

Standards Resource Guide

Grade 8

Overview

This guide is designed to support educators in interpreting and implementing the 2025 Louisiana Student Standards for Mathematics (LSSM). It provides descriptions of each standard to clarify its meaning and application to student learning. The document outlines the intended level of rigor and includes coherence to prerequisite and corequisite standards. Examples are provided for illustrative purposes only and do not represent a comprehensive list.

Additional information on the 2025 Louisiana Student Standards for Mathematics, including guidance on reading standards codes, a listing of standards for each grade or course, and links to additional resources, is available on the [Louisiana Math](#) Page. Questions may be directed to math@la.gov.

Posted Date

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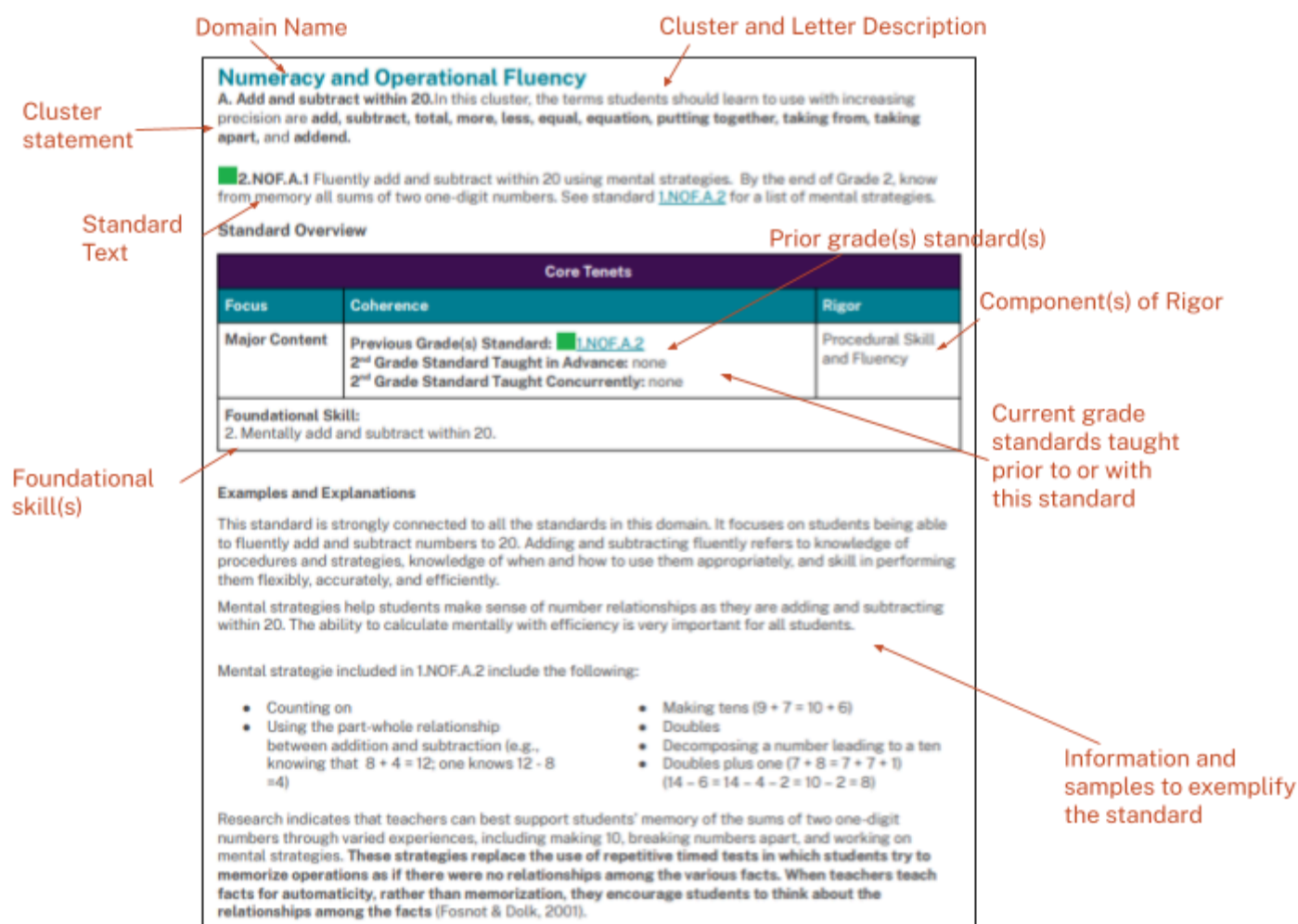
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Introduction

How to Read This Guide

The diagram below provides an overview of the information found in all standards resource guides. Definitions and more complete descriptions are provided on the next page.



*Grades 3 through Geometry will also include a section with connections to assessment item types and achievement level descriptors.

Standards Codes: ■ Major Work, ■ Supporting Work, ● Additional Work

- Domain Name and Abbreviation:** A grouping of standards consisting of related content that is further divided into clusters. Each domain has a unique abbreviation, which is provided in parentheses beside the domain name.
- Cluster Letter and Description:** Each cluster within a domain begins with a letter. The description provides a general overview of the focus of the standards in the cluster.

3. **Previous Grade(s) Standards:** One or more standards that students should have mastered in previous grades to prepare them for new learning related to the current grade-level standard. For students who have unfinished learning, teachers should build in proactive, just-in-time supports to build essential prerequisite knowledge.
4. **Standards Taught in Advance:** These grade-level standards demonstrate within-grade coherence and include concepts on which the target standard is built. Students should have exposure to these standards before instruction in the target standard. As with previous-grade standards, teachers should plan proactive, just-in-time supports to build within-grade prerequisite knowledge ahead of instruction on the target standard.
5. **Standards Taught Concurrently:** These grade-level standards demonstrate within-grade coherence and include standards that should be taught at the same time as the target standard to provide coherence and connectedness in instruction.
6. **Component(s) of Rigor:** See full explanation on components of rigor below.
7. **Sample Problem:** The sample problem provides an example of how a student might meet the requirements of the standard. Multiple examples are provided for some standards. However, sample problems should not be considered an exhaustive list. Explanations, when appropriate, are also included.
8. **Text of Standard:** The complete text of the targeted Louisiana Student Standards of Mathematics is provided.

Classification of Major, Supporting, and Additional Work

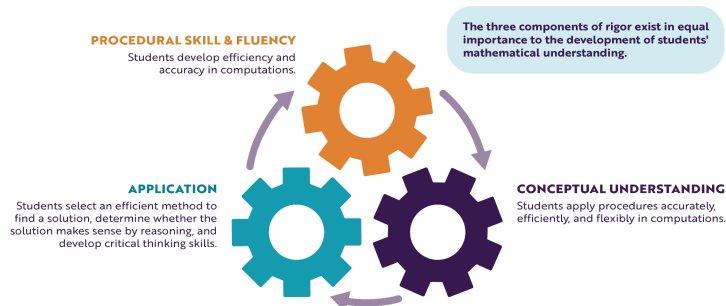
Students should spend the majority of time on the ■ major work of the grade, ■ supporting work, and, where appropriate, ● additional work engages students in the major work of the grade, often through a change of the **context** within which students are performing mathematics. Each standard is color-coded to quickly and simply determine the focus for the grade. Furthermore, standards from previous grades that provide foundational skills for current grade standards are also color-coded to show whether those standards are classified as ■ major, ■ supporting, or ● additional in respective grades.

Core Tenets

The 2016 Louisiana Student Standards for Math called for three instructional shifts. Since then, teachers have used these shifts to ensure deep understanding and consistent application in mathematics classrooms across the state. Now, these shifts are recognized as core tenets that serve as the foundation and guiding principles of Louisiana's mathematics standards.

Coherence in mathematics refers to a coherent body of knowledge composed of interconnected concepts, principles, and procedures. These concepts are logically linked, building upon one another, and work together to deepen understanding, support problem solving, and enable learners to apply mathematical ideas consistently and meaningfully across different contexts.

Rigor in mathematics instruction does not simply mean increasing the difficulty or complexity of practice problems. Incorporating rigor into classroom instruction and student learning requires students to engage deeply with standards and grapple meaningfully with the concepts and ideas embedded within them. The



three components of rigor, listed below, exist in equal importance to the development of students' mathematical understanding.

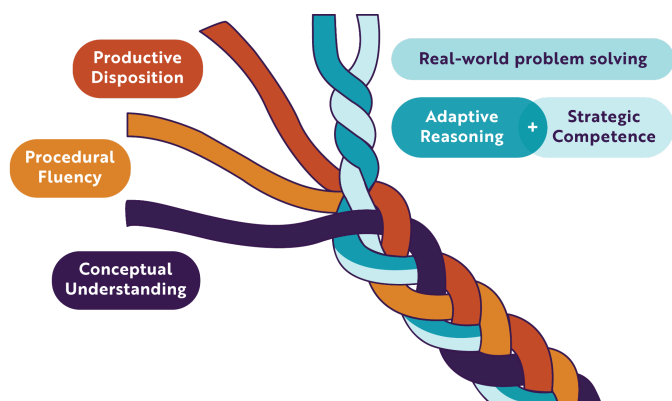
- **Conceptual understanding** refers to understanding mathematical concepts, operations, and relations. It is more than knowing isolated facts and methods. Students should be able to make sense of why a mathematical idea is important and the kinds of contexts in which it is useful. It also allows students to connect prior knowledge to new ideas and concepts.
- **Procedural skill and fluency** is the ability to apply procedures accurately, efficiently, and flexibly. It requires speed and accuracy in calculation while giving students opportunities to practice basic skills without dictating the strategy or method chosen. Students' ability to solve more complex application tasks is dependent on procedural skill and fluency.
- **Application** provides valuable context for learning and the opportunity to solve problems in a relevant and meaningful way. It is through real-world application that students learn to select an efficient method to find a solution, determine whether the solution makes sense by reasoning, and develop critical thinking skills.

Focus calls for intentional emphasis on specific topics, skills, and ideas within grade-level mathematics instruction. Not all content in a given grade is emphasized equally in the standards. Some clusters require greater emphasis than others based on the depth of the ideas, the time that they take to master, and/or the importance to future mathematics or the demands of college and career readiness. More time in these areas is also necessary for students to meet the Louisiana Standards for Mathematical Practice. To say that some things have greater emphasis is not to say that anything in the standards can safely be neglected in instruction. Students should spend the large majority of time on the major (■) work of the grade, supporting (▣) work, and, where appropriate, additional (●) work can engage students in the major work of the grade.

The Strands for Mathematical Proficiency

The strands of mathematical proficiency, as defined by the National Research Council (NRC),¹ provide a framework describing what proficiency means for a learner in mathematics.

The strands of mathematical proficiency are intertwined, gradually developed, and deepened over time. When intentionally presented in a connected and balanced way, each strand supports the others, ultimately strengthening the proficiency of learners.



1. **Conceptual Understanding** - Students develop an understanding of key mathematical ideas and relationships and explain why procedures work.

2. **Procedural Fluency** - Students use mathematical procedures with skill and flexibility, guided by a strong grasp of underlying concepts.

3. **Productive Dispositions** - Students view mathematics as coherent, valuable, and meaningful

4. **Real World and Problem Solving** - A combination of both adaptive reasoning and strategic competence, students represent and solve real-world mathematical problems logically, justify solutions, and clearly explain and defend reasoning.

The Relationship Between Mathematical Proficiency and the Components of Rigor

While there is some overlap between the Strands of Mathematical proficiency and the Core Tenets, there is a distinct difference between the two. The strands are a framework that is focused on learner outcomes and what it means for a student to be proficient in mathematics. The Core Tenets provide a framework for how teachers should design instruction to support learning. The core tenets reflect what should be done instructionally, while the proficiency strands represent the outcome, or what students become, as a result of that instruction.

Mathematical Fluency

Fluency in mathematics is the ability to apply foundational skills and concepts flexibly, accurately, and efficiently, grounded in strong conceptual understanding to solve problems, make connections, and reason mathematically across various contexts. While fluency is an essential component of mathematics instruction, it does not represent the full depth of a mathematical standard; it must be developed alongside conceptual understanding, reasoning, and problem-solving to ensure deep and meaningful learning.

