

# Standards Resource Guide

Grade 7

---

## 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](mailto:math@la.gov).

August 2026

# Table of Contents

Introduction..... 3

Louisiana Standards for Mathematical Practice (MP)..... 8

Grade Level Foundational Skills..... 10

Numeracy and Operational Fluency..... 11

Algebraic Reasoning..... 24

Geometric Reasoning and Logic..... 44

Data Analysis..... 67

Proportionality and Functions..... 92

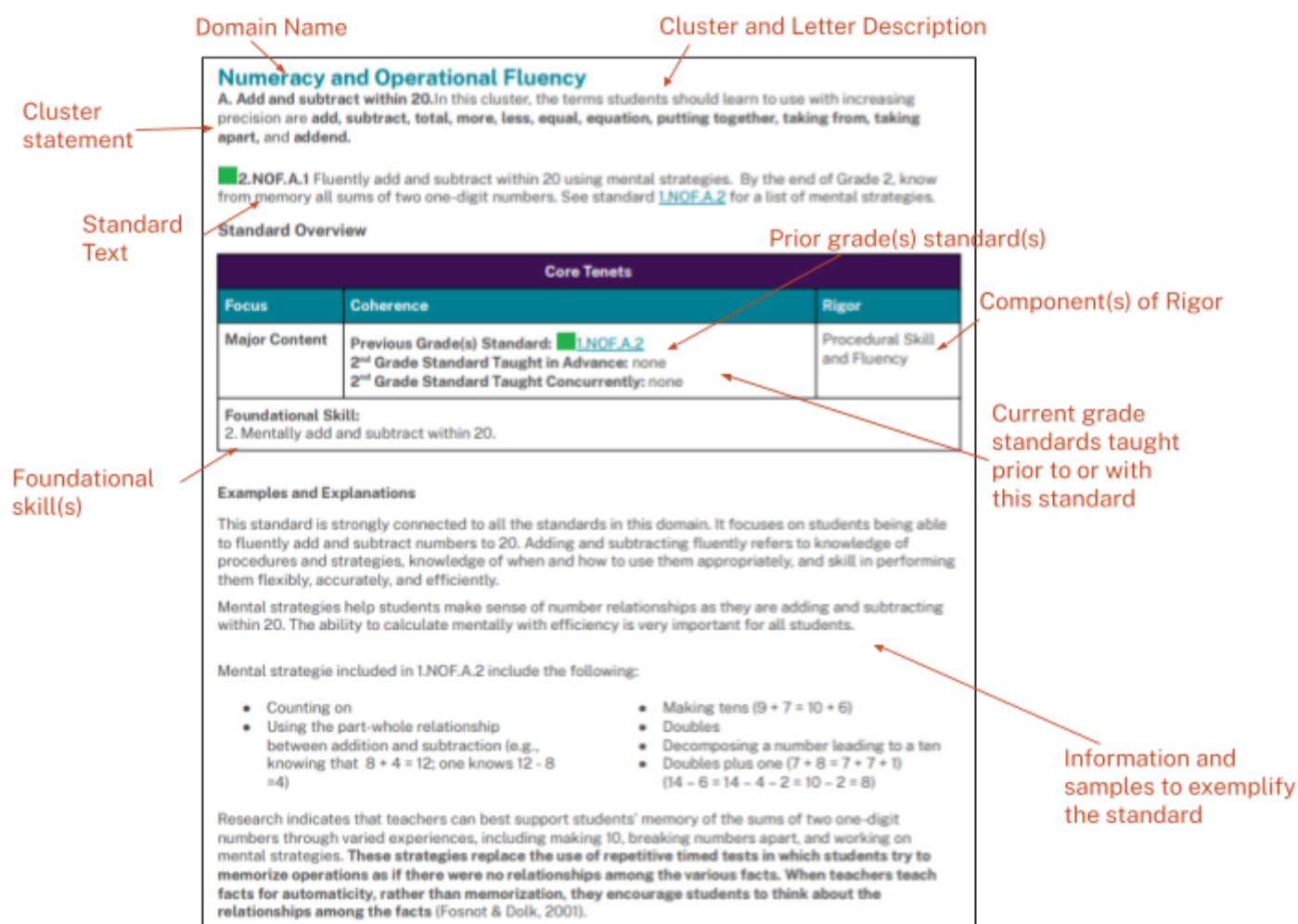
Cross Content Connections..... 104

Leveraging Lower Grade Standards to Support Student Learning..... 106

# 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

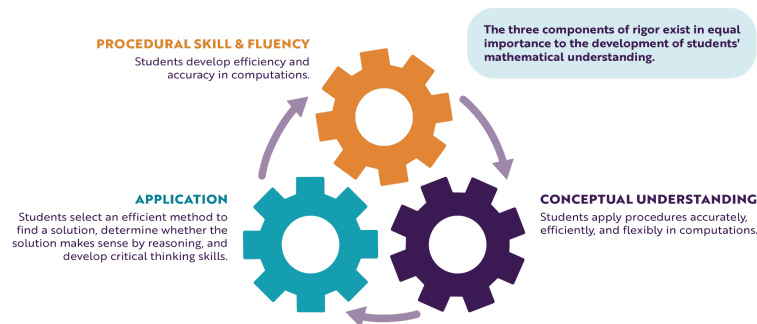
Students should spend the majority of their time on the ■ major work of the grade, ■ supporting work, and, where appropriate, ● additional work engages students in the major work of the grade, often through a change of the **context** within which students are performing mathematics. Each standard is 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. For example,

**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.

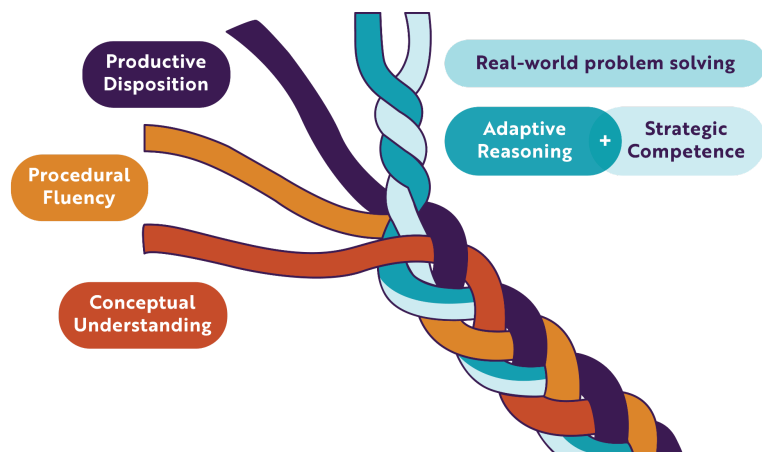
**Focus** calls for intentional emphasis on specific topics, skills, and ideas within grade-level mathematics instruction. Not all content in a given grade is emphasized equally in the standards. Some clusters require greater emphasis than others based on the depth of the ideas, the time that they take 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),<sup>1</sup> 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 a 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 the

<sup>1</sup> 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>.

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 7 complete.

| Louisiana Standards for Mathematical Practice (MP)                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Louisiana Standard                                                             | Explanations and Examples                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>7.MP.1</b> Make sense of problems and persevere in solving them.            | In grade 7, students solve problems involving ratios and rates and discuss how they solved them. 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?”                                                                                                                                                                                                                                                                                                      |
| <b>7.MP.2</b> Reason abstractly and quantitatively.                            | In grade 7, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. 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.                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>7.MP.3</b> Construct viable arguments and critique the reasoning of others. | In grade 7, 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.                                                                                                                                                                                              |
| <b>7.MP.4</b> Model with mathematics.                                          | In grade 7, 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 explore covariance and represent two quantities simultaneously. They use measures of center and variability and data displays (e.g., box plots and histograms) to draw inferences, make comparisons, and formulate predictions. Students use experiments or simulations to generate data sets and create probability models. 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. |
| <b>7.MP.5</b> 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 7 may decide to represent similar data sets using dot plots with the same scale to visually compare the center and variability of the data. Students might use physical objects or applets to generate probability data and use graphing calculators or spreadsheets to manage and represent data in different forms.                                                                                                                                                                                                                                                                          |

|                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>7.MP.6</b> Attend to precision.                                   | In grade 7, 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 define variables, specify units of measure, and label axes accurately. Students use appropriate terminology when referring to rates, ratios, probability models, geometric figures, data displays, and components of expressions, equations, or inequalities.                                                                                                                                                                                                                                                                                                                                                             |
| <b>7.MP.7</b> Look for and make use of structure.                    | Students routinely seek patterns or structures to model and solve problems. For instance, students recognize patterns that exist in ratio tables, making connections between the constant of proportionality in a table with the slope of a graph. Students apply properties to generate equivalent expressions (e.g., $6 + 2x = 2(3 + x)$ by distributive property) and solve equations (e.g., $2c + 3 = 15$ , $2c = 12$ by subtraction property of equality; $c=6$ by division property of equality). Students compose and decompose two- and three-dimensional figures to solve real-world problems involving scale drawings, surface area, and volume. Students examine tree diagrams or systematic lists to determine the sample space for compound events and verify that they have listed all possibilities. |
| <b>7.MP.8</b> Look for and express regularity in repeated reasoning. | In grade 7, students use repeated reasoning to understand algorithms and make generalizations about patterns. During multiple opportunities to solve and model problems, they may notice that $a/b \div c/d = ad/bc$ and construct other examples and models that confirm their generalization. They extend their thinking to include complex fractions and rational numbers. Students formally begin to make connections between covariance, rates, and representations, showing the relationships between quantities. They create, explain, evaluate, and modify probability models to describe simple and compound events.                                                                                                                                                                                       |

## Grade Level Foundational Skills

By the end of grade 7, mathematically proficient students can reliably use all prior foundational skills and the skills foundational to grade 7 to engage in grade-appropriate mathematical tasks. This list does not represent the full depth of learning expected in grade 7, but consists of the foundational skills required by the standards.

1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.
2. Accurately convert a rational number to a decimal, recognizing the decimal form of rational numbers.
3. Use properties of operations to add, subtract, factor, and expand linear expressions with rational coefficients to include multiple sets of grouping symbols.
4. Fluently solve one-variable equations.

## Numeracy and Operational Fluency

**A. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.** In this cluster, the terms students should learn to use with increasing precision are: **rational numbers**, **integers**, and **additive inverse**.

**7.NOF.A.1** Apply and extend previous understandings of addition and subtraction and of fractions to add and subtract rational numbers flexibly and accurately; represent addition and subtraction on a horizontal or vertical number line diagram.

- Describe situations in which opposite quantities combine to make 0.
  - For example, a hydrogen atom has a net charge of 0 because its two components carry opposite charges.
- Understand  $p + q$  as the number located a distance  $|q|$  from  $p$ , in the positive or negative direction depending on whether  $q$  is positive or negative. Show that a number and its opposite have a sum of 0, as they are additive inverses. Interpret sums of rational numbers by describing real-world contexts.
- Understand subtraction of rational numbers as adding the additive inverse,  $p - q = p + (-q)$ . Show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in real-world contexts.
- Apply properties of operations as strategies to add and subtract rational numbers.

### Standard Overview

| Core Tenets                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                               |                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Focus                                                                                                                                                                                                                                                                                                                                            | Coherence                                                                                                                                                     | Rigor                                                                                  |
| Major Content                                                                                                                                                                                                                                                                                                                                    | Previous Grade(s) Standard: <b>5.NOF.A.1</b> , <b>6.NOF.C.5</b><br>7th Grade Standard Taught in Advance: none<br>7th Grade Standard Taught Concurrently: none | Conceptual Understanding (2, 2a, 2b, 2c, 2d), Procedural Skill and Fluency (2, 2c, 2d) |
| <b>Foundational Skills:</b><br>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.<br>3. Use properties of operations to add, subtract, factor, and expand linear expressions with rational coefficients to include multiple sets of grouping symbols. |                                                                                                                                                               |                                                                                        |

### Examples and Explanations

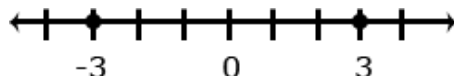
Students add and subtract rational numbers. Visual representations may be helpful as students begin this work; they become less necessary as students become more fluent with these operations. In sixth grade, students found the distance of horizontal and vertical segments on the coordinate plane. In seventh grade, students build on this understanding to recognize subtraction as finding the distance between two numbers on a number line. This standard allows for adding and subtracting negative fractions and decimals and interpreting solutions in a given context.

Louisiana Department of Education

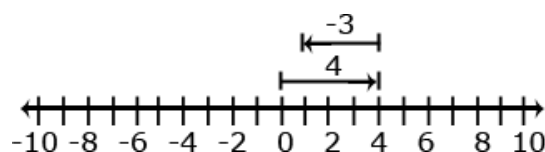
[doe.louisiana.gov](http://doe.louisiana.gov) | P.O. Box 94064 • Baton Rouge, LA • 70804-9064

### Examples:

- Have students substitute rational numbers for
- $p$  and  $q$  and use a number line to find  $p - q$  and  $p + (-q)$ , repeating this multiple times with different numbers. Students should see a pattern that they end up at the same point on the number line. Inductively, students should conclude that  $p - q = p + (-q)$ .
- $-3$  and  $3$  are shown to be opposites on the number line because they are equal distance from zero and therefore have the same absolute value, and the sum of the number and its opposite is zero.



