Curriculum Map: Common Core Math 8

Course: CORE MATH 8 Subtopic: General

Grade(s): None specified

Course Description:	Students formalize and extend the math they learned in kindergarten through seventh grade. Students engage in activities aligned to Common Core Grade 8 Mathematics Standards. Units of study focus primarily on The Number System, Expressions and Equations, Functions, Geometry and Statistics and Probability. Students learn the essential skills for success in today's world, such as critical thinking, problem solving, communication and collaboration.
Course Textbooks, Workbooks, Materials Citations:	Bailey, Rhonda. Glencoe Mathematics: Mathematics Applications and Concepts Course 3. New York: Glencoe/McGraw-Hill, 2004. Print.
Curriculum Map Author(s):	Mrs. Jennifer Chambers Mrs. Jeri Ann Turner
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Unit: Unit 1: Standards for Mathematical Practice

Unit/Module Description:	The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).
Unit/Module Big Ideas:	1. Mathematically proficient students at all levels are able to meet success in mathematics.
Unit/Module Essential Questions:	1. How do we make sense of problems? 2. How do we persevere in solving problems? 3. How do we reason abstractly? 4. How do we reason quantitatively? 5. How do we construct viable arguments? 6. How do we critique the reasoning of others? 7. How do we model with mathematics? 8. How do we use appropriate tools strategically? 9. How do we attend to precision? 10. How do we look for and make use of structure? 11. How do we look for and express regularity in repeated reasoning?
Unit/Module Student Learning Outcomes:	1. Explain the meaning of a problem. 2. Look for entry points to the solution of a problem. 3. Analyze givens, constraints, relationships, and goals of a problem. 4. Make conjectures about the form and meaning of a solution. 5. Plan a solution pathway rather than simply jumping into a solution attempt. 6. Monitor and evaluate progress in problem solving and change course if necessary. 7. Explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. 8. Check answers to problems using a different method, and determine if it makes sense. 9. Understand the approaches of others to solving complex problems and identify correspondences between different approaches. 10. Make sense of quantities and their relationships in problem situations. 11. Decontextualize problems. (abstract a given situation and represent it symbolically and manipulate the representing symbols.) 12. Contextualize problems. (pause as needed during the manipulation process in order to

probe into the referents for the symbols involved.)
13. Create a coherent representation of the problem at hand.
14. Consider the units involved in solving a problem.
15. Attend to the meaning of quantities.
16. Know and be flexible in using different properties of operations and objects.
17. Understand and use stated assumptions, definitions, and previously established results in constructing arguments.
18. Make conjectures and build a logical progression of statements to explore the truth of their conjectures.
19. Analyze situations by breaking them into cases, and can recognize and use counterexamples.
20. Justify conclusions.
21. Communicate conclusions and respond to the arguments about them.
22. Reason inductively and make arguments about data.
23. Compare the effectiveness of two plausible arguments.
24. Distinguish correct logic or reasoning form that which is flawed.
25. Listen or read the arguments of others.
26. Decide whether arguments of others make sense.
27. Ask useful questions to clarify or improve the arguments.
28. Apply known mathematics to solve problems arising in everyday life, society, and the workplace.
29. Make assumptions and approximations to simplify a complicated situation.
30. Apply knowledge of mathematics to solve problems.
31. Identify important quantities in a practical situation.
32. Map relationships using diagrams, two-way tables, graphs, flowcharts and formulas.
33. Analyze relationships mathematically to draw conclusions.
34. Interpret mathematical results in the context of the situation.
35. Reflect on whether results make sense.
36. Consider the available tools when solving a mathematical problem.
37. Become sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.
38. Recognize both the insight to be gained and their limitations.
39. Identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems.
40. Use technological tools to explore and deepen their understanding of concepts.
41. Communicate precisely to others.
42. Use clear definitions in discussion with others and in their own reasoning.
43. State the meaning of the symbols chosen, including using the equal sign consistently and appropriately.
44. Specify units of measures.
45. Label axes to clarify the correspondence with quantities in a problem.
46. Calculate accurately and efficiently.
47. Express numerical answers with a degree of precision appropriate for the problem context.
48. Look closely to discern a pattern or structure.
49. Recognize the significance of an existing line in a geometric figure.
50. Use the strategy of drawing an auxiliary line for solving problems.
51.Notice if calculations are repeated.
52. Look for general methods and for shortcuts.
53. Maintain oversight of the process as they work to solve a problem while attending to the details.
54. Evaluate the reasonableness of their intermediate results.

Unit/Module Notes: Taken from Common Core State Standards for Mathematics by the Common Core State Standards Initiative

Lesson Topic: Core Lesson 1: Make sense of problems and persevere in solving them.

Core Lesson/Topic Description: Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draws diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

Core Lesson/Topic Big Ideas:

1. Mathematically proficient students at all levels are able to meet success in mathematics.

Core Lesson/Topic Essential Questions:

1. How do we make sense of problems?
2. How do we persevere in solving them?

Core Lesson/Topic Student Learning Outcomes:

1. Explain the meaning of a problem.
2. Look for entry points to the solution of a problem.
3. Analyze givens, constraints, relationships, and goals of a problem.
4. Make conjectures about the form and meaning of a solution.
5. Plan a solution pathway rather than simply jumping into a solution attempt.
6. Monitor and evaluate progress in problem solving and change course if necessary.
7. Explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends.
8. Check answers to problems using a different method, and determine if it makes sense.
9. Understand the approaches of others to solving complex problems and identify correspondences between different approaches.

Lesson Topic: Core Lesson 2: Reason abstractly and quantitatively.

Core Lesson/Topic Description:

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

Core Lesson/Topic Big Ideas:

1. Mathematically proficient students at all levels are able to meet success in mathematics.

Core Lesson/Topic Essential Questions:

1. How do we reason abstractly?
2. How do we reason quantitatively?

Core Lesson/Topic Student Learning Outcomes:

1. Make sense of quantities and their relationships in problem situations.
2. Decontextualize problems. (abstract a given situation and represent it symbolically and manipulate the representing symbols.)
3. Contextualize problems. (pause as needed during the manipulation process in order to probe into the referents for the symbols involved.)
4. Create a coherent representation of the problem at hand.
5. Consider the units involved in solving a problem.
6. Attend to the meaning of quantities.
7. Know and be flexible in using different properties of operations and objects.

Lesson Topic: Core Lesson 3:Construct viable arguments and critique the reasoning of others.