Concrete - Representational - Abstract Framework

The Concrete-Representational-Abstract (CRA) Framework describes the instructional processes that students experience to build conceptual understanding of mathematics. The first stage is where students build their concrete understanding of a concept through the use of manipulatives or other physical objects. During the second phase, learners move into visual representations of concepts. Finally, during

¹ ADDING + IT UP HELPING CHILDREN LEARN MATHEMATICS National Academies of Sciences, Engineering, and Medicine. 2001. Adding It Up: Helping Children Learn Mathematics. Washington, DC: The National Academies Press. <https://doi.org/10.17226/5109>.

the abstract phase, students apply their understanding of the concepts abstractly through the use of numbers and symbols. When students engage in learning that follows this process, it allows them to build a solid understanding of key mathematical concepts and ideas, ensuring comprehension that is transferable and flexibly applied across grade bands.

An example of how this framework is represented across the progression of the Louisiana Student Standards for Mathematics can be seen in the way student learning progresses across a concept, such as linear functions. In fourth grade (4.AR.A.1), students are introduced to multiplicative comparison, where much of the learning is very **concrete**. At this phase, students are using counters and other manipulatives to physically compare quantities to determine the meaning of “times as many.” When they move into the middle grades, this becomes more representational as students apply their concrete understanding to recognize and represent proportional relationships. These are represented in various ways, such as ratio tables, double number lines, and graphs (6.PF.A.2, 7.PF.A.2). When students enter high school, the learning becomes **abstract** as they interpret linear functions such as $y=kx$ and come to understand slope as rate of change.

While the example above represents a linear version of this instructional process across multiple grades, it is important to note that the concrete and representational components can occur at different times throughout the progression of learning, and may occur simultaneously across various periods. Additionally, this instructional process may also occur within lessons, units, or within the grade level.

Standards for Mathematical Practice

The Louisiana Standards for Mathematical Practice are expected to be integrated into every mathematics lesson for all students in grades K-12. Below are a few examples of how these practices may be integrated into tasks that students in grade 8 complete.

Louisiana Standards for Mathematical Practice (MP)	
Louisiana Standard	Explanations and Examples
8.MP.1 Make sense of problems and persevere in solving them.	In grade 8, students solve real-world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, “What is the most efficient way to solve the problem?”, “Does this make sense?”, and “Can I solve the problem in a different way?”
8.MP.2 Reason abstractly and quantitatively.	In grade 8, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.
8.MP.3 Construct viable arguments and critique the reasoning of others.	In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, graphs, tables, and other data displays (e.g., box plots, dot plots, histograms). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like “How did you get that?”, “Why is that true?”, and “Does that always work?” They explain their thinking to others and respond to others’ thinking.
8.MP.4 Model with mathematics.	In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real-world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.
8.MP.5 Use appropriate tools strategically.	Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.
8.MP.6 Attend to precision.	In grade 8, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays.

8.MP.7 Look for and make use of structure.	Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.
8.MP.8 Look for and express regularity in repeated reasoning.	In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. During multiple opportunities to solve and model problems, they notice that the slope of a line and the rate of change are the same value. Students flexibly make connections between covariance, rates, and representations, showing the relationships between quantities.

Grade Level Foundational Skills

By the end of grade 8, mathematically proficient students can reliably apply the following skills to engage in grade-appropriate mathematical tasks. This list does not represent the full depth of learning expected in grade 8, but consists of the foundational skills required by the standards.

1. Identify irrational numbers, recognizing the decimal patterns indicating a decimal represents a rational number.
2. Compare the magnitude of irrational numbers using approximations.
3. Fluently apply the properties of integer exponents.
4. Fluently solve simple cube and square root equations.
5. Write and perform operations with numbers written in scientific notation.
6. Solve linear equations algebraically or through graphing.
7. Solve systems of linear equations.
8. Construct a function to model a linear relationship.
9. Use transformation to discuss similarity and congruence.
10. Apply the Pythagorean Theorem to determine distance.
11. Find the volume of cones, cylinders, and spheres.

Numeracy and Operational Fluency

A. Know that there are numbers that are not rational, and approximate them by rational numbers. In this cluster, the terms students should learn to use with increasing precision are: **real numbers, irrational numbers, rational numbers, integers, whole numbers, radical, radicand, square roots, perfect squares, terminating decimals, repeating decimals, and truncate.**

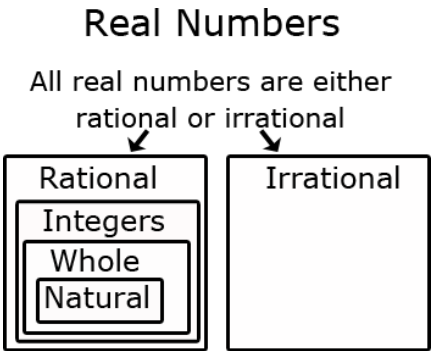
- **8.NOF.A.1** Understand the real number system.
- a. Distinguish between rational and irrational numbers (e.g., know that $\sqrt{2}$ is irrational).
 - b. Understand informally that every number has a decimal expansion.
 - c. For rational numbers, show that the decimal expansion repeats eventually.
 - d. Convert a decimal expansion that repeats eventually into a rational number by analyzing repeating patterns.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Content	Previous Grade(s) Standard: ■ 7.NOF.A.2 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: ■ 8.NOF.A.2 , ■ 8.AR.A.2	Conceptual Understanding (1, 1a, 1b), Procedural Skill and Fluency (1, 1c, 1d)
Foundational Skills: 1. Identify irrational numbers, recognizing the decimal patterns indicating a decimal represents a rational number.		

Examples and Explanations

Students understand that real numbers are either rational or irrational. They distinguish between rational and irrational numbers, recognizing that any number that can be expressed as a fraction is a rational number. The diagram below illustrates the relationship between the subgroups of the real number system.



Students recognize that the decimal equivalent of a fraction will either terminate or repeat. When a fraction has a denominator that contains a prime factor, the fraction only terminates when the denominator contains the prime factors of 2 or 5. This understanding builds on work in seventh grade when students used long division to distinguish between repeating and terminating decimals. For example:

- Let $x = 0.444444.....$
- Multiply both sides so that the repeating digits will be in front of the decimal. In this example, one digit repeats, so both sides are multiplied by 10, giving $10x = 4.444444....$
- Subtract the original equation from the new equation.

$$\begin{array}{r} 10x = 4.444444.... \\ - x = 0.444444..... \\ \hline 9x = 4 \end{array}$$

- Solve the equation to determine the equivalent fraction.

$$x = 4/9$$

Example:

- Change $0.\overline{5}$ to a fraction.
 - Let $x = 0.555555.....$
 - $10 \cdot x = 10 \cdot 0.555555.....$
 - $10x = 5.555555.....$
 - $10x = 5.555555....$
 - $\begin{array}{r} 10x = 5.555555.... \\ - x = 0.555555..... \\ \hline 9x = 5 \end{array}$
 - $\frac{9x}{9} = \frac{5}{9}$
 - $x = \frac{5}{9}$

Additionally, students can investigate repeating patterns that occur when fractions have denominators of 9, 99, or 11 (e.g., $\frac{1}{9} = 0.\overline{1}$).

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Rational and Irrational Numbers 8.NOF.A.1 8.NOF.A.2	Distinguishes between rational and irrational numbers, understands these numbers have decimal expansions, approximates locations on a number line, and converts between terminating decimals or decimals that repeat eventually and fractional representations of rational numbers.	Distinguishes between rational and irrational numbers, understands these numbers have decimal expansions, approximates locations on a number line, and converts between terminating decimals or simple repeating decimals and fractional representations of rational numbers.	Distinguishes between rational and irrational numbers, understands these numbers have decimal expansions, and approximates locations on a number line.	Distinguishes between rational and irrational numbers and approximates locations on a number line.

8.NOF.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 on to get a better approximation to the hundredths place.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Content	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: 8.NOF.A.1, 8.AR.A.2	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 2. Compare the magnitude of irrational numbers using approximations.		

Examples and Explanations

Students locate rational and irrational numbers on the number line. Students compare and order rational and irrational numbers. Students also recognize that square roots may be negative and written as the opposite of the positive square root (i.e., $-\sqrt{28}$).

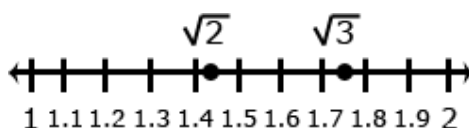
Examples:

- Approximate the value of $\sqrt{5}$ to the nearest hundredth.

Solution: Students start with a rough estimate based on perfect squares. $\sqrt{5}$ falls between 2 and 3 because 5 falls between $2^2 = 4$ and $3^2 = 9$. The value will be closer to 2 than to 3. Students continue the iterative process with the tenths place value. $\sqrt{5}$ falls between 2.2 and 2.3 because 5 falls between $2.2^2 = 4.84$ and $2.3^2 = 5.29$. The value is closer to 2.2 than to 2.3. Further iteration shows that the value of $\sqrt{5}$ is between 2.23 and 2.24 since 2.23^2 is 4.9729 and 2.24^2 is 5.0176.

- Compare $\sqrt{2}$ and $\sqrt{3}$ by estimating their values, plotting them on a number line, and making comparative statements.

Solution:



Statements for the comparison could include:

- o $\sqrt{2}$ is approximately 0.3 less than $\sqrt{3}$.
- o $\sqrt{2}$ is between the whole numbers 1 and 2.
- o $\sqrt{3}$ is between 1.7 and 1.8.

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Rational and Irrational Numbers 8.NOF.A.1 8.NOF.A.2	Distinguishes between rational and irrational numbers, understands these numbers have decimal expansions, approximates locations on a number line, and converts between terminating decimals or decimals that repeat eventually and fractional representations of rational numbers.	Distinguishes between rational and irrational numbers, understands these numbers have decimal expansions, approximates locations on a number line, and converts between terminating decimals or simple repeating decimals and fractional representations of rational numbers.	Distinguishes between rational and irrational numbers, understands these numbers have decimal expansions, and approximates locations on a number line.	Distinguishes between rational and irrational numbers and approximates locations on a number line.

Algebraic Reasoning

A. Work with radicals and integer exponents. In this cluster, the terms students should learn to use with increasing precision are: **laws of exponents, power, perfect squares, perfect cubes, root, square root, cube root, scientific notation, and standard form of a number.** Students should also be able to read and use the symbol $\pm$.

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

- For example, $3^2 \times 3^{-5} = 3^{-3} = \frac{1}{3}^3 = \frac{1}{27}$.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 6.AR.A.1 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 3. Fluently apply the properties of integer exponents.		

Examples and Explanations

In sixth grade, students understood, wrote, and evaluated simple numerical expressions with whole number exponents (i.e., $5^3 = 5 \cdot 5 \cdot 5 = 125$). In eighth grade, integer (positive and negative) exponents are further developed to generate equivalent numerical expressions when multiplying, dividing, or raising a power to a power. Using numerical bases and the laws of exponents, students generate equivalent expressions. These properties need to be developed with understanding (e.g., $3^2 \cdot 3^4 = (3 \times 3) \cdot (3 \times 3 \times 3 \times 3) = 3^6$).

Students understand:

- Bases must be the same before exponents can be added, subtracted, or multiplied.
- Exponents are subtracted when like bases are being divided.
- A number to the zero (0) power is equal to one.
- Factors with negative exponents can be written in the denominator using positive exponents.
- Exponents are added when like bases are being multiplied.
- Exponents are multiplied when an exponential expression is raised to an exponent.
- Several properties may be used to simplify an expression.