- $4 + (-3) = 1$  or  $(-3) + 4 = 1$



- Use a number line to add  $-5\frac{1}{2} + 7$ .
- Use a number line to subtract:  $-6 - (-\frac{2}{3})$

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.1, LEAP.II.7.2, LEAP.II.7.3, LEAP.III.7.1

| Achievement Level Descriptor                                                               |                                                                                                                                                          |                                                                                                                                                          |                                                                                                                                                                 |                                                                                         |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Content                                                                                    | Advanced                                                                                                                                                 | Mastery                                                                                                                                                  | Basic                                                                                                                                                           | Approaching Basic                                                                       |
| <b>Operations with Rational Numbers</b><br>7.NOF.A.1<br>7.NOF.A.2<br>7.NOF.A.3<br>7.AR.B.3 | Performs operations on positive and negative rational numbers in multi-step mathematical and real-world problems.                                        | Performs operations on positive and negative rational numbers in <b>multi-step</b> mathematical and real-world problems.                                 | Performs operations on positive and negative rational numbers in mathematical <b>and real-world problems.</b>                                                   | Performs operations on positive and negative rational numbers in mathematical problems. |
|                                                                                            | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line <b>and recognizes situations in which opposite quantities combine to make zero.</b> | Represents addition and subtraction on a horizontal or vertical number line.            |
|                                                                                            | Determines reasonableness of a solution <b>and interprets solutions in real-world contexts.</b>                                                          | <b>Determines reasonableness of a solution.</b>                                                                                                          |                                                                                                                                                                 |                                                                                         |
|                                                                                            | <b>Understands subtraction of rational numbers as adding the additive inverse and the rules for multiplying/dividing positive and negative numbers.</b>  | <b>Identifies equivalent expressions of positive and negative rational numbers.</b>                                                                      |                                                                                                                                                                 |                                                                                         |

**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.

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

Standard Overview

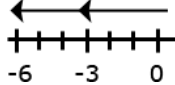
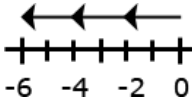
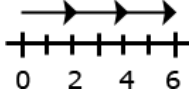
| Core Tenets                                                                                                                                                                             |                                                                                                                                                                                                                                               |                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Focus                                                                                                                                                                                   | Coherence                                                                                                                                                                                                                                     | Rigor                                                                                                |
| Major                                                                                                                                                                                   | <p><b>Previous Grade(s) Standard:</b> <a href="#">5.NOF.B.3</a>, <a href="#">5.NOF.B.4</a>, <a href="#">6.NOF.A.1</a></p> <p><b>7th Grade Standard Taught in Advance:</b> none</p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | <p>Conceptual Understanding (2, 2a, 2b, 2c, 2d),</p> <p>Procedural Skill and Fluency (2, 2c, 2d)</p> |
| <p><b>Foundational Skills:</b></p> <p>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.</p> |                                                                                                                                                                                                                                               |                                                                                                      |

Examples and Explanations

Students understand that multiplication and division of integers is an extension of multiplication and division of whole numbers. Students recognize that when division of rational numbers is represented with a fraction bar, the numerator and denominator signs affect the value of the fraction. Using long division from [6.NOF.B.2](#), students understand the difference between terminating and repeating decimals. This understanding is foundational for the work with rational and irrational numbers in eighth grade.

- Examine the family of equations in the table below. What patterns are evident? Create a model and context for each of the products.

| Equation        | Number Line Model | Context                                           |
|-----------------|-------------------|---------------------------------------------------|
| $2 \cdot 3 = 6$ |                   | Selling two packages of apples at \$3.00 per pack |

|                   |                                                                                   |                                                 |
|-------------------|-----------------------------------------------------------------------------------|-------------------------------------------------|
| $2 \cdot -3 = -6$ |  | Spending 3 dollars each on 2 packages of apples |
| $-2 \cdot 3 = -6$ |  | Owing 2 dollars to each of your three friends   |
| $-2 \cdot -3 = 6$ |  | Forgiving 3 debts of \$2.00 each                |

- Which of the following fractions is equivalent to  $-\frac{4}{5}$ ? Explain your reasoning.  
a.  $\frac{4}{-5}$       b.  $\frac{-16}{20}$       c.  $\frac{-4}{-5}$
- Using long division, express the following fractions as decimals. Which of the following fractions will result in terminating decimals, and which will result in repeating decimals?  
a.  $\frac{7}{8}$       b.  $\frac{4}{11}$       c.  $4\frac{5}{16}$       d.  $\frac{2}{9}$

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.1, LEAP.II.7.2, LEAP.II.7.3, LEAP.II.7.7, LEAP.III.7.1

| Achievement Level Descriptor                                                               |                                                                                                                                                          |                                                                                                                                                          |                                                                                                                                                                 |                                                                                         |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Content                                                                                    | Advanced                                                                                                                                                 | Mastery                                                                                                                                                  | Basic                                                                                                                                                           | Approaching Basic                                                                       |
| <b>Operations with Rational Numbers</b><br>7.NOF.A.1<br>7.NOF.A.2<br>7.NOF.A.3<br>7.AR.B.3 | Performs operations on positive and negative rational numbers in multi-step mathematical and real-world problems.                                        | Performs operations on positive and negative rational numbers in <b>multi-step</b> mathematical and real-world problems.                                 | Performs operations on positive and negative rational numbers in mathematical <b>and real-world problems.</b>                                                   | Performs operations on positive and negative rational numbers in mathematical problems. |
|                                                                                            | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line <b>and recognizes situations in which opposite quantities combine to make zero.</b> | Represents addition and subtraction on a horizontal or vertical number line.            |
|                                                                                            | Determines reasonableness of a solution <b>and interprets solutions in real-world contexts.</b>                                                          | <b>Determines reasonableness of a solution.</b>                                                                                                          |                                                                                                                                                                 |                                                                                         |
|                                                                                            | <b>Understands subtraction of rational numbers as adding the additive inverse and the rules for multiplying/dividing positive and negative numbers.</b>  | <b>Identifies equivalent expressions of positive and negative rational numbers.</b>                                                                      |                                                                                                                                                                 |                                                                                         |

**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.

### Standard Overview

| Core Tenets                                                                                                                                                                  |                                                                                                                                                                                                              |                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Focus                                                                                                                                                                        | Coherence                                                                                                                                                                                                    | Rigor                                     |
| Major                                                                                                                                                                        | Previous Grade(s) Standard: <span>■</span> <a href="#">4.AR.A.3</a> , <span>●</span> <a href="#">6.NOF.B.3</a><br>7th Grade Standard Taught in Advance: none<br>7th Grade Standard Taught Concurrently: none | Procedural Skill and Fluency, Application |
| <b>Foundational Skills:</b><br>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals. |                                                                                                                                                                                                              |                                           |

### Examples and Explanations

Students use order of operations from sixth grade and multiple grouping symbols (parentheses, braces, and brackets) to write and solve problems with all rational numbers.

#### Examples:

- Calculate:  $[-10(-0.9)] - [(-10) \cdot 0.11]$  *Solution:* 10.1
- Jim’s cell phone bill company automatically deducts \$32 from his bank account every month. How much will the cell phone bill deductions affect this bank account over a year? *Solution:* -\$384 (decreases amount by \$384)
- It took a submarine 20 seconds to drop to 100 feet below sea level from the surface. What was the rate of the descent? *Solution:* -5 feet per second
- A newspaper reports these changes in the price of a stock over four days:  $-0.125, -0.625, 0.375, -1.125$ . What is the average daily change? *Solution:*  $-0.375$

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.3, LEAP.II.7.7, LEAP.III.7.1, LEAP.III.7.4

| Achievement Level Descriptor                                                               |                                                                                                                                                          |                                                                                                                                                          |                                                                                                                                                                 |                                                                                         |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Content                                                                                    | Advanced                                                                                                                                                 | Mastery                                                                                                                                                  | Basic                                                                                                                                                           | Approaching Basic                                                                       |
| <b>Operations with Rational Numbers</b><br>7.NOF.A.1<br>7.NOF.A.2<br>7.NOF.A.3<br>7.AR.B.3 | Performs operations on positive and negative rational numbers in multi-step mathematical and real-world problems.                                        | Performs operations on positive and negative rational numbers in <b>multi-step</b> mathematical and real-world problems.                                 | Performs operations on positive and negative rational numbers in mathematical <b>and real-world problems.</b>                                                   | Performs operations on positive and negative rational numbers in mathematical problems. |
|                                                                                            | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line <b>and recognizes situations in which opposite quantities combine to make zero.</b> | Represents addition and subtraction on a horizontal or vertical number line.            |
|                                                                                            | Determines reasonableness of a solution <b>and interprets solutions in real-world contexts.</b>                                                          | <b>Determines reasonableness of a solution.</b>                                                                                                          |                                                                                                                                                                 |                                                                                         |
|                                                                                            | <b>Understands subtraction of rational numbers as adding the additive inverse and the rules for multiplying/dividing positive and negative numbers.</b>  | <b>Identifies equivalent expressions of positive and negative rational numbers.</b>                                                                      |                                                                                                                                                                 |                                                                                         |

## Algebraic Reasoning

### A. Use properties of operations to generate equivalent expressions.

In this cluster, the terms students should learn to use with increasing precision are: **coefficients**, **like terms**, **distributive property**, **factor**, and **linear expression**.

■ **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).

### Standard Overview

| Core Tenets                                                                                                                                                                                                |                                                                                                                                                                                           |                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Focus                                                                                                                                                                                                      | Coherence                                                                                                                                                                                 | Rigor                                                  |
| Major                                                                                                                                                                                                      | <p>Previous Grade(s) Standard: ■ <a href="#">6.AR.A.3</a></p> <p>7th Grade Standard Taught in Advance: none</p> <p>7th Grade Standard Taught Concurrently: ■ <a href="#">7.AR.A.2</a></p> | Conceptual Understanding, Procedural Skill and Fluency |
| <p><b>Foundational Skills:</b></p> <p>4. Use properties of operations to add, subtract, factor, and expand linear expressions with rational coefficients to include multiple sets of grouping symbols.</p> |                                                                                                                                                                                           |                                                        |

### Examples and Explanations

#### Examples:

- Simplify the expression  $3(x + 5) - 2$ .  
*Solution:*  $3x + 13$
- Suzanne says the two expressions  $2(3a - 2) + 4a$  and  $10a - 2$  are equivalent. Is she correct? Explain why or why not?  
*Solution:* No,  $2(3a - 2) + 4a$  is equivalent to  $10a - 4$ . You must multiply  $2(3a - 2)$  and get  $6a - 4$ , and then add  $4a$  to  $6a$ .
- Factor the expression  $3a + 12$ .  
*Solution:*  $3(a + 4)$

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.1, LEAP.III.7.1

| Achievement Level Descriptor                                                        |                                                                                                                                                                                   |                                                                                                                                                                     |                                                                                                                                                       |                                                                                        |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Content                                                                             | Advanced                                                                                                                                                                          | Mastery                                                                                                                                                             | Basic                                                                                                                                                 | Approaching Basic                                                                      |
| <b>Expressions, Inequalities, and Equations</b><br>7.AR.A.1<br>7.AR.A.2<br>7.AR.B.4 | Applies properties of operations as strategies to add, subtract, factor, and expand linear expressions.                                                                           | Applies properties of operations as strategies to add, subtract, <b>factor</b> , and expand linear expressions.                                                     | Applies properties of operations as strategies to add, subtract, <b>and expand</b> linear expressions.                                                | Applies properties of operations as strategies to add and subtract linear expressions. |
|                                                                                     | Fluently solves two-step linear equations with rational coefficients.                                                                                                             | <b>Fluently</b> solves two-step linear equations with rational coefficients.                                                                                        | Solves <b>two-step</b> linear equations with rational coefficients.                                                                                   | Solves one-step linear equations with rational coefficients.                           |
|                                                                                     | In mathematical or real-world contexts, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs <b>and interprets</b> solution sets. | In a mathematical <b>or real-world</b> context, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs solution sets. | <b>In a mathematical context, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs solution sets.</b> |                                                                                        |
|                                                                                     | <b>Rewrites an expression</b> in different forms.                                                                                                                                 | <b>Identifies equivalent expressions in different forms</b>                                                                                                         |                                                                                                                                                       |                                                                                        |
|                                                                                     | <b>Describes</b> the relationship between equivalent quantities that are expressed algebraically in different forms in a problem context <b>and explains their</b>                | <b>Identifies the relationship between equivalent quantities that are expressed algebraically in different forms in a problem context.</b>                          |                                                                                                                                                       |                                                                                        |

|  |                                                     |  |  |  |
|--|-----------------------------------------------------|--|--|--|
|  | equivalence in light of the context of the problem. |  |  |  |
|--|-----------------------------------------------------|--|--|--|

**7.AR.A.2** Understand that rewriting an expression in different forms can help reveal relationships between quantities in the context of a problem.

- For example,  $a + 0.05a$  is equivalent to  $1.05a$ , which means to “increase by 5%” is the same as “multiply by 1.05.”

## Standard Overview

| Core Tenets |                                                                                                                                                                                        |                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Focus       | Coherence                                                                                                                                                                              | Rigor                    |
| Major       | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b> none</p> <p><b>7th Grade Standard Taught Concurrently:</b> <a href="#">7.AR.A.1</a></p> | Conceptual Understanding |

## Examples and Explanations

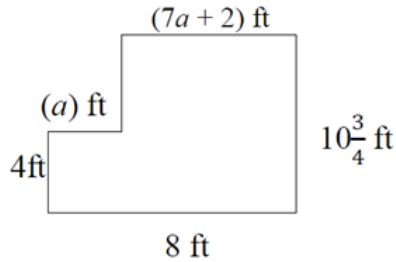
Students understand the reason for rewriting an expression in terms of a contextual situation. For example, students understand that a 20% discount is the same as finding 80% of the cost,  $c$ , which is equivalent to  $0.80c$ .

