EE.A.2 • 8.G.B.6 • 8.G.B.7 • 8.G.B.8 • 8.G.C.9	**Module 6** Lesson 6: Scatter Plots (P) 1 Lesson 7: Patterns in Scatter Plots (P) Lesson 8: Informally Fitting a Line (P) Lesson 9: Determining the Equation of a Line Fit to Data (P) Lesson 10: Linear Models (P)1 Lesson 11: Using Linear Models in a Data Context (P) Lesson 12: Nonlinear Models in a Data Context (Optional) (P) Lesson 13: Summarizing Bivariate Categorical Data in a Two-Way Table (P) 1 Lesson 14: Association Between Categorical Variables (P) **Module 7** Lesson 1: The Pythagorean Theorem (P)1 Lesson 2: Square Roots (S)	

		Lesson 3: Existence and Uniqueness of Square Roots and Cube Roots (S) Lesson 4: Simplifying Square Roots (Optional) (P) Lesson 5: Solving Equations with Radicals (P) Lesson 6: Finite and Infinite Decimals (P)0F 1 Lesson 7: Infinite Decimals (S) Lesson 8: The Long Division Algorithm (E) Lesson 9: Decimal Expansions of Fractions, Part 1 (P) Lesson 10: Converting Repeating Decimals to Fractions (P) Lesson 11: The Decimal Expansion of Some Irrational Numbers (S) Lesson 12: Decimal Expansions of Fractions, Part 2 (S) Lesson 13: Comparing Irrational Numbers (E) Lesson 14: Decimal Expansion of π (S) Lesson 15: Pythagorean Theorem, Revisited (S)1 Lesson 16: Converse of the Pythagorean Theorem (S) Lesson 17: Distance on the Coordinate Plane (P) Lesson 18: Applications of the Pythagorean Theorem (E) Lesson 19: Cones and Spheres (P)1 Lesson 20: Truncated Cones (P) Lesson 21: Volume of Composite Solids (E) Lesson 22: Average Rate of Change (S) Lesson 23: Nonlinear Motion (M)	
Unit 4: ***Suggested Educational Resources***	8.G.B.6 Converse of the Pythagorean Theorem 8.G.B.8 Finding isosceles triangles 8.SP.A.1 Texting and Grades 1 8.SP.A.2 Animal Brains 8.SP.A.3 US Airports 8.SP.A.4 What's Your Favorite Subject 8.SP.A.4 Music and Sports 8.G.B.8 Finding the distance between points		

Unit 1 Grade 8 Math Curriculum			
Content & Practice Standards	**Standards for Mathematical Practice**	**Critical Knowledge & Skills**	**Examples**
MODULE 1 – Topic A: Exponential Notation and Properties of Integer Exponents	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics. MP.7 Look for and make use of structure.		
Lesson 1: Exponential Notation **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.		In Topic A, Lesson 1, students begin by learning the precise definition of exponential notation where the exponent is restricted to being a positive integer.	Lesson 1
Lesson 2: Multiplication of Numbers in Exponential Form **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.		In Lesson 2, students discern the structure of exponents by relating multiplication and division of expressions with the same base to combining like terms using the distributive property, and by relating multiplying 3 factors using the associative property to raising a power to a power.	Lesson 2

Lesson 3: Numbers in Exponential Form Raised to a Power **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.		In Lesson 3, students discern the structure of exponents by relating multiplication and division of expressions with the same base to combining like terms using the distributive property, and by relating multiplying 3 factors using the associative property to raising a power to a power.	Lesson 3
Lesson 4: Numbers Raised to the Zeroth Power **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.		In Lesson 4, students expand the definition of exponential notation to include what it means to raise a nonzero number to a zero power; students verify that the properties of exponents developed in Lessons 2 and 3 remain true.	Lesson 4
Lesson 5: Negative Exponents and the Laws of Exponents **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.		In Lesson 5, students accept the properties of exponents as true for all integer exponents and are shown the value of learning them, i.e., if the three properties of exponents are known, then facts about dividing numbers in exponential notation with the same base and raising fractions to a power are also known.	Lesson 5
Lesson 6: Proofs of Laws of Exponents **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions.		In Lesson 6, students work to prove the laws of exponents for all integer exponents.	Lesson 6
MODULE 1 – Topic B: Magnitude and Scientific Notation			
Lesson 7: Magnitude **8.EE.A.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		In Lesson 7, students learn that positive powers of 10 are large numbers and negative powers of 10 are very small numbers.	Lesson 7

to express how many times as much one is than the other.			
Lesson 8: Estimating Quantities **8.EE.A.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.		In Lesson 8, students express large numbers in the form of a single digit times a positive power of 10 and express how many times as much one of these numbers is compared to another.	Lesson 8
Lesson 9: Scientific Notation **8.EE.A.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. **8.EE.A.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.		In Lesson 9, students learn how to write numbers in scientific notation and the importance of the exponent with respect to magnitude.	Lesson 9
Lesson 10: Operations with Numbers in Scientific Notation **8.EE.A.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		In Lesson 10, students are showed how to operate with numbers in scientific notation by making numbers have the same magnitude.	Lesson 10

seafloor spreading). Interpret scientific notation that has been generated by technology.			
Lesson 11: Efficacy of Scientific Notation **8.EE.A.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.		In Lessons 11–13, students reason quantitatively with scientific notation to understand several instances of how the notation is used in science.	Lesson 11
Lesson 12: Choice of Unit **8.EE.A.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.		In Lesson 12, there is an opportunity for students to understand why certain units were developed, like the gigaelectronvolt. Given a list of very large numbers, students choose a unit of appropriate size and then rewrite numbers in the new unit to make comparisons easier.	Lesson 12
Lesson 13: Comparison of Numbers Written in Scientific Notation and Interpreting Scientific Notation Using Technology **8.EE.A.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		In Lesson 13, students combine all the skills of Module 1 as they compare numbers written in scientific notation by rewriting the given numbers as numbers with the same magnitude, using the properties of exponents.	Lesson 13