Core Lesson/Topic Description:

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

	students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.
Core Lesson/Topic Big Ideas:	1. Mathematically proficient students at all levels are able to meet success in mathematics.
Core Lesson/Topic Essential Questions:	1. How do we construct viable arguments? 2. How do we critique the reasoning of others?
Core Lesson/Topic Student Learning Outcomes:	1. Understand and use stated assumptions, definitions, and previously established results in constructing arguments. 2. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. 3. Analyze situations by breaking them into cases, and can recognize and use counterexamples. 4. Justify conclusions. 5. Communicate conclusions and respond to the arguments about them. 6. Reason inductively and make arguments about data. 7. Compare the effectiveness of two plausible arguments. 8. Distinguish correct logic or reasoning form that which is flawed. 9. Listen or read the arguments of others. 10. Decide whether arguments of others make sense. 11. Ask useful questions to clarify or improve the arguments.

Lesson Topic: Core Lesson 4: Model with mathematics.

Core Lesson/Topic Description:	Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
Core Lesson/Topic Big Ideas:	1. Mathematically proficient students at all levels are able to meet success in mathematics.
Core Lesson/Topic Essential Questions:	1. How do we model with mathematics?
Core Lesson/Topic Student Learning Outcomes:	1. Apply known mathematics to solve problems arising in everyday life, society, and the workplace. 2. Make assumptions and approximations to simplify a complicated situation. 3. Apply knowledge of mathematics to solve problems. 4. Identify important quantities in a practical situation. 5. Map relationships using diagrams, two-way tables, graphs, flowcharts and formulas. 6. Analyze relationships mathematically to draw conclusions. 7. Interpret mathematical results in the context of the situation. 8. Reflect on whether results make sense.

Lesson Topic: Core Lesson 5: Use appropriate tools strategically.

Core Lesson/Topic Description:	Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically

proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

Core Lesson/Topic Big Ideas:
1. Mathematically proficient students at all levels are able to meet success in mathematics.

Core Lesson/Topic Essential Questions:
1. How do we use appropriate tools strategically?

Core Lesson/Topic Student Learning Outcomes:
1. Consider the available tools when solving a mathematical problem.
2. Become sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.
3. Recognize both the insight to be gained and their limitations.
4. Identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems.
5. Use technological tools to explore and deepen their understanding of concepts.

Lesson Topic: Core Lesson 6: Attend to precision.

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

Core Lesson/Topic Big Ideas:
1. Mathematically proficient students at all levels are able to meet success in mathematics.

Core Lesson/Topic Essential Questions:
1. How do we attend to precision?

Core Lesson/Topic Student Learning Outcomes:
1. Communicate precisely to others.
2. Use clear definitions in discussion with others and in their own reasoning.
3. State the meaning of the symbols chosen, including using the equal sign consistently and appropriately.
4. Specify units of measures.
5. Label axes to clarify the correspondence with quantities in a problem.
6. Calculate accurately and efficiently.
7. Express numerical answers with a degree of precision appropriate for the problem context.

Lesson Topic: Core Lesson 7: Look for and make use of structure.

Core Lesson/Topic Description:
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 x 8 equals the well remembered 7 x 5 + 7 x 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 x 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

Core Lesson/Topic
1. Mathematically proficient students at all levels are able to meet success in mathematics.

Big Ideas:

Core Lesson/Topic Essential Questions:

1. How do we look for and make use of structure?

Core Lesson/Topic Student Learning Outcomes:

1. Look closely to discern a pattern or structure.
2. Recognize the significance of an existing line in a geometric figure.
3. Use the strategy of drawing an auxiliary line for solving problems.

Lesson Topic: Core Lesson 8: Look for and express regularity in repeated reasoning.

Core Lesson/Topic Description:

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with 3, middle school students might abstract the equation (y - 2)/(x - 1) = 3. Noticing the regularity in the way terms cancel when expanding (x - 1)(x + 1), (x - 1)(x^2 + x + 1), and (x - 1)(x^3 + x^2 + x + 1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Core Lesson/Topic Big Ideas:

1. Mathematically proficient students at all levels are able to meet success in mathematics.

Core Lesson/Topic Essential Questions:

1. How do we look for and express regularity in repeated reasoning?

Core Lesson/Topic Student Learning Outcomes:

1. Notice if calculations are repeated.
2. Look for general methods and for shortcuts.
3. Maintain oversight of the process as they work to solve a problem while attending to the details.
4. Evaluate the reasonableness of their intermediate results.

Unit: Unit 2:The Number System

Unit/Module Description:

Students know that there are numbers that are not rational, and approximate them by using their knowledge of rational numbers. Students convert numbers into equivalent forms. Students know the approximate positioning of irrational numbers located on a number line.

Unit/Module Big Ideas:

1. Estimation of irrational numbers is sometimes necessary to solve problems involving them.

2. The set of real numbers has infinite subsets including the sets of whole numbers, integers, rational, and irrational numbers.
3. Numbers, measures, expressions, equations, and inequalities can represent mathematical situations and structures in many equivalent forms.

Unit/Module Essential Questions:

1. How can we represent and/or numbers in equivalent forms?
2. How do we approximate an irrational number?
3. How can we locate/identify rational and irrational numbers on a number line?
4. How do we classify numbers as rational or irrational?

Unit/Module Key Terminology & Definitions :

1. rational number- Numbers of the form $\frac{a}{b}$, where a and b are integers and b $\neq$ 0.
2. irrational number- A number that cannot be expressed as $\frac{a}{b}$, where a and b are integers and b $\neq$ 0.
3. terminating decimal- A decimal is called terminating if its repeating digit is 0.
4. repeating decimal- A decimal whose digits repeat in groups of one or more. Examples are 0.181818... and 0.8333... .
5. radical sign- The symbol used to indicate a nonnegative square root. $\sqrt{\ }$
6. radicand- The number under the radical sign.
7. natural number - Numbers used for counting.

8. number line- A straight line on which every point is assumed to correspond to a real number and every real number to a point.
9. integer- The set of whole numbers and their opposites.
10. bar notation- In repeating decimals, the line or bar placed over the digits that repeat.
11. real numbers- The set of rational numbers together with the set of irrational numbers.
12. set - A group of numbers.
13. subset - A set each of whose elements is an element of an inclusive set.
14. whole number - Set of natural numbers and zero.

Unit/Module Student Learning Outcomes:

Concepts
1. Know the difference between a rational and irrational number.
2. Know that there are numbers that are not rational.
3. Understand that decimals either terminate or repeat.
4. Know that irrational numbers have an approximate decimal value.
5. Understand that rational and irrational numbers have a position on the number line.

Competencies
1. Classify a number as rational or irrational.
2. Convert rational numbers into terminating or repeating decimals.
3. Convert terminating and repeating decimals into rational numbers.
4. Estimate the value of irrational numbers without a calculator (limit whole number radicand to less than 144).
5. Compare and order rational and irrational numbers.
6. Locate/identify rational and irrational numbers at their approximate locations on a number line.