### Examples:

- All varieties of a certain brand of cookies are \$3.50. A person buys peanut butter cookies and chocolate chip cookies. Susan wrote two different expressions that represent the total cost of the cookies if  $p$  represents the number of peanut butter cookies and  $c$  represents the number of chocolate chip cookies.
  - One of the expressions Susan wrote was  $\$3.50p + \$3.50c$ . Explain what Susan’s expression means.
  - What is another expression Susan could have written to represent the cost? Explain what the expression means.
    - Solution:** All types of cookies cost \$3.50. In her first expression, Susan is multiplying the cost times the number of peanut butter cookies, multiplying the same cost times the number of chocolate chip cookies, and then adding the two products. Susan could also have written the expression  $\$3.50(p + c)$ . Since the cookies all cost the same, she is first finding the total number of cookies she bought and then multiplying that number of cookies times the cost per cookie.
- Jamie and Ted both get paid an equal hourly wage of \$9 per hour. This week, Ted made an additional \$27 in overtime. Write an expression that represents the weekly wages of both if  $J$  represents the number of hours that Jamie worked this week and  $T$  represents the number of hours Ted worked this week. Can you write the expression in another way?
  - Students may create several different expressions depending upon how they group the quantities in the problem.
  - One student might say: “To find the total wage, I would first multiply the number of hours Jamie worked by 9. Then I would multiply the number of hours Ted worked by 9. I would add these two values with the \$27 overtime to find the total wages for the week.” The student would write the expression  $9J + 9T + 27$ .
  - Another student might say: “To find the total wages, I would add the number of hours that Ted and Jamie worked. I would multiply the total number of hours worked by 9. I

would then add the overtime to that value to get the total wages for the week.” The student would write the expression  $9(J + T) + 27$ .

- o A third student might say: “To find the total wages, I would need to figure out how much Jamie made and add that to how much Ted made for the week. To figure out Jamie’s wages, I would multiply the number of hours she worked by 9. To figure out Ted’s wages, I would multiply the number of hours he worked by 9 and then add the \$27 he earned in overtime. My final step would be to add Jamie’s and Ted’s wages for the week to find their combined total wages.” The student would write the expression  $9J + (9T + 27)$ .
- Write and interpret an expression that represents the area of Anna’s room.



Anna's Room

### Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.7.1

| Achievement Level Descriptor                                                        |                                                                                                                                                                                   |                                                                                                                                                                     |                                                                                                                                                     |                                                                                        |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Content                                                                             | Advanced                                                                                                                                                                          | Mastery                                                                                                                                                             | Basic                                                                                                                                               | Approaching Basic                                                                      |
| <b>Expressions, Inequalities, and Equations</b><br>7.AR.A.1<br>7.AR.A.2<br>7.AR.B.4 | Applies properties of operations as strategies to add, subtract, factor, and expand linear expressions.                                                                           | Applies properties of operations as strategies to add, subtract, <b>factor</b> , and expand linear expressions.                                                     | Applies properties of operations as strategies to add, subtract, <b>and expand</b> linear expressions.                                              | Applies properties of operations as strategies to add and subtract linear expressions. |
|                                                                                     | Fluently solves two-step linear equations with rational coefficients.                                                                                                             | <b>Fluently</b> solves two-step linear equations with rational coefficients.                                                                                        | Solves <b>two-step</b> linear equations with rational coefficients.                                                                                 | Solves one-step linear equations with rational coefficients.                           |
|                                                                                     | In mathematical or real-world contexts, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs <b>and interprets</b> solution sets. | In a mathematical <b>or real-world</b> context, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs solution sets. | <b>In a mathematical context, uses variables to represent quantities, constructs and solve equations and inequalities, and graph solution sets.</b> |                                                                                        |
|                                                                                     | <b>Rewrites an expression</b> in different forms.                                                                                                                                 | <b>Identifies equivalent expressions in different forms.</b>                                                                                                        |                                                                                                                                                     |                                                                                        |
|                                                                                     | <b>Describes</b> the relationship between equivalent quantities that are expressed algebraically in different forms in a problem context <b>and explains their</b>                | <b>Identifies the relationship between equivalent quantities that are expressed algebraically in different forms in a problem context.</b>                          |                                                                                                                                                     |                                                                                        |

|  |                                                     |  |  |  |
|--|-----------------------------------------------------|--|--|--|
|  | equivalence in light of the context of the problem. |  |  |  |
|--|-----------------------------------------------------|--|--|--|

**B. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.**  
 In this cluster, the terms students should learn to use with increasing precision are: **numeric expressions, algebraic expressions, maximum, and minimum.**

**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.

**Standard Overview**

| Core Tenets                                                                                                                                                                  |                                                                                                                                             |                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Focus                                                                                                                                                                        | Coherence                                                                                                                                   | Rigor                                                               |
| Major                                                                                                                                                                        | Previous Grade(s) Standard: none<br>7th Grade Standard Taught in Advance: <b>7.NO.F.A.3</b><br>7th Grade Standard Taught Concurrently: none | Conceptual Understanding, Procedural Skill and Fluency, Application |
| <b>Foundational Skills:</b><br>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals. |                                                                                                                                             |                                                                     |

**Examples and Explanations**

Students solve contextual problems and mathematical problems using rational numbers. Students convert between fractions, decimals, and percents as needed to solve the problem. Students use estimation to justify the reasonableness of answers.

Estimation strategies for calculations with fractions and decimals extend from students’ work with whole number operations. Estimation strategies include, but are not limited to:

- front-end estimation with adjusting (using the highest place value and estimating from the front end, making adjustments to the estimate by taking into account the remaining amounts),
- clustering around an average (when the values are close together, an average value is selected and multiplied by the number of values to determine an estimate),
- rounding and adjusting (students round down or round up and then adjust their estimate depending on how much the rounding affected the original values),

- using friendly or compatible numbers such as factors (students seek to fit numbers together (e.g., rounding to factors and grouping numbers together that have round sums like 100 or 1000), and
- using benchmark numbers that are easy to compute (students select close whole numbers for fractions or decimals to determine an estimate).

**Examples:**

- Calculate:
- $\left(-\frac{3}{2} + 4\frac{1}{5}\right) - \frac{2}{5}(-2.17 + 4.67)$
- Three students conduct the same survey about the number of hours people sleep at night. The results of the number of people who sleep 8 hours a night are shown below. In which person's survey did a higher proportion sleep 8 hours?
  - o Susan reported that 18 of the 48 people she surveyed get 8 hours of sleep a night.
  - o Kenneth reported that 36% of the people he surveyed get 8 hours of sleep a night.
  - o Jamal reported that 0.365 of the people he surveyed get 8 hours of sleep a night.

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.7, LEAP.III.7.1, LEAP.III.7.4

| Achievement Level Descriptor                                                               |                                                                                                                                                          |                                                                                                                                                          |                                                                                                                                                                  |                                                                                         |
|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Content                                                                                    | Advanced                                                                                                                                                 | Mastery                                                                                                                                                  | Basic                                                                                                                                                            | Approaching Basic                                                                       |
| <b>Operations with Rational Numbers</b><br>7.NOF.A.1<br>7.NOF.A.2<br>7.NOF.A.3<br>7.AR.B.3 | Performs operations on positive and negative rational numbers in multi-step mathematical and real-world problems.                                        | Performs operations on positive and negative rational numbers in <b>multi-step</b> mathematical and real-world problems.                                 | Performs operations on positive and negative rational numbers in mathematical <b>and real-world problems</b> .                                                   | Performs operations on positive and negative rational numbers in mathematical problems. |
|                                                                                            | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line and recognizes situations in which opposite quantities combine to make zero. | Represents addition and subtraction on a horizontal or vertical number line <b>and recognizes situations in which opposite quantities combine to make zero</b> . | Represents addition and subtraction on a horizontal or vertical number line.            |
|                                                                                            | Determines reasonableness of a solution <b>and interprets solutions in real-world contexts</b> .                                                         | <b>Determines reasonableness of a solution.</b>                                                                                                          |                                                                                                                                                                  |                                                                                         |
|                                                                                            | <b>Understands subtraction of rational numbers as adding the additive inverse and the rules for multiplying/dividing positive and negative numbers.</b>  | <b>Identifies equivalent expressions of positive and negative rational numbers.</b>                                                                      |                                                                                                                                                                  |                                                                                         |

**7.AR.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities

- Solve word problems leading to equations of the form  $px + q = r$  and  $p(x + q) = r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?
- Solve word problems leading to inequalities of the form  $px + q > r$ ,  $px + q \geq r$ ,  $px + q < r$ , or  $px + q \leq r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example, as a salesperson, you are paid \$50 per week plus \$3 per sale. This week, you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.

## Standard Overview

| Core Tenets                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                     |                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Focus                                                                                                                                                                                                                                    | Coherence                                                                                                                                                                                                                                                                           | Rigor                                                               |
| Major                                                                                                                                                                                                                                    | <p><b>Previous Grade(s) Standard:</b> <a href="#">6.AR.B.5</a>, <a href="#">6.AR.B.6</a>, <a href="#">6.AR.B.7</a></p> <p><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.NOF.A.3</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> <a href="#">7.PF.A.2</a></p> | Conceptual Understanding, Procedural Skill and Fluency, Application |
| <p><b>Foundational Skills:</b></p> <p>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.</p> <p>4. Fluently solve one-variable equations.</p> |                                                                                                                                                                                                                                                                                     |                                                                     |

## Examples and Explanations

Students write an equation or inequality to model the situation. Students explain how they determined whether to write an equation or an inequality and the properties of the real number system that were used to find a solution. In contextual problems, students define the variable and use appropriate units. In part a, students use the arithmetic from the problem to generalize an algebraic solution. In part b, students solve and graph inequalities and make sense of the inequality in context. Rational numbers may include any type of rational number, including negatives. Students may be asked to find a maximum or minimum value in context. Furthermore, it is appropriate for students to sometimes use exact answers (i.e., leaving answers in terms of  $\pi$ ).

## Examples:

- Solve each equation for  $x$ .
  - $\frac{2}{3}x - 7 = 13$
  - $\frac{1}{2}(x - 13) = -5$

**Teacher Note:** Students should recognize that this equation can be solved **without** using the distributive property.

- Amie had \$26 to spend on school supplies. After buying 10 pens, she had \$14.30 left. How much did each pen cost?
- The sum of three consecutive even numbers is 48. What is the smallest of these numbers?
- Florencia has at most \$60 to spend on clothes. She wants to buy a pair of jeans for \$22 and spend the rest on t-shirts. Each t-shirt costs \$8. Write an inequality for the number of t-shirts she can purchase.
- Steven has \$25. He spent \$10.81, including tax, to buy a new DVD. He needs to set aside \$10.00 to pay for his lunch next week. If peanuts cost \$0.38 per package, including tax, what is the maximum number of packages that Steven can buy?

Write an equation or inequality to model the situation. Explain how you determined whether to write an equation or an inequality and the properties of the real number system that you used to find a solution.

- The youth group is going on a trip to the state fair. The trip costs \$52. Included in that price is \$11 for a concert ticket and the cost of 2 passes, one for the rides and one for the game booths. Each of the passes costs the same price. Write an equation representing the cost of the trip and determine the price of one pass.

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.5, LEAP.III.7.1

| Achievement Level Descriptor                                                        |                                                                                                                                                                                   |                                                                                                                                                                     |                                                                                                                                                       |                                                                                        |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Content                                                                             | Advanced                                                                                                                                                                          | Mastery                                                                                                                                                             | Basic                                                                                                                                                 | Approaching Basic                                                                      |
| <b>Expressions, Inequalities, and Equations</b><br>7.AR.A.1<br>7.AR.A.2<br>7.AR.B.4 | Applies properties of operations as strategies to add, subtract, factor, and expand linear expressions.                                                                           | Applies properties of operations as strategies to add, subtract, <b>factor</b> , and expand linear expressions.                                                     | Applies properties of operations as strategies to add, subtract, <b>and expand</b> linear expressions.                                                | Applies properties of operations as strategies to add and subtract linear expressions. |
|                                                                                     | Fluently solves two-step linear equations with rational coefficients.                                                                                                             | <b>Fluently</b> solves two-step linear equations with rational coefficients.                                                                                        | Solves <b>two-step</b> linear equations with rational coefficients.                                                                                   | Solves one-step linear equations with rational coefficients.                           |
|                                                                                     | In mathematical or real-world contexts, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs <b>and interprets</b> solution sets. | In a mathematical <b>or real-world</b> context, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs solution sets. | <b>In a mathematical context, uses variables to represent quantities, constructs and solves equations and inequalities, and graphs solution sets.</b> |                                                                                        |
|                                                                                     | <b>Rewrites an expression</b> in different forms.                                                                                                                                 | <b>Identifies equivalent expressions in different forms</b>                                                                                                         |                                                                                                                                                       |                                                                                        |
|                                                                                     | <b>Describes</b> the relationship between equivalent quantities that are expressed algebraically in different forms in a problem context <b>and explains their</b>                | <b>Identifies the relationship between equivalent quantities that are expressed algebraically in different forms in a problem context.</b>                          |                                                                                                                                                       |                                                                                        |

|  |                                                     |  |  |  |
|--|-----------------------------------------------------|--|--|--|
|  | equivalence in light of the context of the problem. |  |  |  |
|--|-----------------------------------------------------|--|--|--|

# Geometric Reasoning and Logic

**A. Draw, construct, and describe geometrical figures and describe the relationships between them.** In this cluster, the terms students should learn to use with increasing precision are: **scale drawing, dimensions, scale factor, plane sections, right rectangular prism, right rectangular pyramids, parallel, perpendicular, scalene triangle, obtuse triangle, equilateral triangle, and right triangle.**

**7.GL.A.1** Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

## Standard Overview

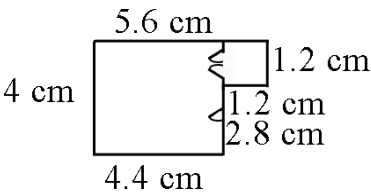
| Core Tenets |                                                                                                                                                                        |                                           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Focus       | Coherence                                                                                                                                                              | Rigor                                     |
| Additional  | Previous Grade(s) Standard: <a href="#">6.GL.A.1</a><br>7th Grade Standard Taught in Advance: <a href="#">7.PF.A.2</a><br>7th Grade Standard Taught Concurrently: none | Procedural Skill and Fluency, Application |

## Examples and Explanations

Students determine the dimensions of figures when given a scale and identify the impact of a scale on actual length (one-dimension) and area (two-dimensions). Students identify the scale factor given two figures. Using a given scale drawing, students reproduce the drawing at a different scale. Students understand that the lengths will change by a factor equal to the product of the magnitude of the two size transformations.