seafloor spreading). Interpret scientific notation that has been generated by technology.			
MODULE 2 – Topic A: Definitions and Properties of the Basic Rigid Motions	MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.5 Use appropriate tools strategically. MP.6 Attend to precision.		
Lesson 1: Why Move Things Around? **8.G.A.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.		In Topic A, students learn about the mathematical needs for rigid motions and begin by exploring the possible effects of rigid motions in Lesson 1.	Lesson 1
Lesson 2: Definition of Translation and Three Basic Properties **8.G.A.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.		In Lesson 2, students learn the basics of translation by translating points, lines, and figures along a vector, and students verify experimentally that translations map lines to lines, segments to segments, rays to rays, and angles to angles.	Lesson 2
Lesson 3: Translating Lines		Lesson 3 focuses on the translation of lines, specifically the idea that a translation maps a line either to	Lesson 3

8.G.A.1 Verify experimentally the properties of rotations, reflections, and translations: c. Parallel lines are taken to parallel lines.		itself or to a parallel line.	
Lesson 4: Definition of Reflection and Basic Properties **8.G.A.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.		In Lesson 4, students verify experimentally that reflections are distance- and angle-preserving.	Lesson 4
Lesson 5: Definition of Rotation and Basic Properties **8.G.A.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.		In Lesson 5, rotation around a point is investigated in a similar manner as the other rigid motions.	Lesson 5
Lesson 6: Rotations of 180 Degrees **8.G.A.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.		In Lesson 6, students are provided proof that -degree rotations map a line to a parallel line and use that knowledge to prove that vertical angles are equal.	Lesson 6

MODULE 2 – Topic B: Sequencing the Basic Rigid Motions			
Lesson 7: Sequencing Translations **8.G.A.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.		Lesson 7 begins with the concept of composing translations and introduces the idea that translations can be undone.	Lesson 7
Lesson 8: Sequencing Reflections and Translations **8.G.A.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.		In Lesson 8, students explore images of figures under a sequence of reflections and translations.	Lesson 8
Lesson 9: Sequencing Rotations **8.G.A.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.		In Lesson 9, students explore with sequences of rotations around the same center and rotations around different centers.	Lesson 9
Lesson 10: Sequences of Rigid Motions **8.G.A.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		In Lesson 10, students perform sequences of translations, rotations, and reflections as a prelude to learning about congruence.	Lesson 10

two congruent figures, describe a sequence that exhibits the congruence between them.			
MODULE 2 – Topic C: Congruence and Angle Relationships			
Lesson 11: Definition of Congruence and Some Basic Properties **8.G.A.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.		Topic C finishes the work of **8.G.A.2** by introducing the concept of congruence as mapping one figure onto another using a sequence of rigid motions. Lesson 11 defines congruence in terms of a sequence of the basic rigid motions (i.e., translations, reflections, and rotations).	Lesson 11
Lesson 12: Angles Associated with Parallel Lines **8.G.A.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.		In Lesson 12, students show why corresponding angles are congruent using translation and why alternate interior angles are congruent using rotation.	Lesson 12
Lesson 13: Angle Sum of a Triangle **8.G.A.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.		In Lessons 13 and 14, the knowledge of rigid motions and angle relationships is put to use to develop informal arguments to show that the sum of the degrees of interior angles of a triangle is 180°.	Lesson 13
Lesson 14: More on the Angles of a Triangle **8.G.A.5** Use informal arguments to establish facts about the angle sum and exterior angle of		In Lesson 14, students take note of a related fact about the exterior angles of triangles.	Lesson 14

triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles.			
MODULE 2 – Topic D: The Pythagorean Theorem (Optional)			
Lesson 15: Informal Proof of the Pythagorean Theorem **8.G.B.6** Explain a proof of the Pythagorean Theorem and its converse.		In Topic D, students are guided through the square within a square proof of the Pythagorean theorem, which requires students to know that congruent figures also have congruent areas.	Lesson 15
Lesson 16: Applications of the Pythagorean Theorem **8.G.B.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.		Once proved, students practice using the Pythagorean theorem and its converse in Lesson 16 to find unknown side lengths in right triangles. Students apply their knowledge of the Pythagorean theorem to real-world problems that involve two-and three-dimensional figures.	Lesson 16

Unit 1 Vocabulary
Module 1 order of magnitude, scientific notation Familiar Terms: base, cube (of a number), equivalent fractions, expanded form (of decimal numbers), exponential notation, integer, power, square (of a number), whole number Module 2 adjacent angles, angle preserving, basic rigid motion, between, congruence, congruent, directed line segment, distance preserving, exterior angle, interior angle, reflection, rotation, sequence, transformation, translation, transversal, vector Familiar Terms: angle, area, complementary angles, line, line segment, parallel and perpendicular lines, perimeter, quadrilateral, ray, , supplementary angles, triangle, vertical angles

Unit 2 Grade 8 Math Curriculum			
Content & Practice Standards	**Standards for Mathematical Practice**	**Critical Knowledge & Skills**	**Examples**
MODULE 3 – Topic A: Dilation	MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics. MP.6 Attend to precision. MP.8 Look for and express regularity in repeated reasoning.		
Lesson 1: What Lies Behind "Same Shape"? **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		In Lesson 1, dilation is defined, and the role of scale factor is demonstrated through the shrinking and magnification of figures.	Lesson 1
Lesson 2: Properties of Dilations **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		In Lesson 2, properties of dilations are discussed. As with rigid motions, students learn that dilations map lines to lines, segments to segments, and rays to rays. Students learn that dilations are angle-preserving transformations.	Lesson 2
Lesson 3: Examples of Dilations **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		In Lesson 3, students use a compass to perform dilations of figures with the same center and figures with different centers. In Lesson 3, students begin to look at figures that are dilated followed by congruence.	Lesson 3