Examples:

- $\frac{4^3}{5^2} = \frac{64}{25}$
- $\frac{4^3}{4^7} = 4^{3-7} = 4^{-4} = \frac{1}{4^4} = \frac{1}{256}$
- $\frac{4^{-3}}{5^2} = 4^{-3} \times \frac{1}{5^2} = \frac{1}{4^3} \times \frac{1}{5^2} = \frac{1}{64} \times \frac{1}{25} = \frac{1}{16,000}$
- $4^0 \times (4^2)^3 = 1 \times 4^{2 \cdot 3} = 1 \times 4^6 = 1 \times 4,096 = 4,096$

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Radicals, Integer Exponents, and Scientific Notation 8.AR.A.1 8.AR.A.2 8.AR.A.3 8.AR.A.4	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.
	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube, representing solutions using $\sqrt{\quad}$ or $\sqrt[3]{\quad}$ symbols.	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube.	Partially solves equations of the form $x^2 = p$, where p is a perfect square less than or equal to 100, by representing only the positive solution of the equation.	
	Estimates very large and very small quantities using scientific notation and determines how many times as large one number is in relation to another.	Estimates very large and very small quantities using scientific notation.	Estimates very large quantities using scientific notation.	Estimates very large quantities using scientific notation.
	Performs operations with numbers expressed in scientific notation. Interprets scientific notation that has been generated by technology.	Performs operations with numbers expressed in scientific notation.	Performs operations with numbers expressed in scientific notation.	

8.AR.A.2 Represent solutions to equations, in the form $x^2 = p$ and $x^3 = p$, using the square root and cube root symbols, and determine if the solution is rational or irrational. Evaluate square roots of small perfect squares and cube roots of small perfect cubes.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 6.AR.B.4, 7.NOF.A.3 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: 8.NOF.A.1, 8.NOF.A.2, 8.GL.B.6	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 4. Fluently solve simple cube and square root equations.		

Examples and Explanations

Students recognize the square roots of perfect squares and the cube roots of perfect cubes are rational, understanding that the square roots of non-perfect squares and the cube roots of non-perfect cubes are irrational. When working with equations in the form $x^2 = p$ and $x^3 = p$, the value of p must be positive. Students recognize that squaring a number and taking the square root of a number are inverse operations; likewise, cubing a number and taking the cube root of a number are inverse operations. Students understand that in geometry, the square root of the area is the length of the side of a square, and the cube root of the volume is the length of the side of a cube.

Examples:

- $3^2 = 9$, $(-3)^2 = 9$, and $\sqrt{9} = \pm 3$ (There is a positive square root and a negative square root because 3×3 and $(-3) \times (-3)$ both equal 9.)

- Solve each equation. State whether each solution is rational or irrational.

o Solve $x^2 = 9$

Solution: $\sqrt{x^2} = \pm\sqrt{9}$

$x = \pm 3$

This solution is **rational**.

o $\left(\frac{1}{3}\right)^3 = \frac{1^3}{3^3} = \frac{1}{27}$ and $\sqrt[3]{\frac{1}{27}} = \frac{\sqrt[3]{1}}{\sqrt[3]{27}} = \frac{1}{3}$ (There is no negative cube root since $(-3)^3 = -27$.)

- o Solve $x^3 = 8$

Solution: $\sqrt[3]{x^3} = \sqrt[3]{8}$

$$x = 2$$

This solution is **rational**.

- o Solve $x^2 = 30$.

Solution: $\sqrt{x^2} = \pm\sqrt{30}$

$$x = \pm\sqrt{30}$$

$$x \approx \pm 5.5$$

This solution is **irrational**.

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Radicals, Integer Exponents, and Scientific Notation 8 AR.A.1 8 AR.A.2 8.AR.A.3 8.AR.A.4	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.
	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube, representing solutions using $\sqrt{}$ or $\sqrt[3]{}$ symbols.	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube.	Partially solves equations of the form $x^2 = p$, where p is a perfect square less than or equal to 100, by representing only the positive solution of the equation.	
	Estimates very large and very small quantities using scientific notation and determines how many times as large one number is in relation to another.	Estimates very large and very small quantities using scientific notation.	Estimates very large quantities using scientific notation.	Estimates very large quantities using scientific notation.
	Performs operations with numbers expressed in scientific notation. Interprets scientific notation that has been generated by technology.	Performs operations with numbers expressed in scientific notation.	Performs operations with numbers expressed in scientific notation.	

- 8.AR.A.3** Use numbers expressed in scientific notation to estimate very large or very small quantities and to express how many times larger or smaller one number is compared to another.
- For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9 , and determine that the world population is more than 20 times larger and the population of the United States is $\frac{1}{20}$ of the population of the world.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 4.AR.A.2, 5.NOF.C.11 8th Grade Standard Taught in Advance: 8.AR.A.1 8th Grade Standard Taught Concurrently: 8.AR.A.4	Conceptual Understanding, Procedural Skill and Fluency

Examples and Explanations

Students use scientific notation to express very large or very small quantities. Students compare and interpret scientific notation quantities in the context of the situation, recognizing that if the exponent increases by one, the value increases 10 times. Likewise, if the exponent decreases by one, the value decreases 10 times.

Example:

An aerospace engineer is comparing the mass of two tiny components used in a satellite:

- A microchip has a mass of 3.2×10^{-6} kg.
 - A nanosensor has a mass of 8.0×10^{-9} kg.
- About how many times heavier is the microchip than the nanosensor? Write your answer in scientific notation.
 - What does your answer tell you about how the sizes (masses) of the microchip and nanosensor compare in real life? Explain in your own words.

Solutions:

- The microchip's mass is 4.0×10^2 larger than the nanosensor's mass.
- This means the microchip is about 400 times heavier than the nanosensor.

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Radicals, Integer Exponents, and Scientific Notation 8 AR.A.1 8 AR.A.2 8.AR.A.3 8.AR.A.4	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.
	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube, representing solutions using $\sqrt{}$ or $\sqrt[3]{}$ symbols.	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube.	Partially solves equations of the form $x^2 = p$, where p is a perfect square less than or equal to 100, by representing only the positive solution of the equation.	
	Estimates very large and very small quantities using scientific notation and determines how many times as large one number is in relation to another.	Estimates very large and very small quantities using scientific notation.	Estimates very large quantities using scientific notation.	Estimates very large quantities using scientific notation.
	Performs operations with numbers expressed in scientific notation. Interprets scientific notation that has been generated by technology.	Performs operations with numbers expressed in scientific notation.	Performs operations with numbers expressed in scientific notation.	

8.AR.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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 7.AR.B.3 8th Grade Standard Taught in Advance: 8.AR.A.1 8th Grade Standard Taught Concurrently: 8.AR.A.3	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 5. Write and perform operations with numbers written in scientific notation.		

Examples and Explanations

Students understand scientific notation as generated on various calculators or other technology. They perform the four operations in which both decimals and scientific notation are used.

Examples:

- $14.305 + 9.571 \times 10^2$
Solution: 971,405 or 9.71405×10^2
- $\frac{3.45 \times 10^5}{6.7 \times 10^{-2}}$
Solution: 5.15×10^6
- $2.45\text{E}+23$ is 2.45×10^{23} and $3.5\text{E}-4$ is 3.5×10^{-4}
 Note: There are other notations for scientific notation depending on the calculator being used.)

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Radicals, Integer Exponents, and Scientific Notation 8 AR.A.1 8 AR.A.2 8.AR.A.3 8.AR.A.4	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates and generates equivalent numerical expressions using and applying properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.	Evaluates numerical expressions using properties of integer exponents.
	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube, representing solutions using $\sqrt{\quad}$ or $\sqrt[3]{\quad}$ symbols.	Solves equations of the form $x^2 = p$ and $x^3 = p$, where p is a perfect square or perfect cube.	Partially solves equations of the form $x^2 = p$, where p is a perfect square less than or equal to 100, by representing only the positive solution of the equation.	
	Estimates very large and very small quantities using scientific notation and determines how many times as large one number is in relation to another.	Estimates very large and very small quantities using scientific notation.	Estimates very large quantities using scientific notation.	Estimates very large quantities using scientific notation.
	Performs operations with numbers expressed in scientific notation. Interprets scientific notation that has been generated by technology.	Performs operations with numbers expressed in scientific notation.	Performs operations with numbers expressed in scientific notation.	

B. Understand the connections between proportional relationships, lines, and linear equations. In this cluster, the terms students should learn to use with increasing precision are: **unit rate, proportional relationships, slope, vertical, horizontal, similar triangles, and y-intercept.**

- **8.AR.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.

Standard Overview

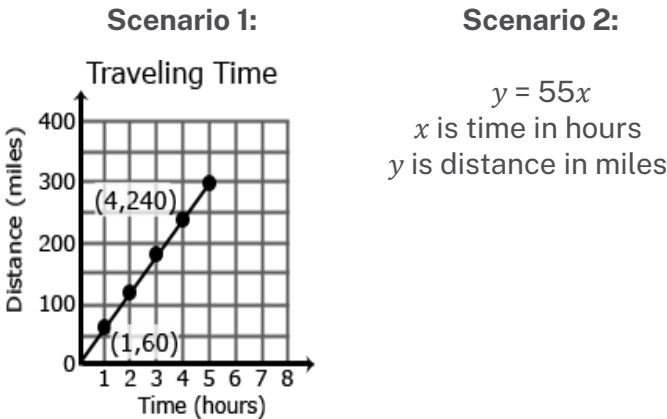
Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: ■ 7.PF.A.2 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: ■ 8.AR.B.6	Conceptual Understanding, Procedural Skill and Fluency, Application

Examples and Explanations

Students build on their work with unit rates from sixth grade and proportional relationships in seventh grade to compare graphs, tables, and equations of proportional relationships. Students identify the unit rate (or slope) in graphs, tables, and equations to compare two proportional relationships represented in different ways. Given an equation of a proportional relationship ($y = mx$), students draw a graph of the relationship. Students recognize that the unit rate is the coefficient of the independent variable and that this value, m , is also the slope of the line.

Example:

- Compare the scenarios to determine which represents a greater speed. Explain your choice, including a written description of each scenario. Be sure to include the rates in your explanation.



Solution: Both scenarios represent the distance traveled, in miles, over a specific amount of time, in hours. The relationships shown in both scenarios are proportional, which means the object is traveling at a constant rate of speed, miles per hour. In Scenario 1, point (1, 60) means the object travels 60 miles in one hour, so the rate the object is traveling is 60 miles per hour. In Scenario B, the unit rate in the equation is 55, which means the object is traveling 55 miles per hour. Scenario 1 represents a greater speed since the object is traveling five more miles per hour than the object in Scenario B.

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1, LEAP.III.8.3, LEAP.III.8.4

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Proportional Relationships and Linear Equations 8.AR.B.5 8.AR.B.6 8.PF.A.3	Graphs linear equations in the form $y = mx + b$, including proportional relationships.	Graphs linear equations in the form $y = mx + b$, including proportional relationships.	Graphs linear equations in the form $y = mx + b$, including proportional relationships.	Graphs linear equations in the form $y = mx + b$.
	Interprets the unit rate as the slope of the graph of a proportional relationship and applies these concepts to solve real-world problems.	Interprets the unit rate as the slope of the graph of a proportional relationship and applies these concepts to solve real-world problems.	Interprets the unit rate as the slope of the graph of a proportional relationship.	
	Compares two different proportional relationships represented in different ways.	Compares two different proportional relationships represented in different ways.	Makes some comparisons between two different proportional relationships represented in different ways.	
	Interprets $y = mx + b$ as defining a linear function.			
	Uses similar triangles to show that the slope is the same between any two distinct points on a non-vertical line in the coordinate plane.	Uses similar triangles to show that the slope is the same between any two distinct points on a non-vertical line in the coordinate plane.		

8.AR.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 .

Standard Overview

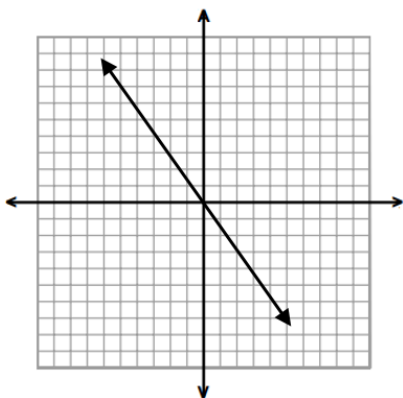
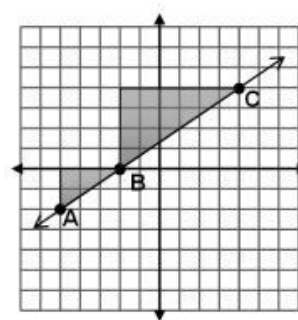
Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 7.PE.A.2 , 7.GL.A.2 8th Grade Standard Taught in Advance: 8.GL.A.5 8th Grade Standard Taught Concurrently: 8.AR.B.5	Conceptual Understanding

Examples and Explanations

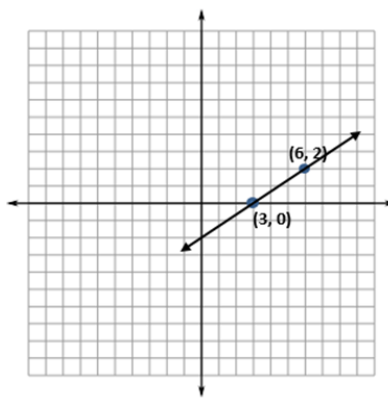
Triangles are similar when there is a constant rate of proportionality between them. Using a graph, students construct triangles between two points on a line and compare the sides to understand that the slope is the value of the ratio of change in y to change in x is the same between any two points on a line.