STANDARDS

STATE: PA Common Core Anchors and Eligible Content (May 2012)

M08.A-N.1.1.1 (Advanced)	Determine whether a number is rational or irrational. For rational numbers, show that the decimal expansion terminates or repeats (limit repeating decimals to thousandths).
M08.A-N.1.1.2 (Advanced)	Convert a terminating or repeating decimal into a rational number (limit repeating decimals to thousandths).
M08.A-N.1.1.3 (Advanced)	Estimate the value of irrational numbers without a calculator (limit whole number radicand to less than 144). Example: 5 is between 2 and 3 but closer to 2.
M08.A-N.1.1.4 (Advanced)	Use rational approximations of irrational numbers to compare and order irrational numbers.
M08.A-N.1.1.5 (Advanced)	Locate/identify rational and irrational numbers at their approximate locations on a number line.

NATIONAL: US Common Core State Standards

MA.8.NS.1 (Advanced)	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.
MA.8.NS.2 (Advanced)	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., pi^2).

Lesson Topic: Core Lesson 1: Sets of Real Numbers

Core Lesson/Topic Description: Students are introduced to the real number system. Students distinguish between rational and irrational numbers.

Core Lesson/Topic Big Ideas:
1. The set of real numbers has infinite subsets including the sets of whole numbers, integers, rational, and irrational numbers.

Core Lesson/Topic Essential Questions:
1. How do we classify numbers as rational or irrational?

Core Lesson/Topic Key
1. integer - The set of whole numbers and their opposites.
2. irrational number - A number that cannot be expressed as $\frac{a}{b}$, where a and b are integers

Terminology & Definitions:

and b $\neq$ 0.

3. natural number - Numbers used for counting.
4. rational number - Numbers of the form $\frac{a}{b}$, where a and b are integers and b $\neq$ 0.
5. real number - The set of rational numbers together with the set of irrational numbers.
6. set - A group of numbers.
7. subset - set each of whose elements is an element of an inclusive set.
8. whole numbers - Set of natural numbers and zero.

Core Lesson/Topic Student Learning Outcomes:

1. Define natural numbers, whole numbers, integers, rational numbers and irrational numbers.
2. Classify numbers as natural, whole, integer, rational, and irrational.
3. Determine whether a number is rational or irrational.

Lesson Topic: Core Lesson 2: Converting Rational and Irrational Numbers

Core Lesson/Topic Description:

Students convert rational numbers into terminating or repeating decimals. Students convert terminating and repeating decimals into rational numbers.

Core Lesson/Topic Big Ideas:

1. Numbers, measures, expressions, equations, and inequalities can represent mathematical situations and structures in many equivalent forms.

Core Lesson/Topic Essential Questions:

1. How can we represent and/or use numbers in equivalent forms?

Core Lesson/Topic Key Terminology & Definitions:

1. bar notation - In repeating decimals, the line or bar placed over the digits that repeat.
2. repeating decimal - A decimal whose digits repeat in groups of one or more.
3. terminating decimal - A decimal is called terminating if its repeating digit is 0.

Core Lesson/Topic Student Learning Outcomes:

1. Understand and know when to use bar notation.
2. Write rational numbers(fractions) as terminating or repeating decimals(limit repeating decimals to thousandths).
3. Write terminating decimals as rational numbers(fractions).
4. Write repeating decimals(limit repeating decimals to thousandths) as rational numbers (fractions).

Core Lesson/Topic Notes:

Rational numbers include positive and negative numbers.

Lesson Topic: Core Lesson 3: Estimate Irrational Numbers

Core Lesson/Topic Description:

Students determine between which perfect squares an irrational number lies and use this to determine an approximate decimal value.

Core Lesson/Topic Big Ideas:

1. Estimation of irrational numbers is sometimes necessary to solve problems involving them.

Core Lesson/Topic Essential Questions:

1. How do we approximate an irrational number?

Core Lesson/Topic Key Terminology & Definitions:

1. Perfect Square - Rational numbers whose square roots are whole numbers.
2. Radical Sign - The symbol $\sqrt{\ }$ used to indicate a non negative square root.
3. Square root - One of the two equal factors of a number.

Core Lesson/Topic Student Learning Outcomes:

1. Know the perfect squares from 1-144.
2. Find the square root of perfect squares less than 144 without a calculator.
3. Estimate the value of irrational numbers without a calculator(limit whole number radicand to less than 144.)

Lesson Topic: Core Lesson 4: Compare and Order Real Numbers

Core Lesson/Topic Description:

Students locate rational and irrational numbers at their approximate locations on a number line. Students compare and order rational and irrational numbers.

Core Lesson/Topic Big Ideas:

1. Estimation of irrational numbers is sometimes necessary to solve problems involving them.
2. Numbers, measures, expressions, equations, and inequalities can represent mathematical situations and structures in many equivalent forms.

Core Lesson/Topic Essential Questions:

1. How can we locate/identify rational and irrational numbers on a number line?
2. How do we classify numbers as rational or irrational?

Core Lesson/Topic Key Terminology & Definitions:

1. equal - of the same measure.
2. greater than(>) - a symbol used to indicate that one number is larger than the other, with the larger number given first.
3. less than(<) - a symbol used to indicate that one number is smaller than the other, with the smaller number given first.
4. number line - A straight line on which every point is assumed to correspond to a real number and every real number to a point.

Core Lesson/Topic Student Learning Outcomes:

1. Locate rational and irrational numbers at their approximate location on a number line.
2. Identify rational and irrational numbers at their approximate locations on a number line.
3. Compare rational and irrational numbers using greater than, less than or equal symbols.
4. Order rational and irrational numbers from both greatest to least and least to greatest.

Unit: Unit 3: Expressions and Equations Part 1

Unit/Module Description:

Students apply concepts of radicals and integer exponents to generate equivalent expressions. Students express numbers in scientific notation and perform operations with them.

Unit/Module Big Ideas:

1. Operations can be performed on radical expressions.
2. Estimation provides an effective tool for judging the reasonableness of computations.
3. Numbers, measures, and expressions can represent mathematical situations and structures in many equivalent forms.

Unit/Module Essential Questions:

1. How can we represent and/or use numbers in equivalent forms?
2. How can square root and cube root symbols be used to represent the solutions to equations?
3. How can estimation be used to represent very large and very small quantities in the form of scientific notation and as a decimal?

Unit/Module Key Terminology & Definitions :

1. base- In a power, the number used as a factor. The number that is being multiplied.
2. cubed- To the third power. An exponent of 3.
3. exponent- In a power, the number of times the base is used as a factor.
4. negative exponent- For any nonzero number a and any integer n, $a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n$.
5. perfect square- A rational number whose square root is a whole number.
6. power- Numbers written using exponents. Powers represent repeated multiplication.
7. radical sign- The symbol used to indicate a nonnegative square root.
8. scientific notation- A way of expressing numbers as the product of a number that is at least 1 but less than 10 and a power of 10.
9. simplify- To reduce to a simpler form by cancellation of common factors, regrouping of terms with the same variable, etc.
10. square- To the second power. An exponent of 2.
11. square root- One of the two equal factors of a number.
12. standard form- a number written without a power of 10 and an exponent.
13. zero exponent- For any nonzero number a, $a^0 = 1$.