Lesson 4: Fundamental Theorem of Similarity **8.EE.A.1** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		In Lessons 4 and 5, students learn and use the fundamental theorem of similarity.	Lesson 4
Lesson 5: First Consequences of FTS **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		In Lessons 4 and 5, students learn and use the fundamental theorem of similarity.	Lesson 5
Lesson 6: Dilations on the Coordinate Plane **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		In Lesson 6, students use what they learned in Lessons 4 and 5 to conclude that when the center of dilation is the origin, the coordinates of a dilated point are found by multiplying each coordinate of the ordered pair by the scale factor.	Lesson 6
Lesson 7: Informal Proofs of Properties of Dilations (Optional) **8.G.A.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.		Lesson 7 provides students with informal proofs of the properties of dilations that they observed in Lesson 2.	Lesson 7
MODULE 3 – Topic B: Similar Figure			
8.G.A.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.		Topic B begins with the definition of similarity and the properties of similarity. In Lesson 8, students learn that similarities map lines to lines, change the lengths of segments by factor r, and are angle-preserving.	Lesson 8
8.G.A.4 Understand that a two-dimensional figure is similar to another if the second can be		In Lesson 9, students investigate additional properties about similarity; first, students learn that	Lesson 9

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.		congruence implies similarity (e.g., congruent figures are also similar).	
8.G.A.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.		Lesson 10 provides students with an informal proof of the angle-angle (AA) criterion for similarity of triangles. Lesson 10 also provides opportunities for students to use the AA criterion to determine if two triangles are similar.	Lesson 10
8.G.A.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.		In Lesson 11, students use what they know about similar triangles and dilation to find an unknown side length of one triangle.	Lesson 11
8.G.A.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.		In Lesson 12, students apply their knowledge of similar triangles and dilation to real-world situations.	Lesson 12
MODULE 3 – Topic C: The Pythagorean Theorem			

Lesson 13: Proof of the Pythagorean Theorem **8.G.B.6** Explain a proof of the Pythagorean Theorem and its converse.		Lesson 13 of Topic C presents students with a general proof that uses the angle-angle criterion.	Lesson 13
Lesson 14: The Converse of the Pythagorean Theorem **8.G.B.6** Explain a proof of the Pythagorean Theorem and its converse. **8.G.B.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.		In Lesson 14, students are presented with a proof of the converse of the Pythagorean theorem. Also in Lesson 14, students apply their knowledge of the Pythagorean theorem (i.e., given a right triangle with sides *a*, *b*, and *c*, where *c* is the hypotenuse, then *a*2 +*b*2 = *c*2) to determine unknown side lengths in right triangles. Students also use the converse of the theorem (i.e., given a triangle with lengths , *b*, and *c*, so that *a*2 +*b*2 = *c*2, then the triangle is a right triangle with hypotenuse *c*) to determine if a given triangle is in fact a right triangle.	Lesson 14
MODULE 4 – Topic A: Writing and Solving Linear Equations	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics. MP.7 Look for and make use of structure.		
Lesson 1: Writing Equations Using Symbols **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using		In Lesson 1, students begin by transcribing written statements into symbolic language. Students learn that before they can write a symbolic statement, they must first define the symbols they intend to use.	Lesson 1

the distributive property and collecting like terms.			
Lesson 2: Linear and Nonlinear Expressions in x **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.		In Lesson 2, students learn the difference between linear expressions in x and nonlinear expressions in x, a distinction that is necessary to know whether or not an equation can be solved (at this point). Also, Lesson 2 contains a quick review of terms related to linear equations, such as constant, term, and coefficient.	Lesson 2
Lesson 3: Linear Equations in x **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.		In Lesson 3, students learn that a linear equation in x is a statement of equality between two linear expressions in x.	Lesson 3
Lesson 4: Solving a Linear Equation **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.		In Lesson 4, students begin using properties of equality to rewrite linear expressions, specifically using the distributive property to "combine like terms." Further, students practice substituting numbers into equations to determine if a true number sentence is produced.	Lesson 4
Lesson 5: Writing and Solving Linear Equations **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using		In Lesson 5, students practice the skills of the first few lessons in a geometric context. Students transcribe written statements about angles and triangles into symbolic language and use properties of equality to begin solving equations	Lesson 5

the distributive property and collecting like terms.		**(8.EE.C.7b)**.	
Lesson 6: Solutions of a Linear Equation **8.EE.C.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 $x = a$, $= a$, 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.		More work on solving equations occurs in Lesson 6, where the equations are more complicated and require more steps to solve **(8.EE.C.7b)**. In Lesson 6, students learn that not every linear equation has a solution **(8.EE.C.7a)**.	<u>Lesson 6</u>
Lesson 7: Classification of Solutions **8.EE.C.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 $x = a$, $= a$, or $a = b$ results (where a and b are different numbers).		This leads to Lesson 7, where students learn that linear equations either have a unique solution, no solution, or infinitely many solutions **(8.EE.C.7a)**.	<u>Lesson 7</u>
Lesson 8: Linear Equations in Disguise **8.EE.C.7** Solve linear equations in one variable. b. Solve linear equations with rational number		In Lesson 8, students rewrite equations that are not obviously linear equations and then solve them **(8.EE.C.7b)**.	<u>Lesson 8</u>

coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.			
Lesson 9: An Application of Linear Equations **8.EE.C.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 $x = a$, $= a$, or $a = b$ results (where a and b are different numbers).		In Lesson 9, students take another look at the Facebook problem from Module 1 in terms of linear equations **(8.EE.C.7a)**.	Lesson 9
MODULE 4 – Topic B: Linear Equations in Two Variables and Their Graphs			
Lesson 10: A Critical Look at Proportional Relationships **8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.		Topic B begins with students working with proportional relationships related to average speed and constant speed. In Lesson 10, students use information that is organized in the form of a table to write linear equations.	Lesson 10
Lesson 11: Constant Rate **8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.		In Lesson 10, students use information that is organized in the form of a table to write linear equations.	Lesson 11
Lesson 12: Linear Equations in Two Variables		Lesson 12 introduces students to the standard form of an equation in two variables. At this point,	Lesson 12