Examples:

- The triangle between A and B has a vertical height of 2 and a horizontal length of 3.
 The triangle between B and C has a vertical height of 4 and a horizontal length of 6.
 The simplified ratio of the vertical height to the horizontal length of both triangles is 2 to 3, which has a value of $\frac{2}{3}$ and represents the slope of the line AC, indicating that the triangles are similar.
- Write equations to represent the two graphs below.



Solution: $y = -\frac{3}{2}x$



Solution: $y = \frac{2}{3}x - 2$

Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.1, LEAP.II.8.5, LEAP.III.8.1, LEAP.III.8.3, LEAP.III.8.4

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Proportional Relationships and Linear Equations 8.AR.B.5 8.AR.B.6 8.PF.A.3	Graphs linear equations in the form $y = mx + b$, including proportional relationships.	Graphs linear equations in the form $y = mx + b$, including proportional relationships.	Graphs linear equations in the form $y = mx + b$, including proportional relationships.	Graphs linear equations in the form $y = mx + b$.
	Interprets the unit rate as the slope of the graph of a proportional relationship and applies these concepts to solve real-world problems.	Interprets the unit rate as the slope of the graph of a proportional relationship and applies these concepts to solve real-world problems.	Interprets the unit rate as the slope of the graph of a proportional relationship.	
	Compares two different proportional relationships represented in different ways.	Compares two different proportional relationships represented in different ways.	Makes some comparisons between two different proportional relationships represented in different ways.	
	Interprets $y = mx + b$ as defining a linear function.			
	Uses similar triangles to show that the slope is the same between any two distinct points on a non-vertical line in the coordinate plane.	Uses similar triangles to show that the slope is the same between any two distinct points on a non-vertical line in the coordinate plane.		

C. Analyze and solve linear equations and pairs of simultaneous linear equations. In this cluster, the terms students should learn to use with increasing precision are: **intersecting, parallel lines, coefficient, distributive property, like terms, substitution,** and **system of linear equations.**

- 8.AR.C.7** Solve linear equations in one variable.

 - 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).
 - Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 7.AR.A.1 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: 8.DA.A.3	Conceptual Understanding (7a), Procedural Skill and Fluency (7, 7a, 7b)
Foundational Skills: 6. Solve linear equations algebraically or through graphing.		

Examples and Explanations

Students have been working informally with one-variable linear equations since as early as kindergarten. This important line of development culminates in grade 8 with the solution of general one-variable linear equations, including cases with infinitely many solutions or no solutions, as well as cases requiring algebraic manipulation using properties of operations. Coefficients and constants in these equations may be any rational numbers.

As students transform linear equations in one variable into simpler forms, they discover that the equations can have one solution, infinitely many solutions, or no solution.

When the equation has one solution, the variable has one value that makes the equation true, as in $12 - 4y = 16$. The only value for y that makes this equation true is $- 1$.

When the equation has infinitely many solutions, the equation is true for all real numbers, as in $7x + 14 = 7(x + 2)$. As this equation is simplified, the variable terms cancel, leaving $14 = 14$ or $0 = 0$. Since the expressions are equivalent, the value for the two sides of the equation will be the same regardless of which real number is used for the substitution.

When an equation has no solutions, it is also called an inconsistent equation. This is the case when the two expressions are not equivalent, as in $5x - 2 = 5(x + 1)$. When simplifying this equation, students will find that the solution appears to be two numbers that are not equal or $-2 \neq 1$. In this case, regardless of which real number is used for the substitution, the equation is not true and therefore has no solution.

Examples:

- Solve for x :

- o $3x - 8 = 4x - 8$

- Solution:* $x = 0$

- o $3(x + 1) - 5 = 3x - 2$

- Solution:* infinitely many solutions

- Give an example of a linear equation in one variable with no solutions. Prove why there are no solutions.

Possible solution: $-4x + 2 = -2(2x + 1) - 3$; I can rewrite the equation in simpler forms, including $-4x + 2 = -4x - 2 - 3$, $-4x + 2 = -4x - 5$, and $2 \neq -5$. Since $2 \neq -5$, I know the equation is not true. It has no solution.

- Solve for the missing value:

- o $\frac{1}{4} - \frac{2}{3}y = \frac{3}{4} - \frac{1}{3}y$

- Solution:* $y = \frac{-3}{2}$

Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.2, LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Solving Linear Equations 8.AR.C.7b	Fluently solves linear equations in one variable, with rational number coefficients, including those that require use of the distributive property and combining like terms.	Fluently solves linear equations in one variable, with rational number coefficients, including those that require use of the distributive property and combining like terms.	Solves linear equations in one variable, with rational number coefficients, including those that require use of the distributive property or combining like terms.	Solves linear equations in one variable, with rational number coefficients.

8.AR.C.8 Analyze and solve pairs of simultaneous linear equations.

- 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.
- 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.
- 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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Content	Previous Grade(s) Standard: 6.AR.B.4 8th Grade Standard Taught in Advance: 8.AR.B.6 8th Grade Standard Taught Concurrently: none	Conceptual Understanding (8, 8a, 8b), Procedural Skill and Fluency (8, 8b, 8c), Application (8c)
Foundational Skills: 7. Solve systems of linear equations.		

Examples and Explanations

Systems of linear equations can also have one solution, infinitely many solutions, or no solutions. Students will discover these cases as they graph systems of linear equations and solve them algebraically.

Students graph a system of two linear equations, recognizing that the ordered pair for the point of intersection is the x-value that will generate the given y-value for both equations. Students recognize that graphed lines with one point of intersection (different slopes) will have one solution, parallel lines (same slope, different y-intercepts) have no solutions, and lines that are the same (same slope, same y-intercept) will have infinitely many solutions.

By making connections between algebraic and graphical solutions and the context of the system of linear equations, students are able to make sense of their solutions. Students need opportunities to work with equations and contexts that include whole numbers and/or decimals/fractions. Students define variables and create a system of linear equations in two variables.

Examples:

- Solve this system of equations.

$$\begin{cases} 3x + 4y = 8 \\ y = x - 5 \end{cases}$$

Solution: (4, -1)

- Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same.

Let W = number of weeks

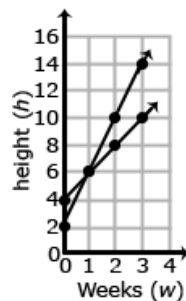
Let H = height of the plant after W weeks

Plant A		
W	H	(W, H)
0	4	(0, 4)
1	6	(1, 6)
2	8	(2, 8)
3	10	(3, 10)

Plant B		
W	H	(W, H)
0	2	(0, 2)
1	6	(1, 6)
2	10	(2, 10)
3	14	(3, 14)

Graph the lines that represent the growth of each plant on the same coordinate plane.

Solution:



- Write equations that represent the growth rates of Plant A and Plant B.

Solution:

Plant A

$$H = 2W + 4$$

Plant B $H = 4W + 2$

- At which week will the plants have the same height? Explain using the graphs you drew.

Solution: After one week, the height of Plant A and Plant B is both 6 inches. I know because the point where the lines intersect is at (1, 6), which means that after 1 week, both plants had a height of 6 inches.

Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.1, LEAP.II.8.2, LEAP.II.8.4, LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Systems Linear Equations 8.EE.C.8	Analyzes and solves mathematical and real-world problems leading to pairs of simultaneous linear equations graphically, algebraically, and by inspection.	Analyzes and solves mathematical problems leading to pairs of simultaneous linear equations graphically, algebraically , and by inspection.	Solves mathematical problems leading to pairs of simultaneous linear equations graphically and by inspection.	Solves mathematical problems leading to pairs of simultaneous linear equations graphically, where the graph is provided.
	Understands the relationship between the graphic representation and the algebraic solution to the system.	Understands the relationship between the graphic representation and the algebraic solution to the system.		

Geometric Reasoning and Logic

A. Understand congruence and similarity using physical models, transparencies, or geometry software. In this cluster, the terms students should learn to use with increasing precision are: **translations, rotations, reflections, line of reflection, center of rotation, clockwise, counterclockwise, parallel lines, congruence, $\cong$, reading A' as "A prime", similarity, dilations, pre-image, image, rigid transformations, exterior angles, interior angles, alternate interior angles, angle-angle criterion, deductive reasoning, vertical angles, adjacent, supplementary, complementary, corresponding, scale factor, transversal, and parallel.**

- 8.GL.A.1** Verify experimentally the properties of rotations, reflections, and translations:
- Lines are taken to lines, and line segments to line segments of the same length.
 - Angles are taken to angles of the same measure.
 - Parallel lines are taken to parallel lines.

Standard Overview

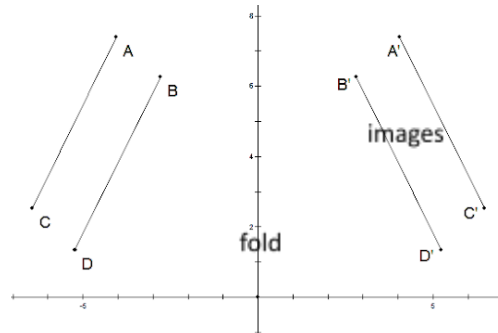
Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: 7.GL.A.2 , 7.GL.B.5 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: none	Conceptual Understanding (1, 1a, 1b, 1c)

Examples and Explanations

Students use compasses, protractors, rulers, tracing paper, and/or technology to explore figures created from translations, reflections, and rotations. Characteristics of figures, such as lengths of line segments, angle measures, and parallel lines, are explored before the transformation (pre-image) and after the transformation (image). Students understand that these transformations produce images of exactly the same size and shape as the pre-image and are known as rigid transformations.

Reflections can be made by completing the following steps, using graph paper or tracing paper.

- 1) Draw a set of axes and two parallel segments.
- 2) Fold the paper on the y-axis, flip the folded paper over, and trace the two segments. The y-axis is now the line of reflection.
- 3) Open the tracing paper and retrace the segments on the same side of the paper as segments AC and BD.



Students should see that a reflection of parallel segments results in parallel segments. If needed, students should use a ruler to verify that the lengths are the same. (Some deviations may occur due to tracing.) Have the students mark the corresponding endpoints of the reflected segments as A', C', B', and D'. Students should learn to interpret these labels as “A prime,” etc.

Since segments are parts of a line, most students will not need to repeat the process for parallel lines.

The same process can be used to show that the reflection of an angle results in an image with the same measure. This can be verified by using a protractor to measure the angle and its image.

The following can be used to verify informally the results of rotations and reflections.

- Rotate the paper with the images around the origin. A straightened paper clip or the end of a student’s pencil can be placed on the origin as the paper is rotated.
- Slide the paper with the images by a specified distance and direction (e.g., 4 inches vertically, 5 inches to the right).

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Congruence and Similarity 8.GL.A.1 8.GL.A.2 8.GL.A.3 8.GL.A.4	Describes the effect of dilations, translations, rotations, and reflections on two-dimensional figures with and without coordinates; determines whether two given figures are congruent or similar through one or more transformations; and describes a sequence of transformations to justify congruence or similarity of two figures.	Describes the effect of dilations , translations, rotations, and reflections on two-dimensional figures with coordinates, and determines whether two given figures are congruent or similar through one or more transformations.	Describes the effect of translations, rotations, and reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.	Describes the effect of translations, rotations, or reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.

8.GL.A.2 Explain 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. (Rotations are only about the origin, and reflections are only over the y-axis and x-axis in grade 8.)