Unit/Module Student Learning Outcomes:

Concepts:

1. Know the properties of integer exponents to generate equivalent numerical expressions.
2. Know square and cube root symbols to represent solutions to equations.
3. Know how to evaluate square roots of perfect squares without a calculator.
4. Know how to evaluate cube roots of perfect cubes without a calculator.
5. Understand appropriate units of measurements of very large or very small quantities.
6. Understand that numbers can be written in scientific notation.

Competency:

1. Apply one or more properties of integer exponents to generate equivalent numerical expressions without a calculator.
2. Perform operations with numbers expressed in scientific notation, including problems where both decimals and scientific notation are used.
3. Interpret scientific notation that has been generated by technology.

STANDARDS

STATE: PA Common Core Anchors and Eligible Content (May 2012)

M08.B-E.1.1.1 (Advanced)	Apply one or more properties of integer exponents to generate equivalent numerical expressions without a calculator (with final answers expressed in exponential form with positive exponents). Properties will be provided. Example: 312 × 3 i15 = 3 i3 = 1/(33)
M08.B-E.1.1.2 (Advanced)	Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of perfect squares (up to and including 122) and cube roots of perfect cubes (up to and including 53) without a calculator. Example: If x2 = 25 then x = ± 25.
M08.B-E.1.1.3 (Advanced)	Estimate very large or very small quantities by using numbers expressed in the form of a single digit times an integer power of 10, and express how many times larger or smaller one number is than another. Example: Estimate the population of the United States as 3 × 108 and the population of the world as 7 × 109, and determine that the world population is more than 20 times larger than the United States population.
M08.B-E.1.1.4 (Advanced)	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Express answers in 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 (e.g., interpret 4.7EE9 displayed on a calculator as 4.7 × 109).

NATIONAL: US Common Core State Standards

MA.8.EE.1 (Advanced)	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
MA.8.EE.2 (Advanced)	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 the square root of 2 is irrational.
MA.8.EE.3 (Advanced)	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.
MA.8.EE.4 (Advanced)	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.

Lesson Topic: Core Lesson 1: Exponents

Core Lesson/Topic Description: Students apply one or more properties of integer exponents to generate an equivalent numerical expression without the use of a calculator. The solution to these numerical expressions are expressed in exponential form with positive exponents.

Core Lesson/Topic Big Ideas:	1. Numbers, measures, and expressions can represent mathematical situations and structures in many equivalent forms.
Core Lesson/Topic Essential Questions:	1. How can we represent and/or use numbers in equivalent forms? 2. How can we simplify an expression using the properties of integer exponents?
Core Lesson/Topic Key Terminology & Definitions:	1. base- In a power, the number used as a factor. The number that is being multiplied. 2. cubed- To the third power. An exponent of 3. 3. exponent- In a power, the number of times the base is used as a factor. 4. negative exponent- For any nonzero number a and any integer n, $a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n$. 5. perfect square- A number whose square root is a rational number. 6. power- Number written using exponents. Powers represent repeated multiplication. 7. square- To the second power. An exponent of 2. 8. zero exponent- For any nonzero number a, $a^0=1$.
Core Lesson/Topic Student Learning Outcomes:	1. Write expressions using exponents. 2. Evaluate expressions containing exponents. 3. Multiply monomials without variables. 4. Divide monomials without variables. 5. Write expressions using negative exponents. 6. Evaluate numerical expressions containing negative exponents. 7. Define base, cubed, exponent, negative exponent, perfect square, power, squared, zero exponent.

Lesson Topic: Core Lesson 2: Square Roots

Core Lesson/Topic Description:	Students use square root and cube root symbols to represent solutions to equations without the use of a calculator. Students evaluate square roots of perfect squares and cube roots of perfect cubes without a calculator.
Core Lesson/Topic Big Ideas:	1. Numbers, measures, and expressions can represent mathematical situations and structures in many equivalent forms. 2. Operations can be performed on radical expressions.
Core Lesson/Topic Essential Questions:	1. How can we represent and/or use numbers in equivalent forms? 2. How can square roots and cube roots be used to represent the solutions to equations?
Core Lesson/Topic Key Terminology & Definitions:	1. perfect square- A rational number whose square root is a whole number. 2. radical sign- The symbol used to indicate a non-negative square root. 3. square root- One of the two equal factors of a number.
Core Lesson/Topic Student Learning Outcomes:	1. Find square roots of perfect squares. 2. Find cube roots of perfect cubes. 3. Find negative square roots. 4. Use square roots and cube roots to solve an equation.
Core Lesson/Topic Notes:	1. Perfect squares up to 12^2. 2. Perfect cubes up to 5^3.

Lesson Topic: Core Lesson 3: Scientific Notation

Core Lesson/Topic Description:	Students express numbers in scientific notation and perform operations with them.
Core Lesson/Topic Big Ideas:	1. Numbers, measures, and expressions can represent mathematical situations and structures in many equivalent forms. 2. Estimation provides an effective tool for judging the reasonableness of computations.

Core Lesson/Topic Essential Questions:

1. How can we represent and/or use numbers in equivalent forms?
2. How can estimation be used to represent very large and very small quantities in the form of scientific notation and as a decimal?
3. How can answers be expressed in scientific notation and standard form?
4. How can scientific notation be interpreted with the use of technology?
5. What appropriate size units can be use for very large and very small quantities?

Core Lesson/Topic Key Terminology & Definitions:

1. scientific notation- A way of expressing numbers as the product of a number that is at least 1 but less than 10 and a power of 10.
2. standard form- A number written without a power of 10 and an exponent.

Core Lesson/Topic Student Learning Outcomes:

1. Express numbers in standard form.
2. Express numbers in scientific notation.
3. Compare numbers in scientific notation.
4. Interpret scientific notation that has been generated by technology.
5. Compare to estimate the factor of very large and very small numbers expressed in scientific notation.

Unit: Unit 4: Functions

Unit/Module Description:

Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions and they describe how aspects of the function are reflected in the different representations.

Unit/Module Big Ideas:

1. Relations and functions are mathematical relationships that can be represented and analyzed using words, tables, graphs and equations.
2. Mathematical functions are relationships that assign each member of one set(domain) to a unique member of another set(range), and the relationship is recognizable across representations.

Unit/Module Essential Questions:

1. How do we determine whether a relation is a function?
2. What different ways can functions be represented?
3. How do equations represent linear functions and their graphs?
4. How do functions model linear relationships between two quantities?
5. What is a rate of change?
6. How do you sketch graphs of functions?
7. How do we determine the input and output of a function?