8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.		students use a table to help them find and organize solutions to a linear equation in two variables.	
Lesson 13: The Graph of a Linear Equation in Two Variables **8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.		In Lesson 13, students begin to question whether or not the graph of a linear equation is a line, as opposed to something that is curved.	Lesson 13
Lesson 14: The Graph of a Linear Equation—Horizontal and Vertical Lines **8.EE.B.5** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.		Lesson 14 presents students with equations in standard form, $+by = c$, where $a = 0$ or $b = 0$, which produces lines that are either vertical or horizontal.	Lesson 14

Unit 2 Vocabulary
Module 3 angle of rotation, center of dilation, center of rotation, dilation, interior angles, image, line of reflection, line of symmetry, reflection, rotation, rotational symmetry, scale factor, ratio, similar, similarity transformation, tessellations, translation Familiar Terms: angle-preserving, scale drawing Module 4 Average Speed, Constant Speed, Horizontal Line, Linear Equation, Point-Slope Equation of Line, Slope of a in a Cartesian Plane, Slope-Intercept Equation of a Line, Solution to a System of Linear Equations, Standard Form of a Linear Equation, Systems of Linear Equations, Vertical Line, X-intercept, Y-Intercept Familiar Terms: Coefficient, Equation, Like Terms, Linear Equation, Solution, Term, Unit Rate, Variable

Unit 3 Grade 8 Math Curriculum			
Content & Practice Standards	**Standards for Mathematical Practice**	**Critical Knowledge & Skills**	**Examples**
MODULE 4 - Topic C: Slope and Equations of Lines	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning of others. MP.4 Model with mathematics. MP.7 Look for and make use of structure.		
Lesson 15: The Slope of a Non-Vertical Line. **8.EE.B.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.	.	Topic C begins with students examining the slope of non-vertical lines. Students relate what they know about unit rate in terms of the slope of the graph of a line (**8.EE.B.5**).	Lesson 15
Lesson 16: The Computation of the Slope of a Non-Vertical Line **8.EE.B.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.		In Lesson 16, students learn the formula for computing slope between any two points. Students reason that any two points on the same line can be used to determine slope because of what they know about similar triangles (**8.EE.B.6**).	Lesson 16
Lesson 17: The Line Joining Two Distinct Points of the Graph y=mx +b Has slope m.		In Lesson 17, students transform the standard form of an equation into slope-intercept form. Further, students learn that the slope of a	Lesson 17

8.EE.B.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.		line joining any two distinct points is the graph of a linear equation with slope,	
Lesson 18: There is Only One Line Passing Through a Given Slope **8.EE.B.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.		In Lesson 18, students investigate the concept of uniqueness of a line and recognize that if two lines have the same slope and a common point, the two lines are the same.	Lesson 18
Lesson 19: The Graph of a Linear Equation with Two Variables is a Line **8.EE.B.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.		Lessons 19 and 20 prove to students that the graph of a linear equation is a line and that a line is a graph of a linear equation.	Lesson 19
Lesson 20: Every Line Is a Graph of a Linear Equation **8.EE.B.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.		Lessons 19 and 20 prove to students that the graph of a linear equation is a line and that a line is a graph of a linear equation.	Lesson 20
Lesson 21: Some Facts About Graphs of Linear Equations in Two Variables **8.EE.B.5** Graph proportional relationships, interpreting		In Lesson 21, students learn that the -intercept is the location on the coordinate plane where the graph of a linear equation crosses the -	Lesson 21

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.		axis. Also in this lesson, students learn to write the equation of a line given the slope and a point.	
Lesson 22: Constant Rates Revisited **8.EE.B.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.		In Lesson 22, constant rate problems are revisited. Students learn that any constant rate problem can be described by a linear equation in two variables where the slope of the graph is the constant rate (i.e., rate of change). Lesson 22 also presents students with two proportional relationships expressed in different ways. Given a graph and an equation, students must use what they know about slope to determine which of the two has a greater rate of change.	Lesson 22
Lesson 23: The Defining Equation of a Line **8.EE.B.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.		Lesson 23 introduces students to the symbolic representation of two linear equations that would graph as the same line.	Lesson 23
MODULE 4 - Topic D: Systems of Linear Equations and Their Solutions			
Lesson 24: Introduction to Simultaneous Equations **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear		Lesson 24 introduces students to systems of linear equations by comparing distance-time graphs to determine which of two objects has greater speed (**8.EE.B.5**, **8.EE.C.8c**).	Lesson 24

equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.			
Lesson 25: Geometric Interpretation of the Solutions of a Linear System **8.EE.C.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.		Lessons 25–27 expose students to the possibilities for solutions of a system of linear equations. In Lesson 25, students graph two linear equations on a coordinate plane and identify the point of intersection of the two lines as the solution to the system (**8.EE.C.8a**). Next, students look at systems of equations that graph as parallel lines (**8.EE.C.8b**).	Lesson 25
Lesson 26: Characterization of Parallel Lines **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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.		Lessons 25–27 expose students to the possibilities for solutions of a system of linear equations. In Lesson 26, students learn that a system can have no solutions because parallel lines do not have a point of intersection (**8.EE.C.8b**).	Lesson 26
Lesson 27: Nature of Solutions of a System of Linear Equations **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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 $3x + 2y = 6$		Lessons 25–27 expose students to the possibilities for solutions of a system of linear equations. Lesson 27 continues this thinking with respect to systems that have infinitely many solutions (**8.EE.C.8b**).	Lesson 27