### Example:

- Julie showed you the scale drawing of her room. If each 2 cm on the scale drawing equals 5 ft, what are the actual dimensions of Julie’s room? Reproduce the drawing at 3 times its current size.



- If the rectangle below is enlarged using a scale factor of 1.5, what will be the perimeter and area of the new rectangle?

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                                                      |                                                                                                                                          |                                                                                                                                   |                                                                                              |                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Content                                                                                                                           | Advanced                                                                                                                                 | Mastery                                                                                                                           | Basic                                                                                        | Approaching Basic                                              |
| <b>Solve Scale, Angle, Area, Circumference, Surface Area, and Volume Problems</b><br>7.GL.A.1<br>7.GL.B.4<br>7.GL.B.5<br>7.GL.B.6 | Solves mathematical and real-world problems involving circumference, area, surface area, and volume, <b>including composite objects.</b> | Solves mathematical <b>and real-world</b> problems involving circumference, area, surface area, and volume.                       | Solves mathematical problems involving circumference, area, <b>surface area, and volume.</b> | Solves mathematical problems involving circumference and area. |
|                                                                                                                                   | Solves problems involving scale drawings of geometric figures, including reproducing a scale drawing at a different scale.               | Solves problems involving scale drawings of geometric figures, <b>including reproducing a scale drawing at a different scale.</b> | Solves problems involving scale drawings of geometric figures.                               | Solves problems involving scale drawings of geometric figures. |
|                                                                                                                                   | Represents angle relationships using equations to solve for unknown angles.                                                              | <b>Represents angle relationships using equations to solve for unknown angles.</b>                                                | <b>Uses facts about angle relationships to determine the measure of unknown angles.</b>      |                                                                |
|                                                                                                                                   | <b>Produces a logical conclusion about</b> the relationship between the circumference and area of a circle.                              | <b>Identifies an informal derivation of the relationship between the circumference and area of a circle.</b>                      |                                                                                              |                                                                |

**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.

### Standard Overview

| Core Tenets |                                                                                                                                                     |                                                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Focus       | Coherence                                                                                                                                           | Rigor                                                  |
| Additional  | <b>Previous Grade(s) Standard:</b> none<br><b>7th Grade Standard Taught in Advance:</b> none<br><b>7th Grade Standard Taught Concurrently:</b> none | Conceptual Understanding, Procedural Skill and Fluency |

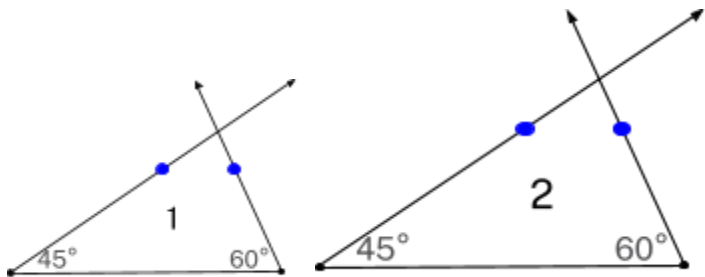
### Examples and Explanations

Students draw geometric shapes with given parameters. Conditions could involve points, line segments, angles, parallelism, congruence, angles, and perpendicularity. Being able to successfully master this standard depends on several facts that grade 7 students have not learned in the past. Teachers should allow students to investigate these rather than providing students the information.

- The sum of the angles in a triangle is  $180^\circ$ .
- An infinite number of triangles can be created using the same three angle measures (e.g., there are many triangles with angles whose measures are  $45^\circ$ ,  $60^\circ$ , and  $75^\circ$ ). Below is a sample investigation that can be repeated multiple times to show that multiple triangles can be created using these angles.

Tools Needed: pencil, paper, protractor, and ruler

- Create Triangle 1. Draw a  $45^\circ$  angle. Extend the horizontal side and then draw a  $60^\circ$  angle on the other side of this side. Extend the other side of the  $45^\circ$  angle and the  $60^\circ$  angle so that they intersect to form a triangle. What is the measure of the third angle? Measure the length of each side.
- Create Triangle 2. Repeat step 1 and make the horizontal side between the  $45^\circ$  and  $60^\circ$  at least 1 inch longer than in step 1. Find the measure of the third angle and measure the length of each side.



- To form a triangle using side lengths, the sum of any two sides must be greater than the length of the third side.

Technology Investigation: <https://www.geogebra.org/m/tx8ckqXg>

4. When #3 is true, only one triangle can be made using a given set of 3 side lengths.

**Examples:**

- Draw a triangle with angles that are 60 degrees. Is this a unique triangle? Why or why not?
- Draw an isosceles triangle with only one 80-degree angle. Is this the only possibility, or can you draw another triangle that will also meet these conditions?



- Can you draw a triangle with sides that are 13 cm, 5 cm, and 6cm? Why or why not?
- Draw a quadrilateral with one set of parallel sides and no right angles.
- Is it possible to draw more than one triangle with angles of 45, 35, and 100 degrees? Show that this is possible or indicate why it would be impossible.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                  |                                                                                                                                                                  |                                                                                                                                                                         |                                                                   |                   |
|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------|
| Content                                                       | Advanced                                                                                                                                                         | Mastery                                                                                                                                                                 | Basic                                                             | Approaching Basic |
| <b>Representing Geometric Figures</b><br>7.GL.A.2<br>7.GL.A.3 | Identifies triangles with given angle and side conditions and notices when those conditions determine a unique triangle, more than one triangle, or no triangle. | Identifies triangles with given angle and side conditions <b>and notices when those conditions determine a unique triangle, more than one triangle, or no triangle.</b> | <b>Identifies triangles with given angle and side conditions.</b> |                   |
|                                                               | Identifies a two-dimensional figure as the result of slicing a three-dimensional figure by a plane.                                                              | <b>Identifies a two-dimensional figure as the result of slicing a three-dimensional figure by a plane perpendicular or parallel to a base or face.</b>                  |                                                                   |                   |

**7.GL.A.3** Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

## Standard Overview

| Core Tenets |                                                                                                                                                     |                          |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Focus       | Coherence                                                                                                                                           | Rigor                    |
| Additional  | <b>Previous Grade(s) Standard:</b> none<br><b>7th Grade Standard Taught in Advance:</b> none<br><b>7th Grade Standard Taught Concurrently:</b> none | Conceptual Understanding |

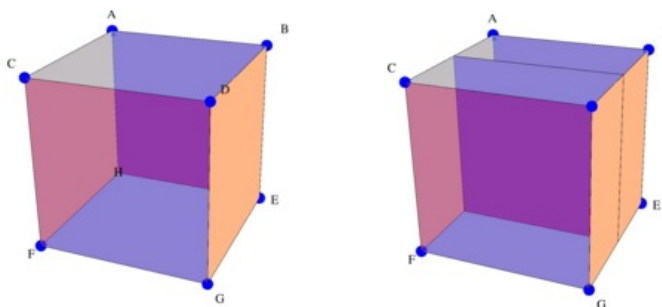
## Examples and Explanations

Students need to describe the resulting face shape from cuts made parallel and perpendicular to the bases of right rectangular prisms and pyramids.

### Example:

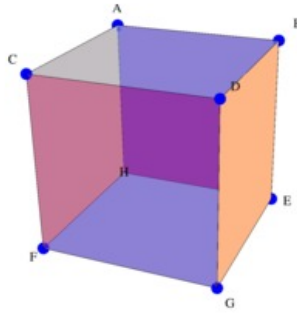
Cube Ninjas!

<sup>2</sup>Imagine you are a ninja who can slice solid objects straight through. You have a solid cube in front of you. You are curious about what 2-dimensional shapes are formed when you slice the cube. For example, if you make a slice through the center of the cube that is parallel to one of the faces, the cross-section is a square:



For each of the following slices, (i) describe using precise mathematical language the shape of the cross-section, and (ii) draw a diagram showing the cross-section of the cube.

<sup>2</sup> <https://tasks.illustrativemathematics.org/content-standards/7/G/A/3/tasks/1532>



- A slice containing edge AC and edge EG
- A slice containing the vertices C, B, and G.
- A slice containing the vertex A, the midpoint of edge EG, and the midpoint of edge FG.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                  |                                                                                                                                                                  |                                                                                                                                                                         |                                                                   |                   |
|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------|
| Content                                                       | Advanced                                                                                                                                                         | Mastery                                                                                                                                                                 | Basic                                                             | Approaching Basic |
| <b>Representing Geometric Figures</b><br>7.GL.A.2<br>7.GL.A.3 | Identifies triangles with given angle and side conditions and notices when those conditions determine a unique triangle, more than one triangle, or no triangle. | Identifies triangles with given angle and side conditions <b>and notices when those conditions determine a unique triangle, more than one triangle, or no triangle.</b> | <b>Identifies triangles with given angle and side conditions.</b> |                   |
|                                                               | Identifies a two-dimensional figure as the result of slicing a three-dimensional figure by a plane.                                                              | <b>Identifies a two-dimensional figure as the result of slicing a three-dimensional figure by a plane perpendicular or parallel to a base or face.</b>                  |                                                                   |                   |

**B. Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.** In this cluster, the terms students should learn to use with increasing precision are: **inscribed, circumference, radius, diameter, pi,  $\Pi$ , supplementary, vertical, adjacent, complementary, pyramids, face, and base.**

**7.GL.B.4** Know the formulas for the area and circumference of a circle and solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

## Standard Overview

| Core Tenets                                                                                                                                                                                                                              |                                                                                                                                                                                        |                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Focus                                                                                                                                                                                                                                    | Coherence                                                                                                                                                                              | Rigor                                                               |
| Additional                                                                                                                                                                                                                               | <p><b>Previous Grade(s) Standard:</b> <a href="#">6.GL.A.1</a></p> <p><b>7th Grade Standard Taught in Advance:</b> none</p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | Conceptual Understanding, Procedural Skill and Fluency, Application |
| <p><b>Foundational Skills:</b></p> <p>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.</p> <p>4. Fluently solve one-variable equations.</p> |                                                                                                                                                                                        |                                                                     |

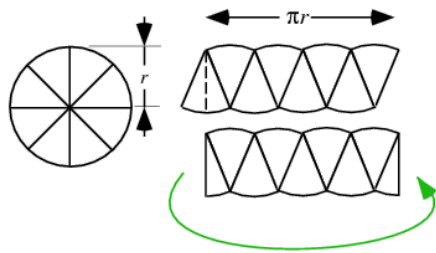
## Examples and Explanations

Students understand the relationship between radius and diameter. Students also understand that the ratio of circumference to diameter can be expressed as Pi. Building on these understandings, students generate the formulas for circumference and area. “Know the formula” does not mean memorization of the formula. To “know” means to have an understanding of **why** the formula works and how the formula relates to the measure (area and circumference) and the figure. This understanding should be for *all* students. Students solve problems (mathematical and real-world) involving circles or semi-circles. **Note:** Because Pi is an irrational number that neither repeats nor terminates, the measurements are approximate when 3.14 is used in place of  $\pi$ . Furthermore, it is appropriate for students to sometimes use exact answers (i.e., leaving answers in terms of  $\pi$ ).

## Examples:

- Students measure the circumference and diameter of several circular objects in the room (clock, trash can, doorknob, wheel, etc.). Students organize their information and discover the relationship between circumference and diameter by noticing the pattern in the ratio of the measures. Students write an expression that could be used to find the circumference of a circle with any diameter and check their expression on other circles.
- The illustration shows the relationship between the circumference and area. If a circle is cut into wedges and laid out as shown, a parallelogram results. Half of an end wedge can be moved to the other end, and a rectangle results. The height of the rectangle is the same as the radius of the

circle. The base length is  $\frac{1}{2}$  the circumference ( $2\pi r$ ). The area of the rectangle (and therefore the circle) is found by the following calculations:



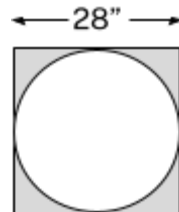
Area = Base x Height

$$\text{Area} = \frac{1}{2}(2\pi r) \times r$$

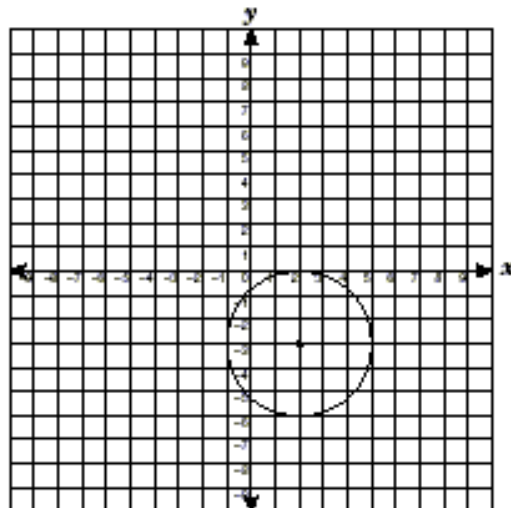
$$\text{Area} = \pi r \times r$$

$$\text{Area} = \pi r^2$$

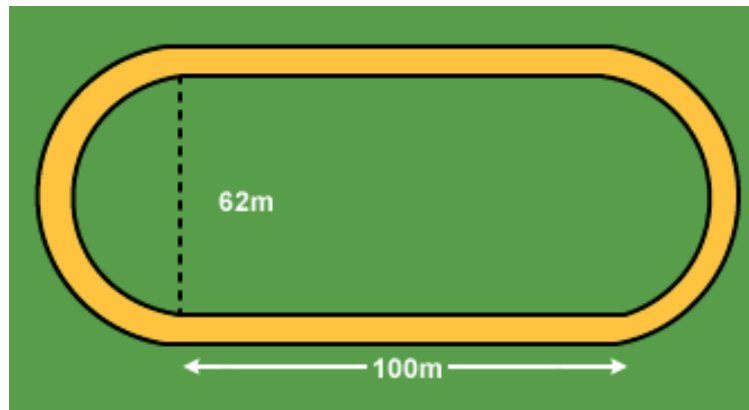
- The seventh-grade class is building a mini golf game for the school carnival. The end of the putting green will be a circle. If the circle is 10 feet in diameter, how many square feet of grass carpet will they need to buy to cover the circle? How might you communicate this information to the salesperson to make sure you receive a piece of carpet that is the correct size?
- If a circle is cut from a square piece of plywood as shown, how much plywood would be left over?