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.GL.A.1 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 9. Use transformation to discuss similarity and congruence.		

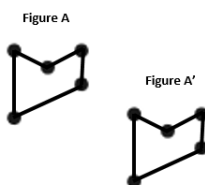
Examples and Explanations

This standard is the students' introduction to congruence. Congruent figures have the same shape and size. Translations, reflections, and rotations are examples of rigid transformations. A rigid transformation is one in which the pre-image and the image both have exactly the same size and shape since the measures of the corresponding angles and corresponding line segments remain equal (are congruent).

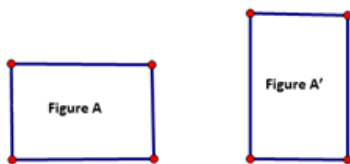
Examples:

Students examine two figures to determine congruence by identifying the rigid transformation(s) that produced the figures. Students recognize the symbol for congruence ($\cong$) and write statements of congruence.

- Is Figure A congruent to Figure A'? Explain how you know.



- Describe the sequence of transformations that results in the transformation of Figure A to Figure A'.



Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.3, LEAP.II.8.5, LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Congruence and Similarity 8.GL.A.1 8.GL.A.2 8.GL.A.3 8.GL.A.4	Describes the effect of dilations, translations, rotations, and reflections on two-dimensional figures with and without coordinates; determines whether two given figures are congruent or similar through one or more transformations; and describes a sequence of transformations to justify congruence or similarity of two figures.	Describes the effect of dilations , translations, rotations, and reflections on two-dimensional figures with coordinates, and determines whether two given figures are congruent or similar through one or more transformations.	Describes the effect of translations, rotations, and reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.	Describes the effect of translations, rotations, or reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.

8.GL.A.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. (Rotations are only about the origin, dilations only use the origin as the center of dilation, and reflections are only over the y-axis and x-axis in grade 8.)

Standard Overview

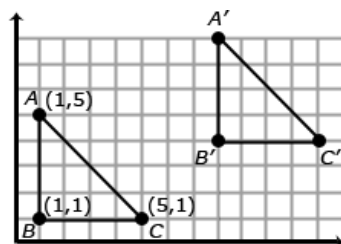
Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: 6.GL.A.3 8th Grade Standard Taught in Advance: 8.GL.A.1 8th Grade Standard Taught Concurrently: none	Conceptual Understanding

Examples and Explanations

Students identify resulting coordinates from translations, reflections, and rotations (90° , 180° , and 270° both clockwise and counterclockwise), recognizing the relationship between the coordinates and the transformation.

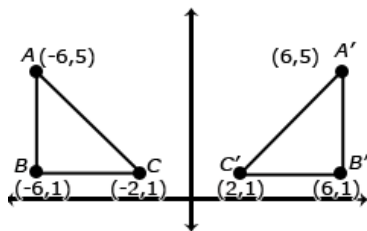
Translations

Translations move the object so that every point of the object moves in the same direction and by the same distance. In a translation, the translated object is *congruent* to its pre-image. Triangle ABC has been translated 7 units to the right and 3 units up. To get from A (1, 5) to A' (8, 8), move point A 7 units to the right (from $x = 1$ to $x = 8$) and 3 units up (from $y = 5$ to $y = 8$). Points B and C also move in the same direction (7 units to the right and 3 units up), resulting in the same changes to each coordinate.



Reflections

A reflection is the “flipping” of an object over a line, known as the “line of reflection”. In the 8th grade, the line of reflection will be the x-axis or the y-axis. Students recognize that when an object is reflected across the y-axis, the reflected x-coordinate is the opposite of the pre-image x-coordinate (see figure below).

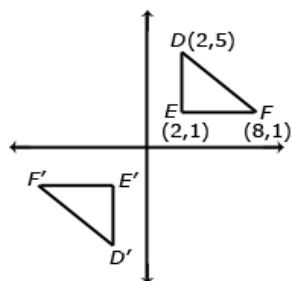


Likewise, a reflection across the x-axis would change a pre-image coordinate (3, -8) to the image coordinate of (3, 8). NOTE: The reflected y-coordinate is opposite of the pre-image y-coordinate.

Rotations

A rotation is a transformation performed by “turning” the figure around a fixed point known as the center of rotation. The figure may be rotated clockwise or counterclockwise up to 360° (at 8th grade, rotations will be centered around the origin). In a rotation, the rotated object is *congruent* to its pre-image.

Consider when triangle DEF is rotated 180° clockwise about the origin. The coordinates of triangle DEF are D (2, 5), E (2, 1), and F (8, 1). When rotated 180° about the origin, the new coordinates are D'(-2, -5), E'(-2, -1) and F'(-8, -1). In this case, each coordinate is the opposite of its pre-image (see figure below).



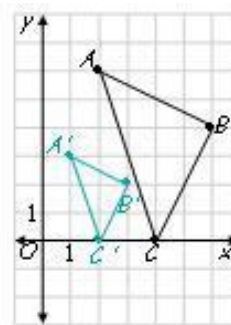
Dilations

A dilation is a non-rigid transformation that moves each point along a ray that starts from a fixed center, and multiplies distances from this center by a common scale factor. Dilations enlarge (scale factors greater than one) or reduce (scale factors less than one) the size of a figure by the scale factor. In 8th grade, dilations will be from the origin. The dilated figure is *similar* to its pre-image.

The coordinates of A are (2, 6); A' (1, 3). The coordinates of B are (6, 4), and B' are (3, 2). The coordinates of C are (4, 0) and C' are (2, 0). Each of the image coordinates is $\frac{1}{2}$ the value of the pre-image coordinates, indicating a scale factor of $\frac{1}{2}$.

The scale factor would also be evident in the length of the line segments using the value of the

$$\text{ratio: } \frac{\text{image length}}{\text{pre-image length}}.$$



Students recognize the relationship between the coordinates of its image length and pre-image length, and the scale factor for a dilation from the origin. Using the coordinates, students can identify the scale factor (image/pre-image)

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Congruence and Similarity 8.GL.A.1 8.GL.A.2 8.GL.A.3 8.GL.A.4	Describes the effect of dilations, translations, rotations, and reflections on two-dimensional figures with and without coordinates; determines whether two given figures are congruent or similar through one or more transformations; and describes a sequence of transformations to justify congruence or similarity of two figures.	Describes the effect of dilations , translations, rotations, and reflections on two-dimensional figures with coordinates, and determines whether two given figures are congruent or similar through one or more transformations.	Describes the effect of translations, rotations, and reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.	Describes the effect of translations, rotations, or reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.

8.GL.A.4 Explain 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. (Rotations are only about the origin, dilations only use the origin as the center of dilation, and reflections are only over the y-axis and x-axis in grade 8.)

Standard Overview

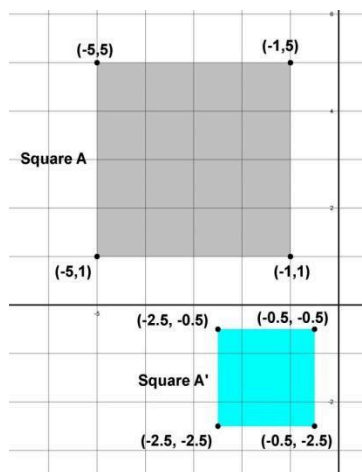
Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.GL.A.2, 8.GL.A.3 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 9. Use transformation to discuss similarity and congruence.		

Examples and Explanations

Similar figures and similarity are first introduced in the eighth grade. Students understand similar figures have congruent angles and sides that are proportional. Similar figures are produced from dilations. Dilations are limited to those with the origin as the center of dilation. Students describe the sequence that would produce similar figures, including the scale factors. Students understand that a scale factor greater than one will produce an enlargement in the figure, while a scale factor less than one will produce a reduction in size.

Examples:

- Describe the sequence of transformations that create Square A' from Square A.

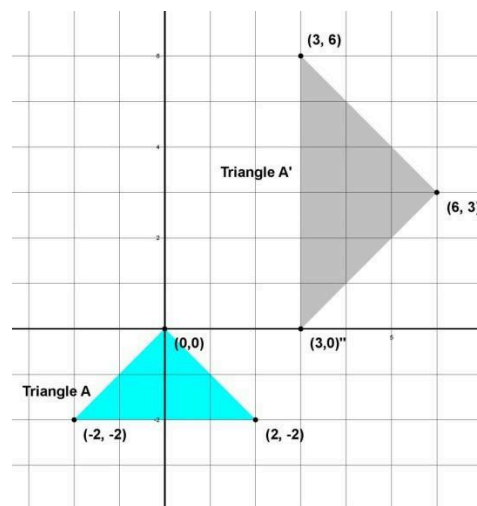


Solution: Square A is dilated with a scale factor of $\frac{1}{2}$, then reflected across the x -axis.

- Describe the sequence of transformations that results in the transformation of Triangle A to Triangle A'.

Solution: Triangle A is rotated 90° clockwise, translated 4 units right and 2 units up, and then dilated by $\frac{3}{2}$. In this case, the scale factor of the dilation can be found by using the bases of each isosceles triangle (Base of Triangle A' = 6 units; Base of Triangle A = 4 units)

- Teacher Video Resource: [Dilations in the Plane](#)



Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.3, LEAP.II.8.5, LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Congruence and Similarity 8.GL.A.1 8.GL.A.2 8.GL.A.3 8.GL.A.4	Describes the effect of dilations, translations, rotations, and reflections on two-dimensional figures with and without coordinates; determines whether two given figures are congruent or similar through one or more transformations; and describes a sequence of transformations to justify congruence or similarity of two figures.	Describes the effect of dilations , translations, rotations, and reflections on two-dimensional figures with coordinates, and determines whether two given figures are congruent or similar through one or more transformations.	Describes the effect of translations, rotations, and reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.	Describes the effect of translations, rotations, or reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.

8.GL.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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.GL.A.2, 8.GL.A.4 8th Grade Standard Taught Concurrently: none	Conceptual Understanding

Examples and Explanations

Students use exploration and deductive reasoning to determine relationships that exist between the following:

- angle sums and exterior angle sums of triangles,
- angles created when parallel lines are cut by a transversal, and
- the angle-angle criterion for the similarity of a triangle.

Students construct various triangles and find the measures of the interior and exterior angles. Students make conjectures about the relationship between the measure of an exterior angle and the other two angles of a triangle (the measure of an exterior angle of a triangle is equal to the sum of the measures of the other two interior angles) and the sum of the exterior angles (360°). Using these relationships, students use deductive reasoning to find the measure of missing angles.

Students construct parallel lines and a transversal to examine the relationships between the created angles. Students recognize vertical angles, adjacent angles, and supplementary angles from seventh grade and build on these relationships to identify other pairs of congruent angles. Using these relationships, students use deductive reasoning to find the measure of missing angles.

Example:

- Show that $m\angle 3 + m\angle 4 + m\angle 5 = 180^\circ$ if line l and line m are parallel lines, and lines t_1 and t_2 are transversals.

Solution:

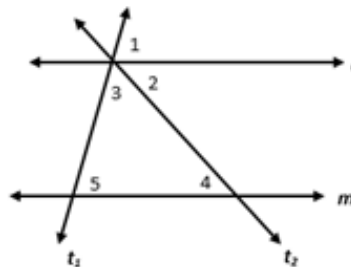
$$m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ.$$

Angle 1 and Angle 5 are congruent ($\angle 1 \cong \angle 5$) because they are corresponding angles.

1 can be substituted for 5.

$\angle 4 \cong \angle 2$ because alternate interior angles are congruent.

4 can be substituted for 2.

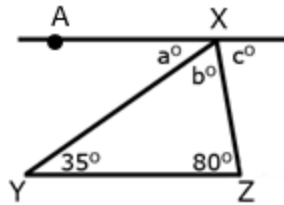


Therefore, $m3 + m4 + m5 = 180^\circ$.

Students can informally conclude that the sum of the angles in a triangle is 180° (the angle-sum theorem) by applying their understanding of lines and alternate interior angles.