have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.			
Lesson 28: Another Computational Method **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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.		In Lesson 28, students learn how to solve a system of equations using computational methods, such as elimination and substitution (**8.EE.C.8b**).	Lesson 28
Lesson 29: Word Problems **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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.		In Lesson 29, students must use all of the skills of the module to transcribe written statements into a system of linear equations, find the solution(s) if it exists, and then verify that it is correct.	Lesson 29
Lesson 30: Conversion Between Celsius and Fahrenheit **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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		Lesson 30 is an application of what students have learned about linear equations. Students develop a linear equation that represents the conversion between temperatures in Celsius to temperatures in Fahrenheit.	Lesson 30

intersects the line through the second pair. **8.EE.B.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.			
MODULE 4 - Topic E: Pythagorean Theorem			
Lesson 31: Systems of Equations Leading to Pythagorean Triples **8.G.B.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.EE.C.8** Analyze and solve pairs of simultaneous linear equations. 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.		Lesson 31 shows students how to apply what they learned about systems of linear equations to find a Pythagorean triple (**8.G.B.7**, **8.EE.C.8b**). The Babylonian method of generating Pythagorean triples, described in Lesson 31, uses a system of linear equations.	Lesson 31
MODULE 5 - Topic A: Functions	MP.2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.8 Look for and express regularity in repeated reasoning.		

Lesson 1: The Concept of a Function **8.F.A.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.		Lesson 1 relies on students' understanding of constant rate, a skill developed in previous grade levels and reviewed in Module 4 (**6.RP.A.3b**, **7.RP.A.2**). Students are confronted with the fact that the concept of constant rate, which requires the assumption that a moving object travels at a constant speed, cannot be applied to all moving objects. Students examine a graph and a table that demonstrate the nonlinear effect of gravity on a falling object. This example provides the reasoning for the need of functions.	Lesson 1
Lesson 2: Formal Definition of a Function **8.F.A.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.		In Lesson 2, students continue their investigation of time and distance data for a falling object and learn that the scenario can be expressed by a formula. Students are introduced to the terms input and output and learn that a function assigns to each input exactly one output. Though students do not learn the traditional "vertical-line test," students know that the graph of a function is the set of ordered pairs consisting of an input and the corresponding output. Students also learn that not all functions can be expressed by a formula, but when they are, the function rule allows us to make predictions about the world around us. For example, with respect to the falling object, the function allows us to predict the height of the object for any given time interval.	Lesson 2

Lesson 3: Linear Functions and Proportionality **8.F.A.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. **8.F.A.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.			In Lesson 3, constant rate is revisited as it applies to the concept of linear functions and proportionality in general.	Lesson 3
Lesson 4: More Examples of Functions **8.F.A.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change. **8.F.A.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. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.			Lesson 4 introduces students to the fact that not all rates are continuous. That is, a cost function for the cost of a book can be written, yet the cost of 3.6 books cannot realistically be found. Students are also introduced to functions that do not use numbers at all, as in a function where the input is a card from a standard deck, and the output is the suit.	Lesson 4
Lesson 5: Graphs of Functions and Equations **8.F.A.2** Compare properties of two functions each represented in a different way (algebraically,			Lesson 5 is when students begin graphing functions of two variables. Students graph linear and nonlinear functions, and the	Lesson 5

graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change. **8.F.A.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. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.			guiding question of the lesson, "Why not just look at graphs of equations in two variables?" is answered because not all graphs of equations are graphs of functions.	
Lesson 6: Graphs of Linear Functions and Rate of Change **8.F.A.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change. **8.F.A.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. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.			Students continue their work on graphs of linear functions in Lesson 6. In this lesson, students investigate the rate of change of functions and conclude that the rate of change for linear functions is the slope of the graph. In other words, this lesson solidifies the fact that the equation $y = mx + b$ defines a linear function whose graph is a straight line.	Lesson 6
Lesson 7: Comparing Linear Functions and Graphs **8.F.A.2** Compare properties of two functions each			With the knowledge that the graph of a linear function is a straight line, students begin to compare properties of two	Lesson 7

represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.		functions that are expressed in different ways in Lesson 7. One example of this relates to a comparison of phone plans. Students are provided a graph of a function for one plan and an equation of a function that represents another plan. In other situations, students are presented with functions that are expressed algebraically, graphically, and numerically in tables, or are described verbally. Students must use the information provided to answer questions about the rate of change of each function.	
Lesson 8: Graphs of Simple Nonlinear Functions **8.F.A.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. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.		In Lesson 8, students work with simple nonlinear functions of area and volume and their graphs.	Lesson 8
MODULE 5 - Topic B: Volume			
Lesson 9: Examples of Functions from Geometry **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		In Lesson 9, students work with functions from geometry. For example, students write the rules that represent the perimeters of various regular shapes and areas of common shapes. Along those same lines, students write functions that represent the area of more complex shapes (e.g., the border of a picture frame).	Lesson 9

Lesson 10: Volumes of Familiar Solids—Cones and Cylinders **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		In Lesson 10, students learn the volume formulas for cylinders and cones. Building upon their knowledge of area of circles and the concept of congruence, students see a cylinder as a stack of circular congruent disks and consider the total area of the disks in three dimensions as the volume of a cylinder. A physical demonstration shows students that it takes exactly three cones of the same dimensions as a cylinder to equal the volume of the cylinder. The demonstration leads students to the formula for the volume of cones in general. Students apply the formulas to answer questions such as, "If a cone is filled with water to half its height, what is the ratio of the volume of water to the container itself?" Students then use what they know about the volume of the cylinder to derive the formula for the volume of a sphere.	Lesson 10
Lesson 11: Volume of a Sphere **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		In Lesson 11, students learn that the volume of a sphere is equal to two-thirds the volume of a cylinder that fits tightly around the sphere and touches only at points. Finally, students apply what they have learned about volume to solve real-world problems where they will need to make decisions about which formulas to apply to a given situation.	Lesson 11
MODULE 6 - Topic A: Linear Functions	MP.2 Reason abstractly and quantitatively.		