- The center of the circle is at (2, -3). What is the area of the circle?



- What is the perimeter of the inside of the track?



### Assessment Connections

Assessment Item Type(s): Type I, III

Evidence Statement(s): LEAP.III.7.3

| Achievement Level Descriptor                                                                                                      |                                                                                                                                          |                                                                                                                                   |                                                                                              |                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Content                                                                                                                           | Advanced                                                                                                                                 | Mastery                                                                                                                           | Basic                                                                                        | Approaching Basic                                              |
| <b>Solve Scale, Angle, Area, Circumference, Surface Area, and Volume Problems</b><br>7.GL.A.1<br>7.GL.B.4<br>7.GL.B.5<br>7.GL.B.6 | Solves mathematical and real-world problems involving circumference, area, surface area, and volume, <b>including composite objects.</b> | Solves mathematical <b>and real-world</b> problems involving circumference, area, surface area, and volume.                       | Solves mathematical problems involving circumference, area, <b>surface area, and volume.</b> | Solves mathematical problems involving circumference and area. |
|                                                                                                                                   | Solves problems involving scale drawings of geometric figures, including reproducing a scale drawing at a different scale.               | Solves problems involving scale drawings of geometric figures, <b>including reproducing a scale drawing at a different scale.</b> | Solves problems involving scale drawings of geometric figures.                               | Solves problems involving scale drawings of geometric figures. |
|                                                                                                                                   | Represents angle relationships using equations to solve for unknown angles.                                                              | <b>Represents angle relationships using equations to solve for unknown angles.</b>                                                | <b>Uses facts about angle relationships to determine the measure of unknown angles.</b>      |                                                                |
|                                                                                                                                   | <b>Produces a logical conclusion about</b> the relationship between the circumference and area of a circle.                              | <b>Identifies an informal derivation of the relationship between the circumference and area of a circle.</b>                      |                                                                                              |                                                                |

**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.

## Standard Overview

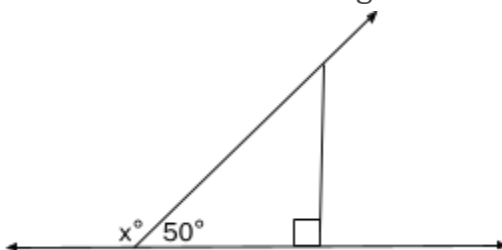
| Core Tenets                                                                                                                                                                                                                              |                                                                                                                                                                                        |                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Focus                                                                                                                                                                                                                                    | Coherence                                                                                                                                                                              | Rigor                                                  |
| Additional                                                                                                                                                                                                                               | <p><b>Previous Grade(s) Standard:</b> <a href="#">4.DM.C.7</a></p> <p><b>7th Grade Standard Taught in Advance:</b> none</p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | Conceptual Understanding, Procedural Skill and Fluency |
| <p><b>Foundational Skills:</b></p> <p>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.</p> <p>4. Fluently solve one-variable equations.</p> |                                                                                                                                                                                        |                                                        |

## Examples and Explanations

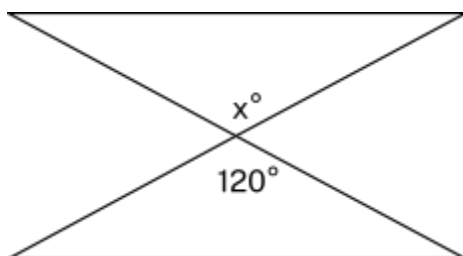
Students use understandings of angles and deductive reasoning to write and solve equations. Teachers should use/create problems that require grade-level equations as defined in [7.AR.B.3](#).

**Examples:** (Figures may not be to scale.)

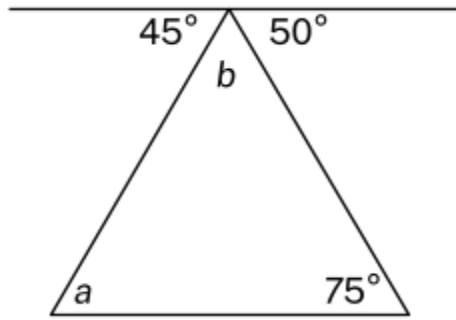
- Write and solve an equation to find the measure of angle  $x$ .



- Write and solve an equation to find the measure of angle  $x$ .



- Find the measure of angle  $b$ .



### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                                                      |                                                                                                                                          |                                                                                                                                   |                                                                                              |                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Content                                                                                                                           | Advanced                                                                                                                                 | Mastery                                                                                                                           | Basic                                                                                        | Approaching Basic                                              |
| <b>Solve Scale, Angle, Area, Circumference, Surface Area, and Volume Problems</b><br>7.GL.A.1<br>7.GL.B.4<br>7.GL.B.5<br>7.GL.B.6 | Solves mathematical and real-world problems involving circumference, area, surface area, and volume, <b>including composite objects.</b> | Solves mathematical <b>and real-world</b> problems involving circumference, area, surface area, and volume.                       | Solves mathematical problems involving circumference, area, <b>surface area, and volume.</b> | Solves mathematical problems involving circumference and area. |
|                                                                                                                                   | Solves problems involving scale drawings of geometric figures, including reproducing a scale drawing at a different scale.               | Solves problems involving scale drawings of geometric figures, <b>including reproducing a scale drawing at a different scale.</b> | Solves problems involving scale drawings of geometric figures.                               | Solves problems involving scale drawings of geometric figures. |
|                                                                                                                                   | Represents angle relationships using equations to solve for unknown angles.                                                              | <b>Represents angle relationships using equations to solve for unknown angles.</b>                                                | <b>Uses facts about angle relationships to determine the measure of unknown angles.</b>      |                                                                |
|                                                                                                                                   | <b>Produces a logical conclusion about</b> the relationship between the circumference and area of a circle.                              | <b>Identifies an informal derivation of the relationship between the circumference and area of a circle.</b>                      |                                                                                              |                                                                |

**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).

## Standard Overview

| Core Tenets                                                                                                                                                                  |                                                                                                                                                                                                                               |                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Focus                                                                                                                                                                        | Coherence                                                                                                                                                                                                                     | Rigor                                     |
| Additional                                                                                                                                                                   | <b>Previous Grade(s) Standard:</b> <a href="#">6.GL.A.1</a> ; <a href="#">6.GL.A.2</a> , <a href="#">6.GL.A.4</a><br><b>7th Grade Standard Taught in Advance:</b> none<br><b>7th Grade Standard Taught Concurrently:</b> none | Procedural Skill and Fluency, Application |
| <b>Foundational Skills:</b><br>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals. |                                                                                                                                                                                                                               |                                           |

## Examples and Explanations

Students continue work from fifth and sixth grades to find area, volume, and surface area of two-dimensional and three-dimensional objects using composite shapes. Students will not work with cylinders, as circles are not polygons. At this level, students determine the dimensions of the figures given the area or volume.

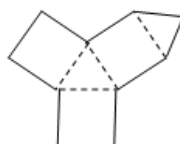
“Know the formula” does not mean memorization of the formula. To “know” means to have an understanding of **why** the formula works and how the formula relates to the measure (area and volume) and the figure. This understanding should be for *all* students.

Surface area formulas are not the expectation with this standard. Building on work with nets in the sixth grade, students should recognize that finding the area of each face of a three-dimensional figure and adding the areas will give the surface area. No nets will be given at this level; however, students could create nets to aid in surface area calculations.

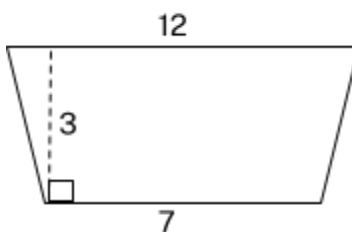
Students' understanding of volume can be supported by focusing on the area of base times the height to calculate volume. Students solve for missing dimensions, given the area or volume. Students determine the surface area of pyramids.

## Examples:

- Choose one of the figures shown below and write a step-by-step procedure for determining the area. Find another person who chose the same figure as you did. How are your procedures the same and different? Would the procedures used by you and your partner give the same result?

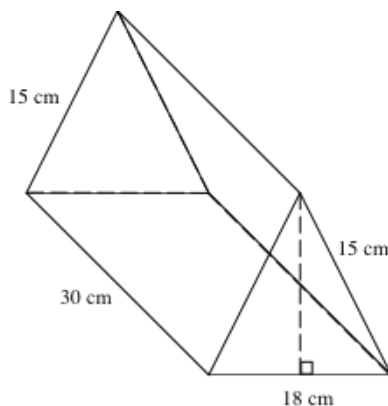


- The surface area of a cube is  $96 \text{ in}^2$ . What is the volume of the cube?
- Find the area of the trapezoid shown below.



**Teacher Note:** Students should decompose the trapezoid into a rectangle and two triangles to find the area. The formula for the area of a trapezoid is not provided on the Grade 7 reference sheet.

- Jennie purchased a box of crackers from the deli. The box is in the shape of a triangular prism (see diagram below). If the volume of the box is 3,240 cubic centimeters, what is the height of the triangular face of the box? How much packaging material was used to construct the cracker box? Explain how you got your answer.



### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                                                      |                                                                                                                                          |                                                                                                                                   |                                                                                              |                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Content                                                                                                                           | Advanced                                                                                                                                 | Mastery                                                                                                                           | Basic                                                                                        | Approaching Basic                                              |
| <b>Solve Scale, Angle, Area, Circumference, Surface Area, and Volume Problems</b><br>7.GL.A.1<br>7.GL.B.4<br>7.GL.B.5<br>7.GL.B.6 | Solves mathematical and real-world problems involving circumference, area, surface area, and volume, <b>including composite objects.</b> | Solves mathematical <b>and real-world</b> problems involving circumference, area, surface area, and volume.                       | Solves mathematical problems involving circumference, area, <b>surface area, and volume.</b> | Solves mathematical problems involving circumference and area. |
|                                                                                                                                   | Solves problems involving scale drawings of geometric figures, including reproducing a scale drawing at a different scale.               | Solves problems involving scale drawings of geometric figures, <b>including reproducing a scale drawing at a different scale.</b> | Solves problems involving scale drawings of geometric figures.                               | Solves problems involving scale drawings of geometric figures. |
|                                                                                                                                   | Represents angle relationships using equations to solve for unknown angles.                                                              | <b>Represents angle relationships using equations to solve for unknown angles.</b>                                                | <b>Uses facts about angle relationships to determine the measure of unknown angles.</b>      |                                                                |
|                                                                                                                                   | <b>Produces a logical conclusion about</b> the relationship between the circumference and area of a circle.                              | <b>Identifies an informal derivation of the relationship between the circumference and area of a circle.</b>                      |                                                                                              |                                                                |

# Data Analysis

**A. Use random sampling to draw inferences about a population.** In this cluster, the terms students should learn to use with increasing precision are: **random sampling, population, representative sample, and inferences.**

**7.DA.A.1** Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

## Standard Overview

| Core Tenets |                                                                                                                                                                                                   |                          |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Focus       | Coherence                                                                                                                                                                                         | Rigor                    |
| Supporting  | Previous Grade(s) Standard: <a href="#">6.DA.A.1</a> , <a href="#">6.DA.A.2</a><br>7th Grade Standard Taught in Advance: <a href="#">7.DA.C.5</a><br>7th Grade Standard Taught Concurrently: none | Conceptual Understanding |

## Examples and Explanations

Students recognize that it is difficult to gather statistics on an entire population. Instead, a random sample can be representative of the total population and will generate valid predictions. Students use this information to draw inferences from data. A random sample must be used in conjunction with the population to get accuracy. For example, a random sample of elementary students cannot be used to give a survey about the senior prom.

### Example:

- The school food service wants to increase the number of students who eat hot lunch in the cafeteria. The student council has been asked to survey the student body to determine the students’ preferences for hot lunch. They have determined two ways to do the survey. The two methods are listed below. Identify the type of sampling used in each survey option. Which survey option should the student council use and why?
  - o Write all of the students’ names on cards and randomly select 20 students to complete the survey.
  - o Survey the first 20 students that enter the lunch room.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                      |                                                                                                                                                                                               |                                                                                                                                                                                                             |                                                                                     |                                                                       |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Content                                                                                           | Advanced                                                                                                                                                                                      | Mastery                                                                                                                                                                                                     | Basic                                                                               | Approaching Basic                                                     |
| <b>Random Sampling and Comparative Inferences</b><br>7.DA.A.1<br>7.DA.A.2<br>7.DA.B.3<br>7.DA.B.4 | Understands and uses random sampling to draw inferences about a population                                                                                                                    | <b>Understands and uses random sampling to</b> draw inferences about a population.                                                                                                                          | <b>Draws inferences about a population from a table or graph of random samples.</b> |                                                                       |
|                                                                                                   | Draws relevant informal comparative inferences about two populations, including <b>assessing the degree</b> of visual overlap of two numerical data distributions with similar variabilities. | Draws <b>relevant</b> informal comparative inferences about two populations, <b>including identifying characteristics of visual overlap of two numerical data distributions with similar variabilities.</b> | <b>Draws informal comparative inferences about</b> two populations.                 | Compares two populations based on measures of center and variability. |
|                                                                                                   | Determines whether a sample is representative of a population.                                                                                                                                | <b>Determines whether a sample is representative of a population.</b>                                                                                                                                       |                                                                                     |                                                                       |

**7.DA.A.2** Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example:

- Estimate the mean word length in a book by randomly sampling words from the book.
- Predict the winner of a school election based on randomly sampled survey data.