Examples:

- In the figure below, Segment AX is parallel to Segment YZ:



Angle a is 35° because it alternates with the angle inside the triangle that measures 35° . Angle c is 80° because it alternates with the angle inside the triangle that measures 80° . Because lines have a measure of 180° , and angles $a + b + c$ form a straight line, then angle b must be 65° ($180 - (35 + 80) = 65$). Therefore, the sum of the angles of the triangle is $35^\circ + 65^\circ + 80^\circ$.

Assessment Connections

Assessment Item Type(s): Type II

Evidence Statement(s): LEAP.II.8.3

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Congruence and Similarity 8.GL.A.1 8.GL.A.2 8.GL.A.3 8.GL.A.4	Describes the effect of dilations, translations, rotations, and reflections on two-dimensional figures with and without coordinates; determines whether two given figures are congruent or similar through one or more transformations; and describes a sequence of transformations to justify congruence or similarity of two figures.	Describes the effect of dilations , translations, rotations, and reflections on two-dimensional figures with coordinates, and determines whether two given figures are congruent or similar through one or more transformations.	Describes the effect of translations, rotations, and reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.	Describes the effect of translations, rotations, or reflections on two-dimensional figures without coordinates and determines whether two given figures are congruent.

B. Understand and apply the Pythagorean Theorem. In this cluster, the terms students should learn to use with increasing precision are: **right triangle, hypotenuse, legs, Pythagorean Theorem, Pythagorean triple, and converse of the Pythagorean Theorem.**

8.GL.B.6 Explain a proof of the Pythagorean Theorem and its converse using the areas of squares.

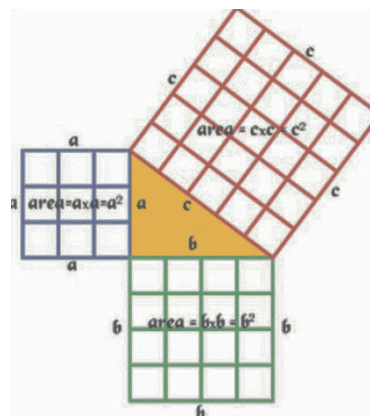
Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: 7.GL.B.6 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: 8.AR.A.2, 8.GL.B.7	Conceptual Understanding

Examples and Explanations

Using models, students explain the Pythagorean Theorem, understanding that the sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle. Students should also understand that if the sum of the squares of the 2 smaller legs of a triangle is equal to the square of the third leg, then the triangle is a right triangle.

Students should be provided opportunities to explore the Pythagorean Theorem using models such as the one to the right so that the formula has meaning. Much of the confusion that students have in applying the Pythagorean Theorem is a result of not recognizing that a and b in the formula $a^2 + b^2 = c^2$ represent the perpendicular sides (legs) of the right triangle and that c is the longest side (hypotenuse), which lies opposite the right angle. Additionally, when asked to solve for a missing side of a right triangle, the squares don't exist; thus, the model helps to give meaning to a^2 , b^2 , and c^2 as areas of squares that can be created on each side of the right triangle.



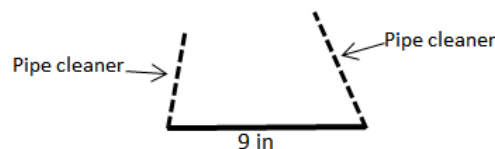
While students can count squares to prove that the relationship works in models such as the one to the right, some students may be more convinced if they can “fit” the two smaller squares into the larger squares. [NOVA online](#) allows the students to experience this interactively.

Students also need experience in testing the Pythagorean Theorem on non-right triangles to see that it only applies to right triangles. An application of the converse of the Pythagorean Theorem is provided below.

- A triangular section on a map has sides with lengths of 5 in, 6 in, and 9 in.
 - Is the section in the shape of a right triangle? Explain how you determined your answer.

Students also need experience in testing the Pythagorean Theorem on non-right triangles to see that it only applies to right triangles. An application of the converse of the Pythagorean Theorem is provided below.

- A triangular section on a map has sides with lengths of 5 in, 6 in, and 9 in.
 - a. Is the section in the shape of a right triangle? Explain how you determined your answer.
 - b. Determine if your answer is correct, making the triangle:
 - Draw a segment that is 9 inches long on a sheet of paper.
 - Cut a 5-inch piece of pipe cleaner*. Place one end of the pipe cleaner on one endpoint of the 9-inch segment.
 - Cut a 6-inch piece of pipe cleaner. Place one end of the pipe cleaner on the second endpoint of the 9-inch segment.
 - Carefully adjust the pipe cleaners so that a triangle is formed. (See diagram to the right.)
 - Did you make a right triangle? How does this answer compare with the answer to Part a?



*Other materials, such as narrow strips of construction paper, can be substituted.

Assessment Connections

Assessment Item Type(s): Type II

Evidence Statement(s): LEAP.II.8.5

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Pythagorean Theorem 8.GL.B.7 8.GL.B.8	Applies the Pythagorean Theorem in real-world and mathematical problems in two and three dimensions and to find the distance between two points in a coordinate system.	Applies the Pythagorean Theorem in a simple planar case and to find the distance between two points in a coordinate system.	Applies the Pythagorean Theorem to determine any side of a right triangle in a simple planar case without coordinates.	Applies the Pythagorean Theorem to determine the hypotenuse of a right triangle in a simple planar case without coordinates.
	Recognizes situations to apply the Pythagorean Theorem in multi-step problems.			

8.GL.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.

Standard Overview

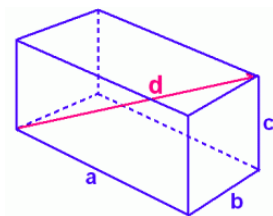
Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: ■ 8.GL.B.6	Procedural Skill and Fluency, Application

Examples and Explanations

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

Examples:

- The Irrational Club wants to build a tree house. They have a 9-foot ladder that must be propped diagonally against the tree. If the base of the ladder is 5 feet from the bottom of the tree, how high will the tree house be off the ground?
- Find the length of d in the figure to the right if $a = 8$ in., $b = 3$ in., and $c = 4$ in.



Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.5, LEAP.III.8.1, LEAP.III.8.3

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Pythagorean Theorem 8.GL.B.7 8.GL.B.8	Applies the Pythagorean Theorem in real-world and mathematical problems in two and three dimensions and to find the distance between two points in a coordinate system.	Applies the Pythagorean Theorem in a simple planar case and to find the distance between two points in a coordinate system.	Applies the Pythagorean Theorem to determine any side of a right triangle in a simple planar case without coordinates.	Applies the Pythagorean Theorem to determine the hypotenuse of a right triangle in a simple planar case without coordinates.
	Recognizes situations to apply the Pythagorean Theorem in multi-step problems.			

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

Standard Overview

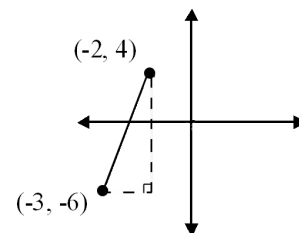
Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: 6.GL.A.3 8th Grade Standard Taught in Advance: 8.GL.B.7 8th Grade Standard Taught Concurrently: none	Procedural Skill and Fluency
Foundational Skills: 10. Apply the Pythagorean Theorem to determine distance.		

Examples and Explanations

One application of the Pythagorean Theorem is finding the distance between two points on the coordinate plane. Students build on work from sixth grade (finding vertical and horizontal distances on the coordinate plane) to determine the lengths of the legs of the right triangle drawn connecting the points. Students understand that the line segment between the two points is the length of the hypotenuse.

Examples:

- Students will create a right triangle from the two points given (as shown in the diagram) and then use the Pythagorean Theorem to find the distance between the two given points.
- Find the distance between $(9, -7)$ and $(-5, 2)$.



Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.5, LEAP.III.8.1, LEAP.III.8.4

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Pythagorean Theorem 8.GL.B.7 8.GL.B.8	Applies the Pythagorean Theorem in real-world and mathematical problems in two and three dimensions and to find the distance between two points in a coordinate system.	Applies the Pythagorean Theorem in a simple planar case and to find the distance between two points in a coordinate system.	Applies the Pythagorean Theorem to determine any side of a right triangle in a simple planar case without coordinates.	Applies the Pythagorean Theorem to determine the hypotenuse of a right triangle in a simple planar case without coordinates.
	Recognizes situations to apply the Pythagorean Theorem in multi-step problems.			

C. Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. In this cluster, the terms students should learn to use with increasing precision are: **cone, cylinder, sphere, radius, volume, height, pi, and depth.**

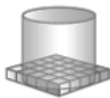
8.GL.C.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Additional Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: ■ 8.AR.A.2 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency, Application
Foundational Skills: 11. Find the volume of cones, cylinders, and spheres.		

Examples and Explanations

Students build on understandings of circles and volume from seventh grade to find the volume of cylinders, finding the area of the base πr^2 and multiplying by the number of layers (the height).



find the area of the base

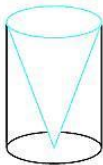
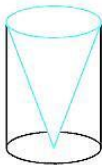
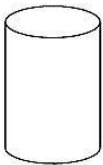
and



multiply by the number of layers

$$V = r^2h$$

Students understand that the volume of a cylinder is 3 times the volume of a cone having the same base area and height, or that the volume of a cone is $\frac{1}{3}$ the volume of a cylinder having the same base area and height.



$$V = \frac{1}{3}\pi r^2h \text{ or } V = \frac{\pi r^2h}{3}$$

As demonstrated in the video posted at <https://www.youtube.com/watch?v=aLyQddyY8ik>, students understand that the volume of a sphere is $\frac{2}{3}$ the volume of a cylinder that has the same height and diameter as the sphere. (Teachers are encouraged to have students explore this relationship if manipulatives are available.) Teachers should guide students to algebraically develop the formula for the volume of the sphere. Volume of Sphere = $\frac{2}{3}$ (Volume of Cylinder) = $\frac{2}{3} \pi r^2 h$. The height of the cylinder and the height of the sphere are the same; therefore, $h = d = 2r$. Using substitution, Volume of Sphere = $\frac{2}{3} \pi r^2 h = \frac{2}{3} \pi r^2 2r = \frac{4}{3} \pi r^3$.

Students then use these formulas to solve real-world and mathematical problems.

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Volume 8.GL.C.9	Uses the formulas for volume of cones, cylinders and spheres to calculate the volume or dimensions of solids in mathematical and real-world problems.	Uses the formulas for volume of cones, cylinders and spheres to calculate the volume of solids in mathematical and real-world problems.	Uses the formulas for volume of cones, cylinders and spheres to calculate the volume of solids in mathematical problems.	
	Applies volume formulas to composite solids in mathematical problems.			

Data Analysis

A. Investigate patterns of association in bivariate data. In this cluster, the terms students should learn to use with increasing precision are: **bivariate data, scatter plot, linear model, clustering, linear association, non-linear association, outliers, positive association, negative association, categorical data, two-way table, and relative frequency.**

8.DA.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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Work	Previous Grade(s) Standard: 6.NOFC.8 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency

Examples and Explanations

Students analyze scatterplots to determine positive and negative associations, the degree of association, and the type of association. Students examine outliers to determine if data points are valid or represent a recording or measurement error. Use of the formula to identify outliers is **not** expected at this level. Students can use tools such as those at the [National Center for Educational Statistics](#) to create a graph or generate data sets.

Examples:

- Data for 10 students’ Math and Science scores are provided in the table below. Describe the association between the Math and Science scores.

Student	1	2	3	4	5	6	7	8	9	10
Math	64	50	85	34	56	24	72	63	42	93
Science	68	70	83	33	60	27	74	63	40	96

- Data for 10 students' Math scores and the distance they live from school are provided in the table below. Describe the association between the Math scores and the distance students live from school.

Student	1	2	3	4	5	6	7	8	9	10
Math score	64	50	85	34	56	24	72	63	42	93
Distance from school (miles)	0.5	1.8	1	2.3	3.4	0.2	2.5	1.6	0.8	2.5

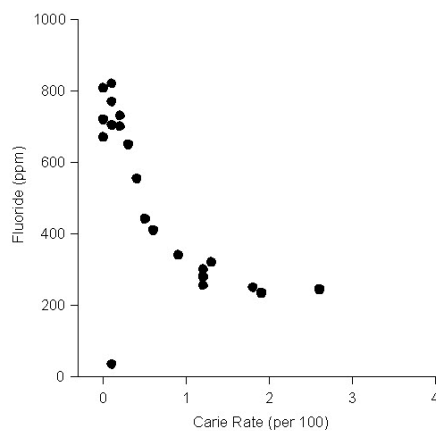
- Data from a local fast food restaurant showing the number of staff members and the average time for filling an order are provided in the table below. Describe the association between the number of staff and the average time for filling an order.