	MP.4 Model with mathematics. MP.6 Attend to precision. MP.7 Look for and make use of structure.		
Lesson 1: Modeling Linear Relationships **8.F.B.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.		In Topic A, students build on their study of functions by recognizing a linear relationship between two variables (**8.F.B.4**). Students use the context of a problem to construct a function to model a linear relationship (**8.F.B.4**). In Lesson 1, students are given a verbal description of a linear relationship between two variables and then must describe a linear model. Students graph linear functions using a table of values and by plotting points. They recognize a linear function given in terms of the slope and initial value, or intercept.	Lesson 1
Lesson 2: Interpreting Rate of Change and Initial Value **8.F.B.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. **8.F.B.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		In Lesson 2, students interpret the rate of change and the y-intercept, or initial value, in the context of the problem. They interpret the sign of the rate of change as indicating that a linear function is increasing or decreasing (**8.F.B.5**) and as indicating the steepness of a line.	Lesson 2

exhibits the qualitative features of a function that has been described verbally.			
Lesson 3: Representations of a Line **8.F.B.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. **8.F.B.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.		In Lesson 3, students graph the line of a given linear function. They express the equation of a linear function as $y = mx + b$, or an equivalent form, when given the initial value and slope.	Lesson 3
Lessons 4–5: Increasing and Decreasing Functions **8.F.B.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.		In Lessons 4 and 5, students describe and interpret a linear function given two points or its graph.	Lesson 4 Lesson 5

Unit 3 Vocabulary
Module 4 Average Speed, Constant Speed, Horizontal Line, Linear Equation, Point-Slope Equation of Line, Slope of a in a Cartesian Plane, Slope-Intercept Equation of a Line, Solution to a System of Linear Equations, Standard Form of a Linear Equation, Systems of Linear Equations, Vertical Line, X-intercept, Y-Intercept Familiar Terms: Coefficient, Equation, Like Terms, Linear Equation, Solution, Term, Unit Rate, Variable Module 5 Cone, Cylinder, Equation Form of a Linear Function, Function, Graph of a Linear Function, Lateral Edge and Face of a Prism, Lateral Edge and Face of a Pyramid, Linear Function, Solid Sphere or Ball, Sphere Familiar Terms: Area, Linear Equation, Nonlinear Equation, Rate of Change, Solids, Volume Module 6 Association, Bivariate Data Set, Column Relative Frequency, Row Relative Frequency, Scatter Plot, Two-Way Frequency Table, Variable Familiar Terms: Categorical variable, intercept or initial value, Numerical variable, slope

Unit 4 Grade 8 Math Curriculum			
Content & Practice Standards	**Standards for Mathematical Practice**	**Critical Knowledge & Skills**	**Examples**
MODULE 6 – Topic B: Bivariate Numerical Data			
Lesson 6: Scatter Plots **8.SP.A.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.		In Topic B, students connect their study of linear functions to applications involving bivariate data. A key tool in developing this connection is a scatter plot. In Lesson 6, students construct scatter plots and focus on identifying linear versus nonlinear patterns (**8.SP.A.1**).	Lesson 6
Lesson 7: Patterns in Scatter Plots **8.SP.A.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.		They distinguish positive linear association and negative linear association based on the scatter plot. Students describe trends in the scatter plot along with clusters and outliers (points that do not fit the pattern).	Lesson 7
Lesson 8: Informally Fitting a Line **8.SP.A.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.		In Lesson 8, students informally fit a straight line to data displayed in a scatter plot (**8.SP.A.2**) by judging the closeness of the data points to the line.	Lesson 8

MODULE 6 – Topic C: Linear and Nonlinear Models			
Lesson 9: Determining the Equation of a Line Fit to Data **8.SP.A.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.		In Lesson 9, students interpret and determine the equation of the line they fit to the data and use the equation to make predictions and to evaluate possible association of the variables. Based on these predictions, students address the need for a *best-fit* line, which is formally introduced in Algebra I.	Lesson 9
Lesson 10: Linear Models **8.SP.A.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.		In Topic C, students interpret and use linear models. They provide verbal descriptions based on how one variable changes as the other variable changes (8.SP.A.3). Students identify and describe how one variable changes as the other variable changes for linear and nonlinear associations. They describe patterns of positive and negative associations using scatter plots (8.SP.A.1, 8.SP.A.2). In Lesson 10, students identify applications in which a linear function models the relationship between two numerical variables.	Lesson 10
Lesson 11: Using Linear Models in a Data Context **8.SP.A.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. **8.SP.A.2** Know that straight lines are widely		In Lesson 11, students use a linear model to answer questions about the relationship between two numerical variables by interpreting the context of a data set (8.SP.A.1). Students use graphs and the patterns of linear association to answer questions about the relationship of the data.	Lesson 11

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.A.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.			
MODULE 6 – Topic D: Bivariate Categorical Data			
Lesson 12: Nonlinear Models in a Data Context (Optional) **8.SP.A.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 the two variables.		Topic D extends the concept of a relationship between variables to bivariate categorical data. In Lesson 12, students also examine patterns and graphs that describe nonlinear associations of data (**8.SP.A.1**)	Lesson 12
Lesson 13: Summarizing Bivariate Categorical Data in a Two-Way Table **8.SP.A.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		In Lesson 13, students organize bivariate categorical data into a two-way table (**8.SP.A.4**). They calculate row and column relative frequencies and interpret them in the context of a problem.	Lesson 13