Unit/Module Key Terminology & Definitions :

1. dependent variable - The variable for the output of the function.
2. domain - The set of input values in a function.
3. function - A relation in which each element of the input is paired with exactly one element of the input is paired with exactly one element of the output according to a specified rule.
4. independent variable - The variable for the input in a function.
5. range - The set of output values in a function.
6. rate of change - A rate that describes how one quantity changes in relation to another.
7. relation - A set of ordered pairs.

Unit/Module Student Learning Outcomes:

Concepts:
1. Understand that a function is a rule that assigns to each input exactly one output.
2. Understand relations and functions.
3. Know that relations and functions can be represented in different ways.
4. Know that equations can be represented graphically.
5. Understand that two quantities model a linear relationship.

Competencies:
1. Calculate outputs for given inputs in a function.
2. Determine whether a relation is a function.
2. Compare properties of two functions represented in different ways(algebraically, graphically, tables or verbally).
3. Interpret linear equations to be a linear function whose graph is a straight line.
4. Construct functions to model a linear relationship between two quantities.
5. Determine and interpret the rate of change of a function.
6. Describe whether functions are increasing or decreasing and linear or nonlinear.

STANDARDS

STATE: PA Common Core Anchors and Eligible Content (May 2012)

M08.B-F.1.1.1 (Advanced) Determine whether a relation is a function.

M08.B-F.1.1.2 (Advanced)	Compare properties of two functions each represented in a different way (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions). 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.
M08.B-F.1.1.3 (Advanced)	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.
M08.B-F.2.1.1 (Advanced)	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.
M08.B-F.2.1.2 (Advanced)	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 or determine a graph that exhibits the qualitative features of a function that has been described verbally.

NATIONAL: US Common Core State Standards

MA.8.CFA.2 (Advanced)	Students grasp the concept of a function as a rule that assigns to each input exactly one output.
MA.8.F.1 (Advanced)	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.
MA.8.F.2 (Advanced)	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MA.8.F.3 (Advanced)	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.
MA.8.F.4 (Advanced)	Construct a function to model a linear relationship between two quantities.
MA.8.F.5 (Advanced)	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.

Lesson Topic: Core Lesson 1: Functions

Core Lesson/Topic Description:	Students calculate outputs from given inputs to grasp the concept of a function as a rule that assigns to each input exactly one output.
Core Lesson/Topic Big Ideas:	1. Relations and functions are mathematical relationships that can be represented and analyzed using words, tables, graphs and equations. 2. Mathematical functions are relationships that assign each member of one set(domain) to a unique member of another set(range), and the relationship is recognizable across representations.
Core Lesson/Topic Essential Questions:	1. How do we determine the input and output of a function?
Core Lesson/Topic Key Terminology & Definitions:	1. domain - The set of input values. 2. function - A relation in which each element of the input is paired with exactly one element of the input is paired with exactly one element of the output according to a specified rule. 3. range - The set of output values.
Core Lesson/Topic Student Learning	1. Recognize function notation. 2. Complete function tables.

Outcomes:

Lesson Topic: Core Lesson 2: Relations & Functions

Core Lesson/Topic Description:	Students define and recognize relations and functions. Students determine whether a relation is a function represented as either set notation or graphing.
Core Lesson/Topic Big Ideas:	1. Mathematical functions are relationships that assign each member of one set(domain) to a unique member of another set(range), and the relationship is recognizable across representations.
Core Lesson/Topic Essential Questions:	1. How do we determine whether a relation is a function?
Core Lesson/Topic Key Terminology & Definitions:	1. domain - The set of input values in a function. 2. function - A relation in which each element of the input is paired with exactly one element of the input is paired with exactly one element of the output according to a specified rule. 3. range - The set of output values in a function. 4. relation - A set of ordered pairs.
Core Lesson/Topic Student Learning Outcomes:	1. Define relation and function. 2. Determine whether a relation is a function. (written as sets) 3. Determine whether a relation is a function. (graphs)

Lesson Topic: Core Lesson 3: Using Functions to Represent Relationships

Core Lesson/Topic Description:	Students translate among representations and partial representations of functions and they describe how aspects of the function are reflected in the different representations. They understand that functions describe situations where one quantity determines another.
Core Lesson/Topic Big Ideas:	1. Relations and functions are mathematical relationships that can be represented and analyzed using words, tables, graphs and equations.
Core Lesson/Topic Essential Questions:	1. What different ways can functions be represented? 2. How do equations represent linear functions and their graphs? 3. How do functions model linear relationships between two quantities? 4. What is a rate of change? 5. How do you sketch graphs of functions?
Core Lesson/Topic Key Terminology & Definitions:	1. rate of change - A rate that describes how one quantity changes in relation to another.
Core Lesson/Topic Student Learning Outcomes:	1. Compare properties of two functions represented in different ways(algebraically, graphically, tables or verbally). 2. Interpret linear equations to be a linear function whose graph is a straight line. 3. Construct functions to model a linear relationship between two quantities. 4. Determine and interpret the rate of change of a function. 5. Describe whether functions are increasing or decreasing and linear or nonlinear.

Unit: Unit 5: Expressions and Equations Part 2-Proportional Relationships

Unit/Module Description:	Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions as special linear equations, understanding that the constant of proportionality is the slope, and the graphs are lines through the origin. They understand that the slope of a line is a constant rate of change. Students also use a linear equation to describe the association between two quantities in bivariate data. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship in terms of the situation. Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve

systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

Unit/Module Big Ideas:

1. Two variable quantities are proportional if their values are in a constant ratio. The relationship between proportional quantities can be represented as a linear function.
2. Numbers, measures, expressions, equations, and inequalities can represent mathematical situations and structures in many equivalent forms.
3. Understand the connection between proportional relationships, lines, and linear equations.
4. Analyze and solve linear equations and pairs of simultaneous linear equations.

Unit/Module Essential Questions:

1. How can we compare two different proportional relationships represented in different ways?
2. How can we graph proportional relationships, interpreting the unit rate as the slope of the graph?
3. How can we use similar right triangles to show and explain why the slope is the same between any two distinct points on a non-vertical line in a coordinate plane?
4. How can we derive an equation for a line through the origin and a line intercepting the vertical axis?
5. How can we write, solve, graph, and interpret linear equations in one or two variables, using various methods?
6. How can we solve real-world and mathematical problems leading to two linear equations in two variables?