## Standard Overview

| Core Tenets |                                                                                                                                                                                        |                                                                     |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                              | Rigor                                                               |
| Supporting  | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.DA.A.1</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | Conceptual Understanding, Procedural Skill and Fluency, Application |

## Examples and Explanations

Students collect and use multiple samples of data to make generalizations about a population. Issues of variation in the samples should be addressed.

### Example:

- Below is the data collected from two random samples of 100 students regarding students' school lunch preferences. Make at least two inferences based on the results.

**Lunch Preferences**

| Student Sample | Hamburgers | Tacos | Pizza | Total |
|----------------|------------|-------|-------|-------|
| #1             | 12         | 14    | 74    | 100   |
| #2             | 12         | 11    | 77    | 100   |

Possible responses: Most students prefer pizza. More people prefer pizza than hamburgers and tacos combined.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                      |                                                                                                                                                                                               |                                                                                                                                                                                                             |                                                                                     |                                                                       |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Content                                                                                           | Advanced                                                                                                                                                                                      | Mastery                                                                                                                                                                                                     | Basic                                                                               | Approaching Basic                                                     |
| <b>Random Sampling and Comparative Inferences</b><br>7.DA.A.1<br>7.DA.A.2<br>7.DA.B.3<br>7.DA.B.4 | Understands and uses random sampling to draw inferences about a population                                                                                                                    | <b>Understands and uses random sampling to</b> draw inferences about a population.                                                                                                                          | <b>Draws inferences about a population from a table or graph of random samples.</b> |                                                                       |
|                                                                                                   | Draws relevant informal comparative inferences about two populations, including <b>assessing the degree</b> of visual overlap of two numerical data distributions with similar variabilities. | Draws <b>relevant</b> informal comparative inferences about two populations, <b>including identifying characteristics of visual overlap of two numerical data distributions with similar variabilities.</b> | <b>Draws informal comparative inferences about</b> two populations.                 | Compares two populations based on measures of center and variability. |
|                                                                                                   | Determines whether a sample is representative of a population.                                                                                                                                | <b>Determines whether a sample is representative of a population.</b>                                                                                                                                       |                                                                                     |                                                                       |

**B. Draw informal comparative inferences about two populations.** In this cluster, the terms students should learn to use with increasing precision are: **variation/variability, distribution, measures of center, and measures of variability.**

**7.DA.B.3** Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities using quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

### Standard Overview

| Core Tenets |                                                                                                                                                                                                              |                                                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                                                    | Rigor                                                  |
| Additional  | Previous Grade(s) Standard: <a href="#">5.NO.F.B.4</a> , <a href="#">6.NO.F.A.1</a> , <a href="#">6.DA.A.1</a><br>7th Grade Standard Taught in Advance: none<br>7th Grade Standard Taught Concurrently: none | Conceptual Understanding, Procedural Skill and Fluency |

### Examples and Explanations

This is the students’ first experience with comparing two data sets. Students build on their understanding of graphs, mean, median, and interquartile range from sixth grade. Students understand that

1. A full understanding of the data requires consideration of the measures of variability as well as the mean or median.
2. Variability is responsible for the overlap of two data sets, and an increase in variability can increase the overlap.
3. The median is paired with the interquartile range, and the mean is paired with the mean absolute deviation.

### Example:

- Jason wanted to compare the mean height of the players on his favorite basketball and soccer teams. He thinks the mean height of the players on the basketball team will be greater, but doesn’t know how much greater. He also wonders if the variability of the heights of the athletes is related to the sport they play. He thinks that there will be a greater variability in the heights of soccer players as compared to basketball players. He used the rosters and player statistics from the team websites to generate the following lists.

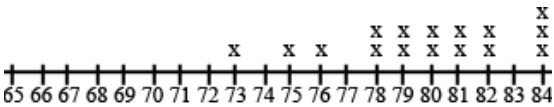
#### Basketball Team – Height of Players in inches for 2010-2011 Season

75, 73, 76, 78, 79, 78, 79, 81, 80, 82, 81, 84, 82, 84, 80, 84

#### Soccer Team – Height of Players in inches for 2010

73, 73, 73, 72, 69, 76, 72, 73, 74, 70, 65, 71, 74, 76, 70, 72, 71, 74, 71, 74, 73, 67, 70, 72, 69, 78, 73, 76, 69

To compare the data sets, Jason creates two dot plots on the same scale. The shortest player is 65 inches. The tallest players are 84 inches.



In looking at the distribution of the data, Jason observes that there is some overlap between the two data sets. Some players on both teams have heights between 73 and 78 inches tall. Jason decides to use the mean and mean absolute deviation to compare the data sets.

The mean height of the basketball players is 79.75 inches, as compared to the mean height of the soccer players at 72.07 inches, a difference of 7.68 inches.

The mean absolute deviation (MAD) is calculated by taking the mean of the absolute deviations for each data point. The difference between each data point and the mean is recorded in the second column of the table. The difference between each data point and the mean is recorded in the second column of the table. Jason used rounded values (80 inches for the mean height of basketball players and 72 inches for the mean height of soccer players) to find the differences. The absolute deviation, absolute value of the deviation, is recorded in the third column. The absolute deviations are summed and divided by the number of data points in the set.

The mean absolute deviation is 2.14 inches for the basketball players and 2.53 for the soccer players. These values indicate moderate variation in both data sets.

There is slightly more variability in the height of the soccer players.

| Soccer Players (n = 29) |                          |                         |
|-------------------------|--------------------------|-------------------------|
| Height (in)             | Deviation from Mean (in) | Absolute Deviation (in) |
| 65                      | -7                       | 7                       |
| 67                      | -5                       | 5                       |
| 69                      | -3                       | 3                       |
| 69                      | -3                       | 3                       |
| 69                      | -3                       | 3                       |
| 70                      | -2                       | 2                       |
| 70                      | -2                       | 2                       |
| 70                      | -2                       | 2                       |
| 71                      | -1                       | 1                       |
| 71                      | -1                       | 1                       |
| 71                      | -1                       | 1                       |
| 71                      | -1                       | 1                       |
| 72                      | 0                        | 0                       |
| 72                      | 0                        | 0                       |
| 72                      | 0                        | 0                       |
| 72                      | 0                        | 0                       |
| 73                      | +1                       | 1                       |
| 73                      | +1                       | 1                       |

| Basketball Players (n = 16) |                          |                         |
|-----------------------------|--------------------------|-------------------------|
| Height (in)                 | Deviation from Mean (in) | Absolute Deviation (in) |
| 73                          | -7                       | 7                       |
| 75                          | -5                       | 5                       |
| 76                          | -4                       | 4                       |
| 78                          | -2                       | 2                       |
| 78                          | -2                       | 2                       |
| 79                          | -1                       | 1                       |
| 79                          | -1                       | 1                       |
| 80                          | 0                        | 0                       |
| 80                          | 0                        | 0                       |
| 81                          | 1                        | 1                       |
| 81                          | 1                        | 1                       |
| 82                          | 2                        | 2                       |
| 82                          | 2                        | 2                       |
| 84                          | 4                        | 4                       |
| 84                          | 4                        | 4                       |
| 84                          | 4                        | 4                       |
|                             |                          |                         |

|                 |    |               |
|-----------------|----|---------------|
| 73              | +1 | 1             |
| 73              | +1 | 1             |
| 73              | +1 | 1             |
| 73              | +1 | 1             |
| 74              | +2 | 2             |
| 74              | +2 | 2             |
| 74              | +2 | 2             |
| 74              | +2 | 2             |
| 76              | +4 | 4             |
| 76              | +4 | 4             |
| 76              | +4 | 4             |
| 78              | +6 | 6             |
| $\Sigma = 2090$ |    | $\Sigma = 62$ |

Mean =  $2090 \div 29 = 72$  inches

MAD =  $62 \div 29 = 2.14$  inches

|                 |  |               |
|-----------------|--|---------------|
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
|                 |  |               |
| $\Sigma = 1276$ |  | $\Sigma = 40$ |

Mean =  $1276 \div 16 = 80$  inches

MAD =  $40 \div 16 = 2.53$  inches

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                      |                                                                                                                                                                                               |                                                                                                                                                                                                             |                                                                                     |                                                                       |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Content                                                                                           | Advanced                                                                                                                                                                                      | Mastery                                                                                                                                                                                                     | Basic                                                                               | Approaching Basic                                                     |
| <b>Random Sampling and Comparative Inferences</b><br>7.DA.A.1<br>7.DA.A.2<br>7.DA.B.3<br>7.DA.B.4 | Understands and uses random sampling to draw inferences about a population.                                                                                                                   | <b>Understands and uses random sampling to</b> draw inferences about a population.                                                                                                                          | <b>Draws inferences about a population from a table or graph of random samples.</b> |                                                                       |
|                                                                                                   | Draws relevant informal comparative inferences about two populations, including <b>assessing the degree</b> of visual overlap of two numerical data distributions with similar variabilities. | Draws <b>relevant</b> informal comparative inferences about two populations, <b>including identifying characteristics of visual overlap of two numerical data distributions with similar variabilities.</b> | <b>Draws informal comparative inferences about</b> two populations.                 | Compares two populations based on measures of center and variability. |
|                                                                                                   | Determines whether a sample is representative of a population.                                                                                                                                | <b>Determines whether a sample is representative of a population.</b>                                                                                                                                       |                                                                                     |                                                                       |

**7.DA.B.4** Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.

## Standard Overview

| Core Tenets |                                                                                                                                                                                                                  |                                                                     |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                                                        | Rigor                                                               |
| Additional  | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.DA.A.2</a>, <a href="#">7.DA.B.3</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | Conceptual Understanding, Procedural Skill and Fluency, Application |

## Examples and Explanations

Students compare two sets of data using measures of center (mean and median) and variability (MAD and IQR).

### Example:

The two data sets below depict random samples of the management salaries in two companies. Based on the salaries below, which measure of center will provide the most accurate estimation of the salaries for each company?

- Company A: 1.2 million, 242,000, 265,500, 140,000, 281,000, 265,000, 211,000
- Company B: 5 million, 154,000, 250,000, 250,000, 200,000, 160,000, 190,000

### *Solution:*

The median would be the most accurate measure since both companies have one value in the million that is far from the other values and would affect the mean.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                      |                                                                                                                                                                                               |                                                                                                                                                                                                             |                                                                                     |                                                                       |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Content                                                                                           | Advanced                                                                                                                                                                                      | Mastery                                                                                                                                                                                                     | Basic                                                                               | Approaching Basic                                                     |
| <b>Random Sampling and Comparative Inferences</b><br>7.DA.A.1<br>7.DA.A.2<br>7.DA.B.3<br>7.DA.B.4 | Understands and uses random sampling to draw inferences about a population.                                                                                                                   | <b>Understands and uses random sampling to</b> draw inferences about a population.                                                                                                                          | <b>Draws inferences about a population from a table or graph of random samples.</b> |                                                                       |
|                                                                                                   | Draws relevant informal comparative inferences about two populations, including <b>assessing the degree</b> of visual overlap of two numerical data distributions with similar variabilities. | Draws <b>relevant</b> informal comparative inferences about two populations, <b>including identifying characteristics of visual overlap of two numerical data distributions with similar variabilities.</b> | <b>Draws informal comparative inferences about</b> two populations.                 | Compares two populations based on measures of center and variability. |
|                                                                                                   | Determines whether a sample is representative of a population.                                                                                                                                | <b>Determines whether a sample is representative of a population.</b>                                                                                                                                       |                                                                                     |                                                                       |

**C. Investigate chance processes and develop, use, and evaluate probability models.** In this cluster, mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with this cluster are: **sample spaces, probability, chance event, frequency, simple event, compound event, probability model (uniform and not), theoretical probability, and empirical (experimental) probability.**

**7.DA.C.5** Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. For example:

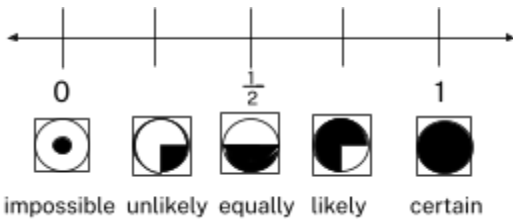
- A probability near 0 indicates an unlikely event;
- A probability around  $\frac{1}{2}$  indicates an event that is neither unlikely nor likely; and
- A probability near 1 indicates a likely event.

### Standard Overview

| Core Tenets |                                                                                                                                                                    |                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Focus       | Coherence                                                                                                                                                          | Rigor                    |
| Supporting  | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b> none</p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | Conceptual Understanding |

### Examples and Explanations

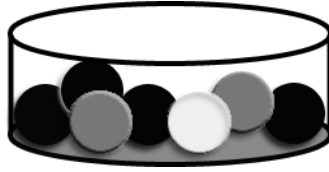
This is the students’ first formal introduction to probability. Students recognize that the probability of any single event can be expressed in terms such as impossible, unlikely, likely, or certain or as a number between 0 and 1, inclusive, as illustrated on the number line below.



The closer the fraction is to 1, the greater the probability the event will occur. Larger numbers indicate greater likelihood. For example, if someone has 10 oranges and 3 apples, you have a greater likelihood of randomly selecting an orange.

**Example:**

- The container below contains 2 gray, 1 white, and 4 black marbles. Without looking, if you choose a marble from the container, will the probability be closer to 0 or to 1 that you will select a white marble? A gray marble? A black marble? Justify each of your predictions.



### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                   |                                                                                                                                                                         |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Content                                                                                        | Advanced                                                                                                                                                                | Mastery                                                                                                                                                                                                  | Basic                                                                                                                                | Approaching Basic                                                                                                                    |
| <b>Chance Processes and Probability Models</b><br>7.SP.C.5<br>7.SP.C.6<br>7.SP.C.7<br>7.SP.C.8 | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                    | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                                                     | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. |
|                                                                                                | <b>Generates a sample space to determine the probability of simple or compound events using methods such as organized lists, tables, tree diagrams, or simulations.</b> | Determines probabilities when given sample spaces for simple <b>and compound</b> events using methods such as organized lists, tables, <b>and tree diagrams.</b>                                         | <b>Determines probabilities when given sample spaces for simple events using methods such as organized lists and tables.</b>         |                                                                                                                                      |
|                                                                                                | <b>Develops probability models to determine the probabilities of events.</b>                                                                                            | <b>Develops a model to approximate the probability of a chance event and predicts approximate frequencies when given the probability or by observing frequencies in data generated from the process.</b> |                                                                                                                                      |                                                                                                                                      |
|                                                                                                | <b>Designs and uses a simulation to generate</b>                                                                                                                        |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |

|  |                                                                         |  |  |  |
|--|-------------------------------------------------------------------------|--|--|--|
|  | <b>frequencies for and estimate the probability of compound events.</b> |  |  |  |
|--|-------------------------------------------------------------------------|--|--|--|

**7.DA.C.6** Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.

## Standard Overview

| Core Tenets |                                                                                                                                                                                                                                                                                                                                                                                        |                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                                                                                                                                                                                                                              | Rigor                                                  |
| Supporting  | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b>  <a href="#">7.PF.A.3</a>,  <a href="#">7.DA.C.5</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | Conceptual Understanding, Procedural Skill and Fluency |

## Examples and Explanations

Students collect data from a probability experiment, recognizing that as the number of trials increases, the experimental probability approaches the theoretical probability. The focus of this standard is relative frequency. The relative frequency is the observed number of successful events for a finite sample of trials. Relative frequency is the observed proportion of successful events, expressed as the value calculated by dividing the number of times an event occurs by the total number of times an experiment is carried out.

### Example:

- Each group receives a bag that contains 4 green marbles, 6 red marbles, and 10 blue marbles. Each group performs 50 pulls, recording the color of marble drawn and replacing the marble into the bag before the next draw. Students compile their data as a group and then as a class. They summarize their data as experimental probabilities and make conjectures about theoretical probabilities (How many green draws would you expect if you were to conduct 1000 pulls? 10,000 pulls?).

Students create another scenario with a different ratio of marbles in the bag and make a conjecture about the outcome of 50 marble pulls with replacement. (An example would be 3 green marbles, 6 blue marbles, 3 blue marbles.)

Students try the experiment and compare their predictions to the experimental outcomes to continue to explore and refine conjectures about theoretical probability.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                               |                                                                                                                                                                                       |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Content                                                                                    | Advanced                                                                                                                                                                              | Mastery                                                                                                                                                                                                  | Basic                                                                                                                                | Approaching Basic                                                                                                                    |
| <b>Chance Processes and Probability Models</b><br>7.SPC.5<br>7.SPC.6<br>7.SPC.7<br>7.SPC.8 | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                                  | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                                                     | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. |
|                                                                                            | <b>Generates a sample space to determine the probability</b> of simple <b>or</b> compound events using methods such as organized lists, tables, tree diagrams, <b>or simulations.</b> | Determines probabilities when given sample spaces for simple <b>and compound</b> events using methods such as organized lists, tables, <b>and tree diagrams.</b>                                         | <b>Determines probabilities when given sample spaces for simple events using methods such as organized lists and tables.</b>         |                                                                                                                                      |
|                                                                                            | <b>Develops probability models to determine the probabilities of events.</b>                                                                                                          | <b>Develops a model to approximate the probability of a chance event and predicts approximate frequencies when given the probability or by observing frequencies in data generated from the process.</b> |                                                                                                                                      |                                                                                                                                      |
|                                                                                            | <b>Designs and uses a simulation to generate frequencies for and estimate the probability of compound events.</b>                                                                     |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |

**7.DA.C.7** Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

- Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.
- Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?

## Standard Overview

| Core Tenets |                                                                                                                                                                                                                  |                                                                                       |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                                                        | Rigor                                                                                 |
| Supporting  | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.PF.A.3</a>, <a href="#">7.DA.C.6</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | <p>Conceptual Understanding (7, 7a, 7b), Procedural Skill and Fluency (7, 7a, 7b)</p> |

## Examples and Explanations

Probabilities are useful for predicting what will happen over the long run. Using theoretical probability, students predict frequencies of outcomes. Students recognize an appropriate design to conduct an experiment with simple probability events, understanding that the experimental data give realistic estimates of the probability of an event but are affected by sample size.

Students need multiple opportunities to perform probability experiments and compare these results to theoretical probabilities. Critical components of the experiment process are making predictions about the outcomes by applying the principles of theoretical probability, comparing the predictions to the outcomes of the experiments, and replicating the experiment to compare results. Experiments can be replicated by the same group or by compiling class data. Experiments can be conducted using various random generation devices, including, but not limited to, bag pulls, spinners, number cubes, coin toss, and colored chips. Students can collect data using physical objects, graphing calculators, or web-based simulations.

## Examples:

- Jason is tossing a fair coin. He tosses the coin ten times, and it lands on heads eight times. If Jason tosses the coin an eleventh time, what is the probability that it will land on heads? *Solution:*  $\frac{1}{2}$  The result of the eleventh toss does not depend on the previous results.
- Conduct an experiment using a Styrofoam cup by tossing the cup and recording how it lands.
  - How many trials were conducted?
  - How many times did it land right side up?
  - How many times did it land upside down?

- o How many times did it land on its side?
- o Determine the probability for each of the above results.

### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                   |                                                                                                                                                                         |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Content                                                                                        | Advanced                                                                                                                                                                | Mastery                                                                                                                                                                                                  | Basic                                                                                                                                | Approaching Basic                                                                                                                    |
| <b>Chance Processes and Probability Models</b><br>7.SP.C.5<br>7.SP.C.6<br>7.SP.C.7<br>7.SP.C.8 | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                    | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                                                     | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. |
|                                                                                                | <b>Generates a sample space to determine the probability of simple or compound events using methods such as organized lists, tables, tree diagrams, or simulations.</b> | Determines probabilities when given sample spaces for simple <b>and compound</b> events using methods such as organized lists, tables, <b>and tree diagrams.</b>                                         | <b>Determines probabilities when given sample spaces for simple events using methods such as organized lists and tables.</b>         |                                                                                                                                      |
|                                                                                                | <b>Develops probability models to determine the probabilities of events.</b>                                                                                            | <b>Develops a model to approximate the probability of a chance event and predicts approximate frequencies when given the probability or by observing frequencies in data generated from the process.</b> |                                                                                                                                      |                                                                                                                                      |
|                                                                                                | <b>Designs and uses a simulation to generate</b>                                                                                                                        |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |

|  |                                                                         |  |  |  |
|--|-------------------------------------------------------------------------|--|--|--|
|  | <b>frequencies for and estimate the probability of compound events.</b> |  |  |  |
|--|-------------------------------------------------------------------------|--|--|--|

**7.DA.C.8** Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

- Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
- Represent sample spaces for compound events using methods such as organized lists, tables, and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space that compose the event.
- Design and use a simulation to generate frequencies for compound events. For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?

## Standard Overview

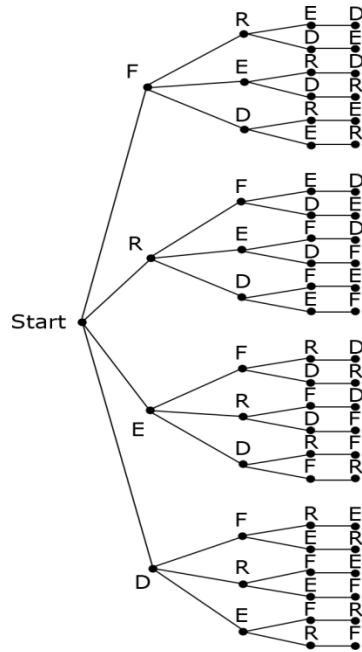
| Core Tenets |                                                                                                                                                                                                                  |                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                                                        | Rigor                                                                                                          |
| Supporting  | <p><b>Previous Grade(s) Standard:</b> none</p> <p><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.PF.A.3</a>, <a href="#">7.DA.C.7</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | <p>Conceptual Understanding (8, 8a, 8b, 8c), Procedural Skill and Fluency (8, 8b, 8c), Application (8, 8c)</p> |

## Examples and Explanations

Students use tree diagrams, frequency tables, organized lists, and simulations to determine the probability of compound events.

### Examples:

- Students conduct a bag pull experiment. A bag contains 5 marbles. There is one red marble, two blue marbles, and two purple marbles. Students will draw one marble without replacement and then draw another. What is the sample space for this situation? Explain how you determined the sample space and how you will use it to find the probability of drawing one blue marble followed by another blue marble.
- Show all possible arrangements of the letters in the word FRED using a tree diagram. If each of the letters is on a tile and drawn at random, what is the probability that you will draw the letters F-R-E-D in that order? What is the probability that your “word” will have an F as the first letter?



### Assessment Connections

Assessment Item Type(s): Type I

Evidence Statement(s): none

| Achievement Level Descriptor                                                                   |                                                                                                                                                                         |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Content                                                                                        | Advanced                                                                                                                                                                | Mastery                                                                                                                                                                                                  | Basic                                                                                                                                | Approaching Basic                                                                                                                    |
| <b>Chance Processes and Probability Models</b><br>7.SP.C.5<br>7.SP.C.6<br>7.SP.C.7<br>7.SP.C.8 | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                    | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.                                                                     | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. | Understands that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. |
|                                                                                                | <b>Generates a sample space to determine the probability of simple or compound events using methods such as organized lists, tables, tree diagrams, or simulations.</b> | Determines probabilities when given sample spaces for simple <b>and compound</b> events using methods such as organized lists, tables, <b>and tree diagrams.</b>                                         | <b>Determines probabilities when given sample spaces for simple events using methods such as organized lists and tables.</b>         |                                                                                                                                      |
|                                                                                                | <b>Develops probability models to determine the probabilities of events.</b>                                                                                            | <b>Develops a model to approximate the probability of a chance event and predicts approximate frequencies when given the probability or by observing frequencies in data generated from the process.</b> |                                                                                                                                      |                                                                                                                                      |
|                                                                                                | <b>Designs and uses a simulation to generate</b>                                                                                                                        |                                                                                                                                                                                                          |                                                                                                                                      |                                                                                                                                      |

|  |                                                                                 |  |  |  |
|--|---------------------------------------------------------------------------------|--|--|--|
|  | <b>frequencies for and estimate<br/>the probability of compound<br/>events.</b> |  |  |  |
|  |                                                                                 |  |  |  |

# Proportionality and Functions

**A. Analyze proportional relationships and use them to solve real-world and mathematical problems.** In this cluster, the terms students should learn to use with increasing precision are: **rates, unit rates, ratios, proportional relationships, constant of proportionality, complex fractions, percent, simple interest, rate, principal, tax, discount, markup, markdown, gratuity, commissions, fees, and percent of error.**

**7.PF.A.1** Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. For example, if a person walks  $\frac{1}{2}$  mile in each  $\frac{1}{4}$  hour, compute the unit rate as the complex fraction  $\frac{1/2}{1/4}$  miles per hour, equivalently 2 miles per hour.

## Standard Overview

| Core Tenets                                                                                                                                                                                                                                                                                                                          |                                                                                                                                           |                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Focus                                                                                                                                                                                                                                                                                                                                | Coherence                                                                                                                                 | Rigor                        |
| Major                                                                                                                                                                                                                                                                                                                                | Previous Grade(s) Standard: <b>6.PF.A.2</b><br>7th Grade Standard Taught in Advance: none<br>7th Grade Standard Taught Concurrently: none | Procedural Skill and Fluency |
| <b>Foundational Skills:</b><br>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.<br>2. Accurately convert a rational number to a decimal, recognizing the decimal form of rational numbers.<br>4. Fluently solve one-variable equations. |                                                                                                                                           |                              |

## Examples and Explanations

Students continue to work with ratios from sixth grade; however, the associated unit rates can now include computations with complex fractions. The ratios can come from quantities with like or different units.

### Example:

If  $\frac{1}{2}$  gallon of paint covers  $\frac{1}{6}$  of a wall, then how much paint is needed for the entire wall?

Solution:  $\frac{\text{gallon}}{\text{wall}}$  3 gallons per wall

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.4, LEAP.III.7.1

| Achievement Level Descriptor                                                                     |                                                                                                                                                                                           |                                                                                                                                                                                                                                              |                                                                                                                                                                                                 |                                                                                                         |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Content                                                                                          | Advanced                                                                                                                                                                                  | Mastery                                                                                                                                                                                                                                      | Basic                                                                                                                                                                                           | Approaching Basic                                                                                       |
| <b>Analyze Proportional Relationships and Solve Problems</b><br>7.PF.A.1<br>7.PF.A.2<br>7.PF.A.3 | Analyzes and uses proportional relationships to solve real-world and mathematical problems, including <b>multi-step</b> ratio/percent problems.                                           | <b>Analyzes and</b> uses proportional relationships to solve real-world and mathematical problems, including simple ratio/percent problems.                                                                                                  | <b>Uses</b> proportional relationships to solve <b>real-world and</b> mathematical problems, including <b>simple</b> ratio/percent problems.                                                    | Identifies proportional relationships to solve mathematical problems, including ratio/percent problems. |
|                                                                                                  | Computes unit rates of quantities associated with ratios of fractions.                                                                                                                    | Computes unit rates of quantities associated with ratios of fractions.                                                                                                                                                                       | <b>Computes unit rates of quantities associated with ratios of fractions.</b>                                                                                                                   |                                                                                                         |
|                                                                                                  | Decides whether two quantities are in a proportional relationship and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.         | Decides whether two quantities are in a proportional relationship and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.                                                            | <b>Decides</b> whether two quantities are in a proportional relationship <b>and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.</b> | Identifies whether two quantities are in a proportional relationship.                                   |
|                                                                                                  | Interprets a point $(x, y)$ on the graph of a proportional relationship in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where $r$ is the unit rate. | <b>Interprets a point <math>(x, y)</math> on the graph of a proportional relationship in terms of the situation, with special attention to the points <math>(0, 0)</math> and <math>(1, r)</math> where <math>r</math> is the unit rate.</b> |                                                                                                                                                                                                 |                                                                                                         |

|  |                                                                                                                                                                                    |                                                                                                                                                                                       |                                                                                                                                                    |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | Represents proportional relationships with equations and uses the equations to solve mathematical and real-world problems, including <b>multi-step</b> ratio and percent problems. | <b>Represents proportional relationships with equations</b> and uses the equations to solve mathematical and real-world problems, including <b>simple</b> ratio and percent problems. | <b>Uses equations representing proportional relationships to solve mathematical and real-world problems, including ratio and percent problems.</b> |  |
|  | <b>Determines when it is appropriate to use a unit rate and understands its limitations.</b>                                                                                       |                                                                                                                                                                                       |                                                                                                                                                    |  |

**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.

### Standard Overview

| Core Tenets |                                                                                                                                                                                                                                      |                                                                                                   |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Focus       | Coherence                                                                                                                                                                                                                            | Rigor                                                                                             |
| Major       | <p><b>Previous Grade(s) Standard:</b> <a href="#">6.PF.A.2</a>, <a href="#">6.PF.A.3</a></p> <p><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.PF.A.1</a></p> <p><b>7th Grade Standard Taught Concurrently:</b> none</p> | <p>Conceptual Understanding (2, 2a, 2b, 2c, 2d),<br/>Procedural Skill and Fluency (2, 2a, 2c)</p> |

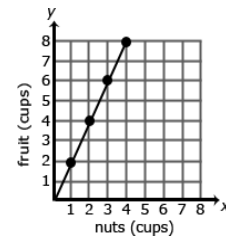
### Examples and Explanations

This standard focuses on the representations of proportional relationships. Solving problems using proportional relationships is addressed in [7.RP.A.3](#). Students create tables and graphs of proportional or non-proportional relationships. Graphing proportional relationships represented in a table helps students recognize that the graph is a line through the origin  $(0,0)$ .