Number of staff	3	4	5	6	7	8
Average time to fill order (seconds)	180	138	120	108	96	84

- The table below lists the life expectancy in years for people in the United States every five years from 1970 to 2005. What would you expect the life expectancy of a person in the United States to be in 2010, 2015, and 2020 based upon this data? Explain how you determined your values.

Date	1970	1975	1980	1985	1990	1995	2000	2005
Life Expectancy (in years)	70.8	72.6	73.7	74.7	75.4	75.8	76.8	77.4

Students recognize that not all data will have a linear association. Some associations will be non-linear, as in the example below:



Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Bivariate Data 8.DA.A.1 8.DA.A.2 8.DA.A.3 8.DA.A.4	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Describes the patterns of association in bivariate data by interpreting scatter plots and two-way tables.	Identifies the patterns of association in bivariate data by interpreting scatter plots and two-way tables.
	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	
	Informally fits a straight line to a scatter plot that suggests a linear association and assesses the model fit.	Informally fits a straight line to a scatter plot that suggests a linear association.	Identifies a line of best fit for a scatter plot that suggests a linear association.	
	Compares linear models used to fit the same set of data to determine which has a better fit.			

8.DA.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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.DA.A.1 8th Grade Standard Taught Concurrently: 8.PF.B.4	Conceptual Understanding

Examples and Explanations

Students understand that a straight line can represent a scatter plot with linear association. The most appropriate linear model is the line that comes closest to most data points. The use of linear regression is not expected. If there is a linear relationship, students draw a linear model. Given a linear model, students write an equation.

Example:

- The capacity of the fuel tank in a car is 13.5 gallons. The table below shows the number of miles traveled and how many gallons of gas have been used. Describe the relationship between the variables. If the data has a linear association, determine a line of best fit. Do you think the line represents a good fit for the data set? Why or why not? What is the average fuel efficiency of the car in miles per gallon?

Miles Traveled	0	75	120	160	250	300
Gallons Used	0	2.3	4.5	5.7	9.7	10.7

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Bivariate Data 8.DA.A.1 8.DA.A.2 8.DA.A.3 8.DA.A.4	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Describes the patterns of association in bivariate data by interpreting scatter plots and two-way tables.	Identifies the patterns of association in bivariate data by interpreting scatter plots and two-way tables.
	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	
	Informally fits a straight line to a scatter plot that suggests a linear association and assesses the model fit.	Informally fits a straight line to a scatter plot that suggests a linear association.	Identifies a line of best fit for a scatter plot that suggests a linear association.	
	Compares linear models used to fit the same set of data to determine which has a better fit.			

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

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.DA.A.2 8th Grade Standard Taught Concurrently: 8.PF.B.4	Conceptual Understanding, Application

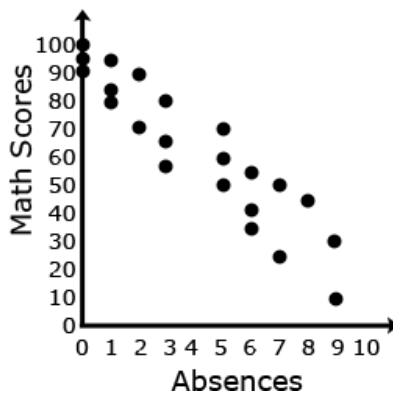
Examples and Explanations

Linear models can be represented with a linear equation. Students interpret the slope and y-intercept of the line in the context of the problem.

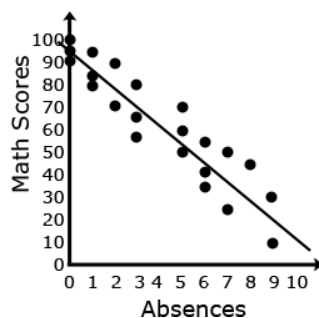
Examples:

- Given data from students' math scores and absences, make a scatterplot.

Absences	Math Scores
3	65
5	50
1	95
1	85
3	80
6	34
5	70
3	56
0	100
7	24
8	45
2	71
9	30
0	95
6	55
6	42
2	90
0	92
5	60
7	50
9	10
1	80



- o Draw a line of best fit, paying attention to the closeness of the data points on either side of the line.



- o From the line of best fit, determine an approximate linear equation that models the given data (about $y = -\frac{25}{3}x + 95$).
- o Students should recognize that 95 represents the approximate score of a student with 0 absences, and $-\frac{25}{3}$ represents the approximate amount of points (25) a student's score decreases for every 3 absences.

Students can use this linear model to solve problems. For example, through substitution, they can use the equation to determine that a student with 4 absences should expect to receive a math score of about 62. They can then compare this value to their line.

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Bivariate Data 8.DA.A.1 8.DA.A.2 8.DA.A.3 8.DA.A.4	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Describes the patterns of association in bivariate data by interpreting scatter plots and two-way tables.	Identifies the patterns of association in bivariate data by interpreting scatter plots and two-way tables.
	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	
	Informally fits a straight line to a scatter plot that suggests a linear association and assesses the model fit.	Informally fits a straight line to a scatter plot that suggests a linear association.	Identifies a line of best fit for a scatter plot that suggests a linear association.	
	Compares linear models used to fit the same set of data to determine which has a better fit.			

8.DA.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 the possible association between the two variables. For example, collect data from students in your class on whether they 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?

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency, Application

Examples and Explanations

Students understand that a two-way table provides a way to organize data between two categorical variables. Data for both categories needs to be collected from each subject. Students calculate the relative frequencies to describe associations.

Examples:

- The table illustrates the results when 100 students were asked the survey questions: “Do you have a curfew?” and “Do you have assigned chores?” Is there evidence that those who have a curfew also tend to have chores?

		Curfew	
		Yes	No
Chores	Yes	40	10
	No	10	40

Solution: Of the students who answered that they had a curfew, 40 had chores, and 10 did not. Of the students who answered that they did not have a curfew, 10 had chores, and 40 did not. From this sample, there appears to be a positive correlation between having a curfew and having chores.

- Twenty-five students were surveyed and asked if they received an allowance and if they did chores. The table below summarizes their responses.

	Receive Allowance	No Allowance
Do Chores	15	5
Do Not Do Chores	3	2

Of the students who do chores, what percent do not receive an allowance?

Solution: 5 of the 20 students who do chores do not receive an allowance, which is 25%.

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Bivariate Data 8.DA.A.1 8.DA.A.2 8.DA.A.3 8.DA.A.4	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Analyzes and describes the patterns of association in bivariate data by constructing, displaying, and interpreting scatter plots and two-way tables.	Describes the patterns of association in bivariate data by interpreting scatter plots and two-way tables.	Identifies the patterns of association in bivariate data by interpreting scatter plots and two-way tables.
	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	Uses the equation of a linear model to solve problems in context.	
	Informally fits a straight line to a scatter plot that suggests a linear association and assesses the model fit.	Informally fits a straight line to a scatter plot that suggests a linear association.	Identifies a line of best fit for a scatter plot that suggests a linear association.	
	Compares linear models used to fit the same set of data to determine which has a better fit.			

Proportionality and Functions

A. Define, evaluate, and compare functions. In this cluster, the terms students should learn to use with increasing precision are: **functions**, **y-value**, **x-value**, **vertical line test**, **input**, **output**, **rate of change**, **linear function**, and **non-linear function**.

8.PF.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. (Function notation is not required in this grade level.)

Standard Overview

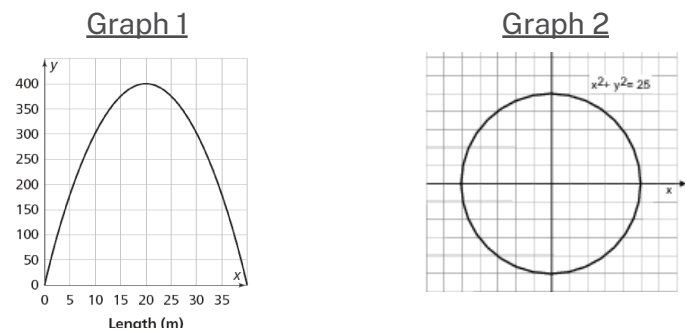
Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: 7.PF.A.2 8th Grade Standard Taught in Advance: none 8th Grade Standard Taught Concurrently: none	Conceptual Understanding

Examples and Explanations

Students understand that a function is a rule that takes an input and produces only one output; therefore, functions occur when there is exactly one y-value associated with any x-value. Students identify functions from equations, graphs, and tables/ordered pairs and are **not** expected to use the function notation $f(x)$ at this level.

Graphs

Students recognize graphs, such as graph 1 below, are functions because each x-value has only one y-value; whereas, graphs such as graph 2 are not functions because there is at least one instance where an input has more than one output (e.g., for $x = 0$, $y = 5$, and $y = -5$).



Tables or Ordered Pairs

Students read tables or look at a set of ordered pairs to determine which are functions, recognizing that functions have only one output (y-value) for each input (x-value).

Functions

x	0	1	2
y	3	9	27

$\{(0, 2), (1, 3), (2, 5), (3, 6)\}$

Not Functions

x	16	16	25	25
y	4	-4	5	-5

$\{(0, 0), (0, 1), (1, 2)\}$

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Functions 8.PF.A.1 8.PF.A.2 8.PF.A.3	Understands a function is a rule assigning to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output.
	Compares properties of two functions represented in different ways.	Compares some of the properties of two functions represented in different ways.		
	Identifies and proves functions as linear or nonlinear.	Identifies functions as linear or nonlinear.		

8.PF.A.2 Compare properties of two functions where each function is represented in a different way (algebraically, graphically, numerically, or through verbal descriptions). For example, given a linear function represented by a table of values (numerically) and a linear function represented by an algebraic expression (algebraically), determine which function has the greater rate of change.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: 7.PF.A.2 8th Grade Standard Taught in Advance: 8.AR.B.5, 8.AR.B.6, 8.PF.A.1 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Application

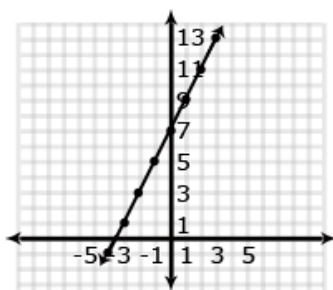
Examples and Explanations

Students compare two functions from different representations.

Examples:

- Compare the two linear functions listed below and determine which function has a greater rate of change.

Function 1



Function 2:
 $y = 3x + 7$

- Compare the two linear functions listed below and determine which has a negative slope.

Function 1: Gift Card

x	y
0	20
1	16.50
2	13.00
3	9.50
4	6.00

Samantha starts with \$20 on a gift card for the bookstore. She spends \$3.50 per week to buy a magazine. Let y be the amount remaining as a function of the number of weeks, x .

Function 2: Calculator Rental

The school bookstore rents graphing calculators for \$5 per month. It also collects a non-refundable fee of \$10.00 for the school year. Write the rule for the total cost (c) of renting a calculator as a function of the number of months (m).

Solution:

Function 1 is an example of a function whose graph has a negative slope. Samantha starts with \$20 and spends money each week. The amount of money left on the gift card decreases each week. The graph has a negative slope of -3.5, which is the amount the gift card balance decreases with Samantha's weekly magazine purchase. Function 2 is an example of a function whose graph has a positive slope. Students pay a yearly nonrefundable fee for renting the calculator and pay \$5 for each month they rent the calculator. This function has a positive slope of 5, which is the amount of the monthly rental fee. An equation for Example 2 could be $c = 5m + 10$.

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.1, LEAP.III.8.3

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Functions 8.PF.A.1 8.PF.A.2 8.PF.A.3	Understands a function is a rule assigning to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output.
	Compares properties of two functions represented in different ways.	Compares some of the properties of two functions represented in different ways.		
	Identifies and proves functions as linear or nonlinear.	Identifies functions as linear or nonlinear.		