Unit/Module Key Terminology & Definitions :

1. algebraic expression- a combination of variables, numbers, and at least one operation.
2. coefficients- The numerical factor of a term that contains a variable.
3. coordinate- A number associated with a point on the number line.
4. derive- To receive or obtain from a source.
5. distributive property- A property indicating a special way in which multiplication is applied to addition of two or more numbers in which each term inside a set of parentheses can be multiplied by a factor outside of the parentheses.
6. equation- A mathematical sentence that contains the equal sign.
7. equivalent- Equal in value.
8. evaluate- To find the value of an expression by replacing the variables with numerals. To solve.
9. infinite- Subject to no limitation.
10. intersections- the point or set of points where one line crosses another.
11. like terms- Terms that contain the same variable.
12. linear equation- An equation in the form $Ax + By = C$, whose graph is a straight line.
13. numerical expression- A mathematical expression that has a combination of numbers and at least one operation.
14. origin- The point of intersection of the x-axis and y-axis in a coordinate plane.
15. proportion- A statement of equality of two ratios.
16. rate- A ratio of two measurements having different units.
17. ratio- A comparison of two numbers by division.
18. right triangle- A triangle having one right angle.
19. similar- The same.
20. slope- The rate of change between any two points on a line.
21. solution- The value for the variable that makes an equation true.
22. system of equations- A set of two or more equations considered together.
23. unit rate- A rate with a denominator of 1.
24. variable- A symbol, usually a letter, used to represent a number in mathematical expressions or sentences.
25. x-axis- The horizontal number line that helps to form the coordinate plane.
26. y-axis- The vertical number line that helps to form the coordinate plane.
27. y-intercept- The value of y where the graph crosses the y-axis.

Unit/Module Student Learning Outcomes:

Concepts:
1. Understand linear relationships between two variables, using slope.

Competencies:
1. Graph proportional relationships, interpreting the unit rate as the slope of the graph.
2. Compare two different proportional relationships represented in different ways.
3. Use similar right triangles to show and explain why the slope is the same between any two distinct points on a non-vertical line in the coordinate plane.
4. 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.
5. Write and identify linear equations in one variable with one solution, infinitely many solutions, or no solutions.
6. Solve linear equations that have rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
7. Interpret solutions to a system of two linear equations in two variables as points of

intersection of their graphs because points of intersection satisfy both equations simultaneously.
8. Solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations.
9. Solve real-world and mathematical problems leading to two linear equations in two variables.

STANDARDS

STATE: PA Common Core Anchors and Eligible Content (May 2012)

M08.B-E.2.1.1 (Advanced)	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. Example: Compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
M08.B-E.2.1.2 (Advanced)	Use similar right triangles to show and explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane.
M08.B-E.2.1.3 (Advanced)	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.
M08.B-E.3.1.1 (Advanced)	Write and identify linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).
M08.B-E.3.1.2 (Advanced)	Solve linear equations that have rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
M08.B-E.3.1.3 (Advanced)	Interpret solutions to a system of two linear equations in two variables as points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
M08.B-E.3.1.4 (Advanced)	Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. Example: 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.
M08.B-E.3.1.5 (Advanced)	Solve real-world and mathematical problems leading to two linear equations in two variables. 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.

NATIONAL: US Common Core State Standards

MA.8.CFA.1 (Advanced)	Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems.
MA.8.EE.5 (Advanced)	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
MA.8.EE.6 (Advanced)	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.
MA.8.EE.7 (Advanced)	Solve linear equations in one variable.
MA.8.EE.7.A (Advanced)	Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).
MA.8.EE.7.B (Advanced)	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
MA.8.EE.8 (Advanced)	Analyze and solve pairs of simultaneous linear equations.
MA.8.EE.8.A (Advanced)	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.

MA.8.EE.8.B (Advanced)	Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.
MA.8.EE.8.C (Advanced)	Solve real-world and mathematical problems leading to two linear equations in two variables.

Lesson Topic: Core Lesson 1: Proportional Relationships

Core Lesson/Topic Description:	Students graph proportional relationships, interpreting the unit rate as the slope of the graph. Students compare two different proportional relationships represented in different ways.
Core Lesson/Topic Big Ideas:	1. Two variable quantities are proportional if their values are in a constant ratio. The relationship between proportional quantities can be represented as a linear function. 2. Numbers, measures, expressions, equations, and inequalities can represent mathematical situations and structures in many equivalent forms.
Core Lesson/Topic Essential Questions:	1. How can we compare two different proportional relationships represented in different ways? 2. How can we graph proportional relationships, interpreting the unit rate as the slope of the graph?
Core Lesson/Topic Key Terminology & Definitions:	1. Coordinate- A number associated with a point on a number line. 2. Derive- to receive or obtain from a source. 3. Origin- The point of intersection of the x-axis and y-axis in a coordinate plane. Ordered pair (0,0). 4. Rise- The vertical change between any two points on a line. 5. Right Triangle- A triangle having one right angle. 6. Run- The horizontal change between any two points on a line. 7. Similar- The same. 8. Slope- The rate of change between any two points on a line. The ratio of vertical change to horizontal change. 9. Unit Rate- A rate with a denominator of 1. 10. Y-intercept- The value of y where the graph crosses the y-axis.
Core Lesson/Topic Student Learning Outcomes:	1. Graph proportional relationships, interpreting the unit rate as the slope of the graph. 2. Compare two different proportional relationships represented in different ways. 3. Use similar triangles to show and explain why the slope is the same between any two distinct points on a non-vertical line in the coordinate plane. 4. 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 Topic: Core Lesson 2: Linear Equations

Core Lesson/Topic Description:	Students write, solve, graph, and interpret linear equations in one or two variables, using various methods.
Core Lesson/Topic Big Ideas:	1. Understand the connection between proportional relationships, lines, and linear equations. 2. Analyze and solve linear equations and pairs of simultaneous linear equations.
Core Lesson/Topic Essential Questions:	1. How can we write, solve, graph, and interpret linear equations in one or two variables, using various methods? 2. How can we solve real-world and mathematical problems leading to two linear equations in two variables?
Core Lesson/Topic Key Terminology & Definitions:	1. Coefficient- The numerical factor of a term that contains a variable. 2. Distributive Property- A property indicating a special way in which multiplication is applied to addition of two or more numbers in which each term inside a set of parentheses can be multiplied by a factor outside the parentheses. 3. Equation- A mathematical sentence that contains the equal sign. 4. Infinite- Subject to no limitation. 5. Like Terms- Terms that contain the same variable. 6. Linear equation- An equation between two variables that gives a straight line when plotted on a graph. An equation in the form of $Ax + By = C$ 7. Solution- The value for the variables that makes an equation true. 8. Variable- a symbol, usually a letter, used to represent a number in mathematical expressions or sentences.
Core	1. Write and identify linear equations in one variable with one solution, infinitely many

Lesson/Topic Student Learning Outcomes:	solutions, or no solutions. 2. Solve linear equations that have rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. 3. Solve linear equations to have one solution, infinitely many solutions, or no solution.