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.			
Lesson 14: Association Between Categorical Variables **8.SP.A.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 the two variables.		In Lesson 14, students informally decide if there is an association between two categorical variables by examining the differences of row or column relative frequencies. They interpret association between two categorical variables as knowing the value of one of the variables provides information about the likelihood of the different possible values of the other variable.	Lesson 14
MODULE 7 – Topic A: Square and Cube Roots	MP.6: Attend to Precision MP.7: Look for and make use of structure MP.8: Look for and express regularity in repeated reasoning		
Lesson 1: The Pythagorean Theorem **8.NS.A.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		The use of the Pythagorean theorem to determine side lengths of right triangles motivates the need for students to learn about square roots and irrational numbers in general. While students have previously applied the Pythagorean theorem using perfect squares, students begin by estimating the length of an unknown side of a right triangle in Lesson 1 by determining which two perfect squares a squared	Lesson 1

eventually into a rational number.		number is between. This leads them to know between which two positive integers the length must be.	
Lesson 2: Square Roots **8.NS.A.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. **8.NS.A.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 to get better approximations. **8.EE.A.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.		In Lesson 2, students are introduced to the notation and meaning of square roots. The term and formal definition for irrational numbers is not given until Topic B, but students know that many of this type of number exist between the positive integers on the number line. That fact allows students to place square roots on a number line in their approximate position using perfect square numbers as reference points.	Lesson 2
Lesson 3: Existence and Uniqueness of Square Roots and Cube Roots **8.EE.A.2** Use square root and cube root		In Lesson 3, students are given proof that the square or cube root of a number exists and is unique. Students then solve simple equations that require them to find	Lesson 3

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.		the square root or cube root of a number. These will be in the form $x^2 = p$ or $x^3 = p$, where p is a positive rational number.	
Lesson 4: Simplifying Square Roots (Optional) **8.EE.A.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.		In the optional Lesson 4, students learn that a square root of a number can be expressed as a product of its factors and use that fact to simplify the perfect square factors.	Lesson 4
Lesson 5: Solving Equations with Radicals **8.EE.A.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.		In Lesson 5, students solve multi-step equations that require students to use the properties of equality to transform an equation until it is in the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number	Lesson 5
MODULE 7 – Topic B: Decimal Expansions of Numbers	MP.6: Attend to Precision MP.7: Look for and make use of structure MP.8: Look for and express regularity in repeated reasoning		
Lesson 6: Finite and Infinite Decimals **8.NS.A.1** Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal		In Lesson 6, students learn that every number has a decimal expansion that is finite or infinite. Finite and infinite decimals are defined, and students learn a strategy for writing a fraction as a finite decimal that focuses on the denominator and its factors.	Lesson 6

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.A.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 $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.		That is, a fraction can be written as a finite decimal if the denominator is a product of twos, a product of fives, or a product of twos and fives.	
Lesson 7: Infinite Decimals **8.NS.A.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. **8.NS.A.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 $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.		In Lesson 7, students learn that numbers that cannot be expressed as finite decimals are infinite decimals. Students write the expanded form of infinite decimals and show on the number line their decimal representation in terms of intervals of tenths, hundredths, thousandths, and so on. This work with infinite decimals prepares students for understanding how to approximate the decimal expansion of an irrational number.	Lesson 7

Lesson 8: The Long Division Algorithm **8.NS.A.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. **8.NS.A.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 to get better approximations.		In Lesson 8, students use the long division algorithm to determine the decimal form of a number and can relate the work of the algorithm to why digits in a decimal expansion repeat. Students engage in a discussion about numbers that have an infinite decimal expansion with no discernable pattern in the digits, leading to the idea that numbers can be irrational. It is in these first few lessons of Topic B that students recognize that rational numbers have a decimal expansion that repeats eventually, either in zeros or in a repeating block of digits.	Lesson 8
Lesson 9: Decimal Expansions of Fractions, Part 1 **8.NS.A.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. **8.NS.A.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		The discussion of infinite decimals continues with Lesson 9, where students learn how to use what they know about powers of 10 and equivalent fractions to make sense of why the long division algorithm can be used to convert a fraction to a decimal. Students know that multiplying the numerator and denominator of a fraction by a power of 10 is similar to putting zeros after the decimal point when doing long division.	Lesson 9

truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.			
Lesson 10: Converting Repeating Decimals to Fractions **8.NS.A.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. **8.NS.A.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 $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.		In Lesson 10, students learn that a number with a decimal expansion that repeats can be expressed as a fraction. Students learn a strategy for writing repeating decimals as fractions that relies on their knowledge of multiplying by powers of 10 and solving linear equations.	Lesson 10
Lesson 11: The Decimal Expansion of Some Irrational Numbers **8.NS.A.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		Lesson 11 introduces students to the method of rational approximation using a series of rational numbers to get closer and closer to a given number. Students write the approximate decimal expansion of irrational numbers in Lesson 11, and it is in this lesson that irrational numbers are defined as numbers that are not equal to rational numbers. Students realize that irrational numbers are different because they have infinite decimal expansions that do not repeat. Therefore,	Lesson 11

eventually into a rational number. **8.NS.A.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 $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations. **8.EE.A.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.		irrational numbers are those that are not equal to rational numbers.	
Lesson 12: Decimal Expansions of Fractions, Part 2 **8.NS.A.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. **8.NS.A.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 $\sqrt{2}$, show		Rational approximation is used again in Lesson 12 to verify the decimal expansions of rational numbers. Students then compare the method of rational approximation to long division.	Lesson 12

that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.			
Lesson 13: Comparing Irrational Numbers **8.NS.A.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. **8.NS.A.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 to get better approximations.		In Lesson 13, students compare the value of rational and irrational numbers. Students use the method of rational approximation to determine the decimal expansion of an irrational number. Then, they compare that value to the decimal expansion of rational numbers in the form of a fraction, decimal, perfect square, or perfect cube. Students can now place irrational numbers on a number line with more accuracy than they did in Lesson 2. I	Lesson 13
Lesson 14: Decimal Expansion of π **8.NS.A.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. **8.NS.A.2** Use rational approximations of irrational numbers to compare the size of		In Lesson 14, students approximate π using the area of a quarter circle that is drawn on grid paper. Students estimate the area of the quarter circle using inner and outer boundaries. As with the method of rational approximation, students continue to refine their estimates of the area, which improves their estimate of the value of π. Students then determine the approximate values of expressions involving π.	Lesson 14