8.PF.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; categorize functions as linear or nonlinear when given equations, graphs, or tables. 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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Major Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.AR.B.6, 8.PF.A.1, 8.PF.A.2 8th Grade Standard Taught Concurrently: none	Conceptual Understanding, Procedural Skill and Fluency

Examples and Explanations

Students understand that linear functions have a constant rate of change between any two points. Students use equations, graphs, and tables to categorize functions as linear or nonlinear.

Example:

- Determine which of the functions listed below are linear and which are not linear, and explain your reasoning.
 - $y = -2x^2 + 3$ nonlinear, because the variable x is squared
 - $y = 2x$ linear, because it has a constant rate of change
 - $A = \pi r^2$ nonlinear, because the radius is squared
 - $y = 0.25 + 0.5(x - 2)$ linear, because it has a constant rate of change

Assessment Connections

Assessment Item Type(s): Type I, II, III

Evidence Statement(s): LEAP.II.8.3, LEAP.III.8.1

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Functions 8.PF.A.1 8.PF.A.2 8.PF.A.3	Understands a function is a rule assigning to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output and can be graphed as a set of ordered pairs.	Understands a function is a rule that assigns to each input exactly one output.
	Compares properties of two functions represented in different ways.	Compares some of the properties of two functions represented in different ways.		
	Identifies and proves functions as linear or nonlinear.	Identifies functions as linear or nonlinear.		

B. Use functions to model relationships between quantities. In this cluster, the terms students should learn to use with increasing precision are: **linear relationship, rate of change, slope, initial value, and y-intercept.**

8.PF.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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Work	Previous Grade(s) Standard: 7.PF.A.2 8th Grade Standard Taught in Advance: 8.PF.A.3 8th Grade Standard Taught Concurrently: 8.PF.B.5 , 8.DA.A.2 , 8.DA.A.3	Conceptual Understanding, Procedural Skill and Fluency
Foundational Skills: 8. Construct a function to model a linear relationship.		

Examples and Explanations

Students identify the rate of change (slope) and initial value (y-intercept) from tables, graphs, equations, or verbal descriptions to write a function (linear equation). Students understand that the equation represents the relationship between the x-value and the y-value; what math operations are performed with the x-value to give the y-value. Slopes could be undefined slopes or zero slopes. Students recognize that in a table, the y-intercept is the y-value when x is equal to 0. The slope can be determined by finding the value of the ratio of the change in two y-values and the change in the two corresponding x-values, $\frac{y_1 - y_2}{x_1 - x_2}$. Using graphs, students identify the y-intercept as the point where the line crosses the y-axis and the slope as the $\frac{\text{change in } y}{\text{change in } x}$. When an equation is written as $y = mx + b$, the coefficient of x is the slope and the constant is the y-intercept. Students need to be given the equations in formats other than $y = mx + b$, such as $y = b + mx$ (often the format from contextual situations). While slope-intercept form is the predominant form for a linear equation in grade 8, functions could be expressed in standard form. However, the intent is not to change from standard form to slope-intercept form but to use the standard form to generate ordered pairs. **Point-slope form is not an expectation at this level.**

Examples:

- The table below shows the cost of renting a car. The company charges \$45 a day for the car as well as a one-time \$25 fee for the car's navigation system (GPS). Write an equation for the cost in dollars, c , as a function of the number of days, d .

Students might write the equation, $c = 45d + 25$, using the verbal description or by first making a table.

Days (d)	Cost (c) in dollars
1	70
2	115
3	160
4	205

Students should recognize that the rate of change is \$45 per day, which means the line will have a slope of 45 (the cost of renting the car) and that initial cost (the first day charge) also includes paying for the navigation system. Classroom discussion about one-time fees vs. recurrent fees will help students model contextual situations.

Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.8.3

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Modeling with Functions 8.PF.B.4 8.PF.B.5	Constructs a function to model a linear relationship between two quantities described with or without a context.	Constructs a function to model a linear relationship between two quantities described with or without a context .	Constructs a function to model a linear relationship between two quantities in a table or graph.	Identifies a function to model a linear relationship between two quantities in a table or graph.
	Determines the rate of change and initial value of the function given a description of a relationship of two or more (x, y) values in a table of values or graph.	Determines the rate of change and initial value of the function given two or more (x, y) values in a table of values or graph.	Determines the rate of change and initial value of the function from a table or graph that contains the initial value.	Determines the rate of change or initial value of the function from a table or graph that contains the initial value .
	Analyzes and describes the functional relationship between two quantities.	Analyzes the graph of a linear function to describe the functional relationship between two quantities.	Analyzes the graph of a linear function to describe the functional relationship between two quantities.	
	Identifies the graph of a function when given a written description.	Identifies the graph of a function when given a written description.		

8.PF.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.

Standard Overview

Core Tenets		
Focus	Coherence	Rigor
Supporting Work	Previous Grade(s) Standard: none 8th Grade Standard Taught in Advance: 8.PF.A.1, 8.PF.A.2, 8.PF.A.3 8th Grade Standard Taught Concurrently: 8.PF.B.4	Conceptual Understanding

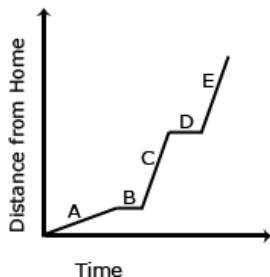
Examples and Explanations

Given a verbal description of a situation, students sketch a graph to model that situation. Given a graph of a situation, students provide a verbal description of the situation.

Example:

- The graph below shows a student’s trip to school. This student walks to his friend’s house and, together, they ride a bus to school. The bus stops once before arriving at school.

Describe how each part A-E of the graph relates to the story.



- Tides: <https://www.illustrativemathematics.org/content-standards/8/F/B/5/tasks/628>
- Distance: <https://www.illustrativemathematics.org/content-standards/8/F/B/5/tasks/632>

Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

Achievement Level Descriptor				
Content	Advanced	Mastery	Basic	Approaching Basic
Modeling with Functions 8.PF.B.4 8.PF.B.5	Constructs a function to model a linear relationship between two quantities described with or without a context.	Constructs a function to model a linear relationship between two quantities described with or without a context .	Constructs a function to model a linear relationship between two quantities in a table or graph.	Identifies a function to model a linear relationship between two quantities in a table or graph.
	Determines the rate of change and initial value of the function given a description of a relationship of two or more (x, y) values in a table of values or graph.	Determines the rate of change and initial value of the function given two or more (x, y) values in a table of values or graph.	Determines the rate of change and initial value of the function from a table or graph that contains the initial value.	Determines the rate of change or initial value of the function from a table or graph that contains the initial value .
	Analyzes and describes the functional relationship between two quantities.	Analyzes the graph of a linear function to describe the functional relationship between two quantities.	Analyzes the graph of a linear function to describe the functional relationship between two quantities.	
	Identifies the graph of a function when given a written description.	Identifies the graph of a function when given a written description.		

Cross Content Connections

Mathematics supports understanding and skills across all disciplines. The ability to apply mathematics learning across disciplines allows students to transform abstract concepts into practical tools, deepen engagement, think critically, and apply mathematics to the real world.

English Language Arts

The connection between math and English language arts (ELA) begins in disciplinary literacy, which requires literacy skills in technical subjects, including the ability to decode complex word problems as narrative structures. Students must master the language of math by using ELA skills like reading comprehension and argumentative writing to explain their reasoning, prove theorems, and articulate the logic behind their numerical solutions.

Science

K-12 math and science are deeply integrated, with mathematics serving as the essential language that allows students to quantify, model, and analyze real-world phenomena they observe in science. As students progress, they use mathematics and computational thinking — ranging from simple data graphing to complex algebraic modeling — to turn raw scientific observations into evidence-based conclusions and predictable patterns. Explicit connections between the LSSM and Louisiana Student Standards for Science (LSSS) can be found on the Connections to K-12 ELA and Math document within the [LSSS files](#).

Computer Science

The integration of mathematics and computer science is codified through state standards that treat computational thinking as a practical application of algebraic logic and problem-solving. Students use mathematical foundations, such as functions and data analysis, to build algorithms and write code that solves real-world challenges in Louisiana's growing technology and energy sectors. The [Louisiana CS Frameworks](#) make explicit connections and embed technology tools such as artificial intelligence to support students as they engage in math and computer science learning. Students can strategically use artificial intelligence tools to explore math ideas, test conjectures, analyze patterns and trends, and refine their thinking. The appropriate and skillful use of artificial intelligence in math requires students to use their mathematical reasoning to validate and critique artificial intelligence outputs in addition to naming how the use of artificial intelligence

supports and extends their thinking, understanding, and reasoning about concepts, ensuring the student maintains ownership of the mathematics, and leverages artificial intelligence as a resource.

Social Studies

The intersection of math and social studies is most evident in the analysis of historical data and economic trends, allowing students to quantify the impact of events such as the Great Flood of 1927 or the evolution of Louisiana’s energy industry. By applying statistical tools to demographic shifts and geographic mapping, students move beyond historical content standards to demonstrate understanding of the skills and practices standards for social studies. Identifying and interpreting mathematical patterns strengthens students’ ability to recognize trends that have shaped the geographical, economic, political, and cultural landscape of our state, nation, and world.

Leveraging Lower Grade Standards to Support Student Learning

Grade 4 Standards

- **4.AR.A.2** Multiply or divide to solve real-world mathematical tasks involving multiplicative comparison.
 - a. Represent these tasks by using drawings and/or equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.

Return to ■ [8.AR.A.3](#)

Grade 5 Standards

- **5.NOF.C.11** Explain and apply patterns when multiplying or dividing a number by powers of 10.
 - a. Explain and apply patterns in the number of zeros of the product when multiplying a number by powers of 10.
 - b. Use whole-number exponents to denote powers of 10.

Return to ■ [8.AR.A.3](#)

Grade 6 Standards

- **6.NOF.C.8** Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Return to ■ [8.PF.A.1](#)

- **6.AR.A.1** Understand, write, and evaluate numerical expressions involving whole-number exponents.
 - a. Identify parts of exponential notation using mathematical terms (base and exponent).
 - b. Represent and evaluate powers using a whole number or fraction as the base and a whole number as an exponent, and evaluate numerical expressions.

Return to ■ [8.AR.A.1](#)

- **6.AR.B.4** Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

Return to ■ [8.AR.A.2](#) ■ [8.AR.C.8](#)

- **6.GL.A.3** Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. Return to ■ [8.GL.A.3](#), ■ [8.GL.B.8](#)

Grade 7 Standards

■ **7.PF.A.2** Recognize and represent proportional relationships between quantities.

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

Return to ■ [8.AR.B.5](#), ■ [8.AR.B.6](#), ■ [8.PF.A.1](#), ■ [8.PF.A.2](#), ■ [8.PF.B.4](#)

■ **7.NOF.A.2** Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers flexibly and accurately.

- Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
- Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with nonzero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts.
- Apply properties of operations as strategies to multiply and divide rational numbers.
- Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.

Return to ■ [8.NOF.A.1](#)

■ **7.NOF.A.3** Solve real-world and mathematical problems involving the four operations with rational numbers. Computations with rational numbers extend the rules for manipulating fractions to complex fractions.

Return to ■ [8.AR.A.2](#)

■ **7.AR.A.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with positive and negative rational coefficients to include multiple grouping symbols (e.g., parentheses, brackets, and braces).

Return to ■ [8.AR.C.7](#)

■ **7.AR.B.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example:

- If a woman making \$25 an hour gets a 10% raise, she will make an additional $\frac{1}{10}$ of her salary an hour, or \$2.50, for a new salary of \$27.50.
- If you want to place a towel bar $9\frac{3}{4}$ inches long in the center of a door that is $27\frac{1}{2}$ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.

Return to ■ [8.AR.A.4](#)

○ **7.GL.A.2** Draw triangles with given conditions. Understand the possible side lengths and angle measures that determine one and only one triangle, more than one triangle, or no triangle.

Return to ■ [8.AR.B.6](#), ■ [8.GL.A.1](#)

○ **7.GL.B.5** Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Return to ■ [8.GL.A.1](#)

○ **7.GL.B.6** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. (Pyramids limited to surface area only.)

Return to ■ [8.GL.B.6](#)