Lesson Topic: Core Lesson 3: System of Equations

Core Lesson/Topic Description:	Students interpret solutions to a system of two linear equations in two variables as points of intersection of their graphs because points of intersection satisfy both equations simultaneously. Students solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations. Students solve real-world and mathematical problems leading to two linear equations in two variables.
Core Lesson/Topic Big Ideas:	1. Analyze and solve linear equations and pairs of simultaneous linear equations.
Core Lesson/Topic Essential Questions:	1. How can we write, solve, graph, and interpret linear equations in one or two variables, using various methods? 2. How can we solve real-world and mathematical problems leading to two linear equations in two variables?
Core Lesson/Topic Key Terminology & Definitions:	1. System of Equations- A set of two of more equations considered together.
Core Lesson/Topic Student Learning Outcomes:	1. Interpret solutions to a system of two equations in two variables as points of intersection of their graphs. 2. Solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations. 3. Solve simple cases by inspection. 4. Solve real-world and mathematical problems leading to two linear equations in two variables.

Unit: Unit 6: Geometry

Unit/Module Description:	Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analysis two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.
Unit/Module Big Ideas:	1. Right triangles have special properties. 2. Volume is the amount of space that a three-dimensional figure occupies. 3. Patterns exhibit relationships that can be extended, described, and generalized. 4. Two-dimensional figures maintain congruence and similarity through transformations.
Unit/Module Essential Questions:	1. How are the lengths of the sides of a right triangle related? 2. How can we use the Pythagorean Theorem to solve real-life problems? 3. How do we know if a triangle is a right triangle? 4. How do we find the volume of cones, cylinders, and spheres? 5. What are the properties of rotations, reflections and translations? 6. How is similarity and congruence related to transformations?
Unit/Module Key Terminology & Definitions :	1. cone - A three-dimensional figure with one circular base. A curved surface connects the base and the vertex. 2. converse - The converse of the Pythagorean Theorem can be used to test whether a triangle is a right triangle. 3. congruent - Have the same measure. 4. cylinder - A solid whose bases are congruent, parallel circles, connected with a curved side. 5. dilations - A transformation that results from the reduction or enlargement of an image. 6. hypotenuse - The side opposite the right angle in a right triangle. 7. legs - The two sides of a right triangle that form the right angle. 8. Pythagorean Theorem - In a right triangle, the square of the length of the hypotenuse c is

equal to the sum of the squares of the lengths of the legs a and b.
9. reflections - A type of transformation in which a mirror image is produced by flipping a figure over a line.
10. rotations - A transformation involving the turning or spinning of a figure around a fixed point.
11. similar - Polygons that have the same shape are called similar polygons.
12. sphere - A sphere is the set of all points in space that are a given distance from a given point, called the center.
13. translation - A transformation in which a figure is slid horizontally, vertically, or both.
14. transformation - A mapping of a geometric figure.
15. transversal - A line that intersects two or more other lines to form eight angles.
16. volume - The number of cubic units needed to fill the space occupied by a solid.

Unit/Module Student Learning Outcomes:

Concepts:
1. Understand the properties of geometric transformations(rotations, reflections, and translations.)
2. Know that two congruent figures maintain their congruence through a sequence of transformations.
3. Understand congruence, similarity, and geometric transformations using various tools.
4. Understand the Pythagorean Theorem and its converse.
5. Understand volume of cones, cylinders and spheres.

Competencies:
1. Identify and apply properties of rotations, reflections, and translations.
2. Describe a sequence of transformations that exhibit the congruence between two congruent figures.
3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
4. Describe a sequence of transformations that exhibits the similarity between two similar two-dimensional figures.
5. Apply the converse of the Pythagorean Theorem to show a triangle is a right triangle.
6. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
7. Apply the Pythagorean Theorem to find the distance between two points in a coordinate plane.
8. Apply formulas for the volumes of cones, cylinders, and spheres to solve real-world and mathematical problems.

STANDARDS

STATE: PA Common Core Anchors and Eligible Content (May 2012)

M08.C-G.1.1.1 (Advanced)	Identify and apply properties of rotations, reflections, and translations. Example: Angle measures are preserved in rotations, reflections, and translations.
M08.C-G.1.1.2 (Advanced)	Given two congruent figures, describe a sequence of transformations that exhibits the congruence between them.
M08.C-G.1.1.3 (Advanced)	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures, using coordinates.
M08.C-G.1.1.4 (Advanced)	Given two similar two-dimensional figures, describe a sequence of transformations that exhibits the similarity between them.
M08.C-G.2.1.1 (Advanced)	Apply the converse of the Pythagorean theorem to show a triangle is a right triangle.
M08.C-G.2.1.2 (Advanced)	Apply the Pythagorean theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. (Figures provided for problems in three dimensions will be consistent with Eligible Content in grade 8 and below.)
M08.C-G.2.1.3 (Advanced)	Apply the Pythagorean theorem to find the distance between two points in a coordinate system.
M08.C-G.3.1.1 (Advanced)	Apply formulas for the volumes of cones, cylinders, and spheres to solve real-world and mathematical problems. Formulas will be provided.

NATIONAL: US Common Core State Standards

MA.8.G.1.A (Advanced)	Lines are taken to lines, and line segments to line segments of the same length.
MA.8.G.1.B (Advanced)	Angles are taken to angles of the same measure.
MA.8.G.1.C (Advanced)	Parallel lines are taken to parallel lines.
MA.8.G.2 (Advanced)	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.

MA.8.G.3 (Advanced)	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
MA.8.G.4 (Advanced)	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.
MA.8.G.5 (Advanced)	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.
MA.8.G.6 (Advanced)	Explain a proof of the Pythagorean Theorem and its converse.
MA.8.G.7 (Advanced)	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
MA.8.G.8 (Advanced)	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
MA.8.G.9 (Advanced)	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Lesson Topic: Core Lesson 1:Transformations

Core Lesson/Topic Description:	Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analysis two-dimensional figures and to solve problems.
Core Lesson/Topic Big Ideas:	1. Two-dimensional figures maintain congruence and similarity through transformations.
Core Lesson/Topic Essential Questions:	1. What are the properties of rotations, reflections and translations? 2. How is similarity and congruence related to transformations?
Core Lesson/Topic Key Terminology & Definitions:	1. congruent - Have the same measure 2. dilations - A transformation that results from the reduction or enlargement of an image. 3. refection - A type of transformation in which a mirror image is produced by flipping a figure over a line. 4. rotation - A transformation involving the turning or spinning of a figure around a fixed point. 5. similar - Polygons that have the same shape are called similar polygons. 6. translation - A mapping of a geometric figure.
Core Lesson/Topic Student Learning Outcomes:	1. Identify and apply properties of rotations, reflections, and translations. 2. Describe a sequence of transformations that exhibit the congruence between two congruent figures. 3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. 4. Describe a sequence of transformations that exhibits the similarity between two similar two-dimensional figures.