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 $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue to get better approximations.			
MODULE 7 – Topic C: The Pythagorean Theorem	MP.6: Attend to Precision MP.7: Look for and make use of structure MP.8: Look for and express regularity in repeated reasoning		
Lesson 15: Pythagorean Theorem, Revisited **8.G.B.6** Explain a proof of the Pythagorean Theorem and its converse. **8.G.B.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.G.B.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.		In Lesson 15, students engage with another proof of the Pythagorean theorem. This time, students compare the areas of squares that are constructed along each side of a right triangle in conjunction with what they know about similar triangles. Now that students know about square roots, students can determine the approximate length of an unknown side of a right triangle even when the length is not a whole number.	Lesson 15
Lesson 16: Converse of the Pythagorean Theorem **8.G.B.6** Explain a proof of the Pythagorean Theorem and its converse.		Lesson 16 shows students another proof of the converse of the Pythagorean theorem based on the notion of congruence. Students practice explaining proofs in their own words in Lessons 15 and 16 and apply the converse of the theorem to make informal arguments about triangles as right	Lesson 16

		triangles.	
Lesson 17: Distance on the Coordinate Plane **8.G.B.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.		Lesson 17 focuses on the application of the Pythagorean theorem to calculate the distance between two points on the coordinate plane.	Lesson 17
Lesson 18: Applications of the Pythagorean Theorem **8.G.B.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.G.B.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.		Lesson 18 gives students practice applying the Pythagorean theorem in a variety of mathematical and real-world scenarios. Students determine the height of isosceles triangles, determine the length of the diagonal of a rectangle, and compare lengths of paths around a right triangle.	Lesson 18
MODULE 7 – Topic D: Applications of Radicals and Roots	MP.6: Attend to Precision MP.7: Look for and make use of structure MP.8: Look for and express regularity in repeated reasoning		
Lesson 19: Cones and Spheres **8.G.B.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.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to		In Lesson 19, students use the Pythagorean theorem to determine the height, lateral length (slant height), or radius of the base of a cone. Students also use the Pythagorean theorem to determine the radius of a sphere given the length of a cord. Many problems in Lesson 19 also require students to use the height, length, or radius they determined using the Pythagorean theorem to then find the volume	Lesson 19

solve real-world and mathematical problems.		of a figure.	
Lesson 20: Truncated Cones **8.G.B.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.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		In Lesson 20, students learn that the volume of a truncated cone can be determined using facts about similar triangles. Specifically, the fact that corresponding parts of similar triangles are equal in ratio is used to determine the height of the part of the cone that has been removed to make the truncated cone. Then, students calculate the volume of the whole cone (i.e., removed part and truncated part) and subtract the volume of the removed portion to determine the volume of the truncated cone. In this lesson, students learn that the formula to determine the volume of a pyramid is analogous to that of a cone. That is, the volume of a pyramid is exactly one-third the volume of a rectangular prism with the same base area and height.	Lesson 20
Lesson 21: Volume of Composite Solids **8.G.B.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.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		In Lesson 21, students determine the volume of solids comprised of cylinders, cones, spheres, and combinations of those figures as composite solids. Students consistently link their understanding of expressions (numerical and algebraic) to the volumes they represent. I	Lesson 21
Lesson 22: Average Rate of Change **8.G.B.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.		In Lesson 22, students apply their knowledge of volume to compute the average rate of change in the height of the water level when water drains into a conical container. Students bring together much of what they have learned in Grade 8, such as Pythagorean theorem, volume of solids,	Lesson 22

8.G.C.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		similarity, constant rate, and rate of change, to work on challenging problems in Lessons 22 and 23.	
Lesson 23: Nonlinear Motion **8.G.B.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.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.		The optional modeling lesson, Lesson 23, challenges students with a problem about nonlinear motion. In describing the motion of a ladder sliding down a wall, students bring together concepts of exponents, roots, average speed, constant rate, functions, and the Pythagorean theorem. Throughout the lesson, students are challenged to reason abstractly and quantitatively while making sense of problems, applying their knowledge of concepts learned throughout the year to persevere in solving them.	Lesson 23

Unit 4 Vocabulary
Module 6 Association, Bivariate Data Set, Column Relative Frequency, Row Relative Frequency, Scatter Plot, Two-Way Frequency Table, Variable Familiar Terms: Categorical variable, intercept or initial value, Numerical variable, slope Module 7 Cube Root, Decimal Expansion, Decimal Expansion of a Negative number, Decimal Expansion of Positive Real Number, Decimal System, Irrational Number, The n^{th} Decimal Digit of a Decimal Expansion, The n^{th} Finite Decimal of a Decimal Expansion, Perfect Square, Rational Approximation, Real Number, A Square Root of a Number, The Square Root of a Number, Truncated Cone Familiar Terms: Decimal Expansion, Finite Decimal, Number Line, Rate of Change, Rational Number, Volume

Research-Based Effective Teaching Strategies	21st Century Learning Skills
Task/Activities that solidifies mathematical concepts Use questioning techniques to facilitate learning Reinforcing Effort, Providing Recognition Practice , reinforce and connect to other ideas within mathematics Promotes linguistic and nonlinguistic representations Cooperative Learning Setting Objectives, Providing Feedback Varied opportunities for students to communicate mathematically Use technological and /or physical tools	Teamwork and Collaboration Initiative and Leadership Curiosity and Imagination Innovation and Creativity Critical thinking and Problem Solving Flexibility and Adaptability Effective Oral and Written Communication Accessing and Analyzing Information

Formative Assessment	Summative Assessment	Technology
Short constructed responses Extended responses Checks for understanding Exit tickets Teacher observation Projects Timed Practice Test – Multiple Choice & Open-Ended Questions	End of Unit Assessment	NJ CORE Annenberg Learning : Insight into Algebra 1 Mathematics Assessment Projects Get the Math Achieve the Core Webmath.com sosmath.com Mathplanet.com Interactive Mathematics.com Illustrative Mathematics Inside Mathmatics.org Asia Pacific Economic Cooperation : :Lesson Study Videos Genderchip.org Interactive Geometry Mathematical Association of America National Council of Teachers of