Lesson Topic: Core Lesson 2: Pythagorean Theorem

Core Lesson/Topic Description:	Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons.
Core Lesson/Topic Big Ideas:	1. Right triangles have special properties.
Core Lesson/Topic Essential Questions:	1. How can we use the Pythagorean Theorem to solve real-life problems? 2. How do we know if a triangle is a right triangle?
Core	1. converse - The converse of a Pythagorean Theorem can be used to test whether a triangle is

Lesson/Topic Key Terminology & Definitions:	a right triangle. 2. hypotenuse - The side opposite the right angle in a right triangle. 3. legs - The two sides of a right triangle that form the right angle. 4. Pythagorean Theorem - In a right triangle, the square of the length of the hypotenuse c is equal to the sum of the squares of the lengths of the legs a and b.
Core Lesson/Topic Student Learning Outcomes:	1. Apply the converse of the Pythagorean Theorem to show a triangle is a right triangle. 2. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. 3. Apply the Pythagorean Theorem to find the distance between two points in a coordinate plane.

Lesson Topic: Core Lesson 3:Volume

Core Lesson/Topic Description:	Students find volume by solving problems involving cones, cylinders, and spheres.
Core Lesson/Topic Big Ideas:	1. Volume is the amount of space that a three-dimensional figure occupies.
Core Lesson/Topic Essential Questions:	1. How do we find the volume of cones, cylinders, and spheres?
Core Lesson/Topic Key Terminology & Definitions:	1. cone - A three-dimensional figure with one circular base. A curved surface connects the base and the vertex. 2. cylinder - A solid whose bases are congruent, parallel circles, connected with a curved side. 3. dilations - A transformation that results from the reduction or enlargement of an image. 4. sphere - A sphere is the set of all points in space that are a given distance from a given point, called the center.
Core Lesson/Topic Student Learning Outcomes:	1. Apply formulas for the volumes of cones, cylinders, and spheres to solve real-world and mathematical problems.

Unit: Unit 7:Statistics & Probability

Unit/Module Description:	Students construct and interpret scatter plots for data and investigate and describe patterns of association between two quantities. They informally find a line of best fit for scatter plots that suggest a linear relationship. Students use an equation to solve problems in the context of the data represented in a scatter plot. They construct and interpret data to describe possible association and understand patterns.
Unit/Module Big Ideas:	1. Some questions can be answered by collecting, representing and analyzing data, and the questions to be answered determines the data to be collected, how best to collect it, and how best to represent it. 2. Patterns of association can also be seen in bivariate categorical data by displaying data in tables.
Unit/Module Essential Questions:	1. How do we construct scatter plots? 2. Why do we construct scatter plots? 3. How can we find patterns of association in data? 4. How can we model relationships between variables?
Unit/Module Key Terminology & Definitions :	1. Bivariate data - Pairs of linked numerical observations. 2. Clustering - A method used in estimation when all numbers are about the same as a common number. 3. Correlation - A relationship between two variables that vary together. If one variable always increases as the other increases, the relationship is said to be positive or direct. Otherwise, the relationship is negative or inverse. 4. Line of Fit - A line that describes the trend of the data in a scatter plot. 5. Outliers - Any element of a set of data that is at least 1.5 interquartile ranges less than the lower quartile or greater than the upper quartile. 6. Scatter plot - Two sets of data plotted as ordered pairs in a coordinate plane.
Unit/Module	Concepts:

Student Learning Outcomes:	1. Know that straight lines are widely used to model relationships between two quantitative variables. 2. Know how to construct scatter plots. 3. Understand patterns of association between two quantities. 4. Understand that scatter plots can suggest a linear suggestion. Competencies: 1. Construct a scatter plot. 2. Interpret scatter plots to investigate patterns of association. 3. (Informally) fit a line of best fit. 4. Use the equation of a linear model to solve problems by interpreting the slope and intercept. 5. Represent data in tables to see patterns of association.

STANDARDS

STATE: PA Common Core Anchors and Eligible Content (May 2012)

M08.D-S.1.1.1 (Advanced)	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 correlation, linear association, and nonlinear association.
M08.D-S.1.1.2 (Advanced)	For scatter plots that suggest a linear association, identify a line of best fit by judging the closeness of the data points to the line.
M08.D-S.1.1.3 (Advanced)	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. Example: In a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.
M08.D-S.1.2.1 (Advanced)	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 associations between the two variables. Example: Given data on whether students have a curfew on school nights and whether they have assigned chores at home, is there evidence that those who have a curfew also tend to have chores?

NATIONAL: US Common Core State Standards

MA.8.SP.1 (Advanced)	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.
MA.8.SP.2 (Advanced)	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.
MA.8.SP.3 (Advanced)	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
MA.8.SP.4 (Advanced)	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.

Lesson Topic: Core Lesson 1: Scatterplots

Core Lesson/Topic Description:	Students construct and interpret scatter plots for data and investigate and describe patterns of association between two quantities. They informally find a line of fit for scatter plots that suggest a linear relationship.
Core Lesson/Topic Big Ideas:	1. Some questions can be answered by collecting, representing and analyzing data, and the questions to be answered determines the data to be collected, how best to collect it, and how best to represent it.

Core Lesson/Topic Essential Questions:	1. Why do we construct scatter plots? 2. How do we construct scatter plots? 3. How can we find patterns of association in data?
Core Lesson/Topic Key Terminology & Definitions:	1. Clustering - A method used in estimation when all numbers are about the same as a common number. 3. Correlation - A relationship between two variables that vary together. If one variable always increases as the other increases, the relationship is said to be positive or direct. Otherwise, the relationship is negative or inverse. 4. Line of Fit - A line that describes the trend of the data in a scatter plot. 5. Outliers - Any element of a set of data that is at least 1.5 interquartile ranges less than the lower quartile or greater than the upper quartile. 6. Scatter plot - Two sets of data plotted as ordered pairs in a coordinate plane.
Core Lesson/Topic Student Learning Outcomes:	1. Construct a scatter plot. 2. Interpret scatter plots to investigate patterns of association. 3. (Informally) fit a line of best fit.

Lesson Topic: Core Lesson 2: Patterns

Core Lesson/Topic Description:	Students use an equation to solve problems in the context of the data represented in a scatter plot. They construct and interpret data to describe possible association and understand patterns.
Core Lesson/Topic Big Ideas:	1. Patterns of association can also be seen in bivariate categorical data by displaying data in tables.
Core Lesson/Topic Essential Questions:	1. How can we find patterns of association in data? 2. How can we model relationships between variables?
Core Lesson/Topic Key Terminology & Definitions:	1. Bivariate - Pairs of linked numerical observations.2 2. Correlation - Describes a relationship between two varying quantities 4. Outliers - Data that is more than 1.5 times the interquartile range from the upper or lower quartiles.
Core Lesson/Topic Student Learning Outcomes:	1. Use the equation of a linear model to solve problems by interpreting the slope and intercept. 2. Represent data in tables to see patterns of association.