#### Examples:

- A student is making a trail mix. Using the table below, create a graph to show the relationship between cups of fruit and cups of nuts. Is this a proportional relationship? If the graph does not show a proportional relationship, then explain why not. If the graph shows a proportional relationship, then determine the constant of proportionality and explain how it relates to both the table and graph.

| Serving Size          | 1 | 2 | 3 | 4 |
|-----------------------|---|---|---|---|
| Cups of Nuts ( $x$ )  | 1 | 2 | 3 | 4 |
| Cups of Fruit ( $y$ ) | 2 | 4 | 6 | 8 |



The graph shows a proportional relationship. For each serving size, there are 2 cups of fruit for every 1 cup of nuts (2:1). The constant of proportionality is 2 and can be seen on the

graph at the coordinate point (1, 2). The constant of proportionality can be seen in the table as the value by which you multiply the number of cups of nuts to get the number of cups of fruit for each serving size.

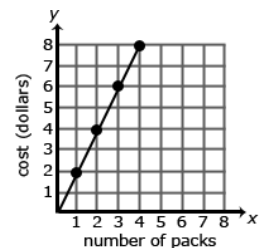
- The table below gives the price for different numbers of books. Is the price proportional to the number of books?

| Number of Books | Price |
|-----------------|-------|
| 1               | 3     |
| 3               | 9     |
| 4               | 12    |
| 7               | 18    |

No, the price is not proportional to the number of books. If the relationship were proportional, the price per book would be \$3 as indicated by the ordered pair (1, 3). However, the ordered pair (7, 18) does not indicate a price per book of \$3. A proportional relationship would require a constant that allows you to calculate the price for any number of books, i.e., a constant of proportionality.

- The graph below represents the cost of gum packs at a rate of \$2 for every pack of gum, represented as \$2/pack. Represent the relationship using a table and an equation.

| Number of Packs of Gum ( $g$ ) | Cost in Dollars ( $d$ ) |
|--------------------------------|-------------------------|
| 0                              | 0                       |
| 1                              | 2                       |
| 2                              | 4                       |
| 3                              | 6                       |
| 4                              | 8                       |



Equation:  $d = 2g$ , where  $d$  is the cost in dollars and  $g$  is the number of packs of gum. The unit rate and constant of proportionality, 2, can be read from the graph at the coordinate point (1, 2). The constant of proportionality, 2, can be seen in the table as the value by which you multiply the number of packs of gum to get the cost in dollars

A common error is to reverse the position of the variables when writing equations. Students may find it useful to use variables specifically related to the quantities rather than using  $x$  and  $y$ . Describing the relationship verbally or in writing may be helpful. A student might describe the situation as “the number of packs of gum times the cost for each pack is the total cost in dollars.” They can use this verbal model to construct the equation. Students can check their equation by substituting values and comparing their results to the table. The checking process helps students revise and recheck their model as necessary. The number of packs of gum times the cost for each pack is the total cost.

### Assessment Connections

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

Evidence Statement(s): LEAP.II.7.4, LEAP.II.7.6, LEAP.III.7.1, LEAP.III.7.3

| Achievement Level Descriptor                                                                     |                                                                                                                                                                                           |                                                                                                                                                                                                                                              |                                                                                                                                                                                                 |                                                                                                         |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Content                                                                                          | Advanced                                                                                                                                                                                  | Mastery                                                                                                                                                                                                                                      | Basic                                                                                                                                                                                           | Approaching Basic                                                                                       |
| <b>Analyze Proportional Relationships and Solve Problems</b><br>7.PF.A.1<br>7.PF.A.2<br>7.PF.A.3 | Analyzes and uses proportional relationships to solve real-world and mathematical problems, including <b>multi-step</b> ratio/percent problems.                                           | <b>Analyzes and</b> uses proportional relationships to solve real-world and mathematical problems, including simple ratio/percent problems.                                                                                                  | <b>Uses</b> proportional relationships to solve <b>real-world and</b> mathematical problems, including <b>simple</b> ratio/percent problems.                                                    | Identifies proportional relationships to solve mathematical problems, including ratio/percent problems. |
|                                                                                                  | Computes unit rates of quantities associated with ratios of fractions.                                                                                                                    | Computes unit rates of quantities associated with ratios of fractions.                                                                                                                                                                       | <b>Computes unit rates of quantities associated with ratios of fractions.</b>                                                                                                                   |                                                                                                         |
|                                                                                                  | Decides whether two quantities are in a proportional relationship and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.         | Decides whether two quantities are in a proportional relationship and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.                                                            | <b>Decides</b> whether two quantities are in a proportional relationship <b>and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.</b> | Identifies whether two quantities are in a proportional relationship.                                   |
|                                                                                                  | Interprets a point $(x, y)$ on the graph of a proportional relationship in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where $r$ is the unit rate. | <b>Interprets a point <math>(x, y)</math> on the graph of a proportional relationship in terms of the situation, with special attention to the points <math>(0, 0)</math> and <math>(1, r)</math> where <math>r</math> is the unit rate.</b> |                                                                                                                                                                                                 |                                                                                                         |

|  |                                                                                                                                                                                    |                                                                                                                                                                                       |                                                                                                                                                    |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | Represents proportional relationships with equations and uses the equations to solve mathematical and real-world problems, including <b>multi-step</b> ratio and percent problems. | <b>Represents proportional relationships with equations and</b> uses the equations to solve mathematical and real-world problems, including <b>simple</b> ratio and percent problems. | <b>Uses equations representing proportional relationships to solve mathematical and real-world problems, including ratio and percent problems.</b> |  |
|  | <b>Determines when it is appropriate to use a unit rate and understands its limitations.</b>                                                                                       |                                                                                                                                                                                       |                                                                                                                                                    |  |

**7.PF.A.3** Use proportional relationships to reason and solve multistep ratio and percent problems of simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, and percent error.

## Standard Overview

| Core Tenets                                                                                                                                                                                                                                                                             |                                                                                                                                                                                             |                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Focus                                                                                                                                                                                                                                                                                   | Coherence                                                                                                                                                                                   | Rigor                                     |
| Major                                                                                                                                                                                                                                                                                   | <b>Previous Grade(s) Standard:</b> <a href="#">6.PF.A.3</a><br><b>7th Grade Standard Taught in Advance:</b> <a href="#">7.PF.A.2</a><br><b>7th Grade Standard Taught Concurrently:</b> none | Procedural Skill and Fluency, Application |
| <b>Foundational Skills:</b><br>1. Fluently add, subtract, multiply, and divide positive and negative rational numbers in the form of whole numbers, fractions, and decimals.<br>2. Accurately convert a rational number to a decimal, recognizing the decimal form of rational numbers. |                                                                                                                                                                                             |                                           |

## Examples and Explanations

Students should be able to explain or show their work using a representation (numbers, words, pictures, physical objects, or equations) and verify that their answer is reasonable. Models help students to identify the parts of the problem and how the values are related. For percent increase and decrease, students first identify the whole amount for which the percent is defined in order to understand the meaning of the percent of increase/decrease.

### Examples:

- Gas prices are projected to increase 124% within the next year. A gallon of gas currently costs \$1.85. What is the projected cost of a gallon of gas?

A student might say: “The original cost of a gallon of gas is \$1.85. An increase of 100% means that the cost will double. I will also need to add another 24% to figure out the final projected cost of a gallon of gas. Since 24% of \$1.85 is about \$0.44, the projected cost of a gallon of gas should be around \$4.14.”

$$\$1.85 + 1.85 + (0.24 \cdot 1.85) = 2.24 \times 1.85$$

|        |        |     |
|--------|--------|-----|
| 100%   | 100%   | 24% |
| \$1.85 | \$1.85 | ??  |

- A sweater is marked down 33%. Its original price was \$37.50. What is the price of the sweater before sales tax?

|              |              |
|--------------|--------------|
| 37.50        |              |
| 33% of 37.50 | 67% of 37.50 |

The sale price is the original price minus the discount (\$37.50 - \$37.50 × 0.33) or \$37.50(1–0.33) or \$37.50 × 0.67. Students should recognize that if the original price is decreased by 33%, then a person pays 67% of the original price.

Finding the percent error is the process of expressing the size of the error (or deviation) between two measurements. To calculate the percent error, students determine the absolute deviation (positive difference) between an expected measurement and the actual measurement and then divide by the actual measurement. Multiplying by 100 will give the percent error. (Note the similarity between percent error and percent of increase or decrease.) **The students must understand this connection rather than just applying the formula.** This can be done by asking students how they think the size of an error can be determined.

$$\text{" \% error = } \frac{|\text{amount of error}|}{\text{actual measurement}} \times 100\% \text{"}$$

### Examples:

- Jamal needs to purchase a countertop for his kitchen. Jamal measured the countertop as 5 ft. The actual measurement is 4.5 ft. What is Jamal's percent error?

*Solution:*

$$\% \text{ error} = \frac{|5 \text{ ft} - 4.5 \text{ ft}|}{4.5 \text{ ft}} \times 100\%$$

$$\% \text{ error} = \frac{0.5}{4.5} \times 100$$

$$\approx 11\%$$

4.5 ft

- A shirt is on sale for 40% off. The sale price is \$12. What was the original price? What was the amount of the discount?

|                             |                                      |
|-----------------------------|--------------------------------------|
| Discount<br>40% of original | Sale Price = \$12<br>60% of original |
| Original Price (p)          |                                      |

The sale price is 60% of the original price. This reasoning can be expressed as  $12 = 0.60p$ . Dividing both sides of the equation by 60 gives an original price of \$20.

- At a certain store, 48 television sets were sold in April. The manager at the store wants to encourage the sales team to sell more TVs and is going to give all the sales team members a bonus if the number of TVs sold increases by 30% in May. How many TVs must the sales team sell in May to receive the bonus? Justify your solution.
- A salesperson set a goal to earn \$2,000 in May. He receives a base salary of \$500 as well as a 10% commission for all sales. How much merchandise will he have to sell to meet his goal?
- After eating at a restaurant, your bill before tax is \$52.60. The sales tax rate is 8%. You decide to leave a 20% tip for the waiter based on the pre-tax amount. How much is the tip you leave for the waiter? How much will the total bill be, including tax and tip?

## Assessment Connections

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

Evidence Statement(s): LEAP.II.7.4, LEAP.II.7.7, LEAP.III.7.1, LEAP.III.7.4

| Achievement Level Descriptor                                                                     |                                                                                                                                                                                           |                                                                                                                                                                                                                                              |                                                                                                                                                                                                 |                                                                                                         |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Content                                                                                          | Advanced                                                                                                                                                                                  | Mastery                                                                                                                                                                                                                                      | Basic                                                                                                                                                                                           | Approaching Basic                                                                                       |
| <b>Analyze Proportional Relationships and Solve Problems</b><br>7.PF.A.1<br>7.PF.A.2<br>7.PF.A.3 | Analyzes and uses proportional relationships to solve real-world and mathematical problems, including <b>multi-step</b> ratio/percent problems.                                           | <b>Analyzes and</b> uses proportional relationships to solve real-world and mathematical problems, including simple ratio/percent problems.                                                                                                  | <b>Uses</b> proportional relationships to solve <b>real-world and</b> mathematical problems, including <b>simple</b> ratio/percent problems.                                                    | Identifies proportional relationships to solve mathematical problems, including ratio/percent problems. |
|                                                                                                  | Computes unit rates of quantities associated with ratios of fractions.                                                                                                                    | Computes unit rates of quantities associated with ratios of fractions.                                                                                                                                                                       | <b>Computes unit rates of quantities associated with ratios of fractions.</b>                                                                                                                   |                                                                                                         |
|                                                                                                  | Decides whether two quantities are in a proportional relationship and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.         | Decides whether two quantities are in a proportional relationship and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.                                                            | <b>Decides</b> whether two quantities are in a proportional relationship <b>and identifies the constant of proportionality in tables, equations, diagrams, verbal descriptions, and graphs.</b> | Identifies whether two quantities are in a proportional relationship.                                   |
|                                                                                                  | Interprets a point $(x, y)$ on the graph of a proportional relationship in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where $r$ is the unit rate. | <b>Interprets a point <math>(x, y)</math> on the graph of a proportional relationship in terms of the situation, with special attention to the points <math>(0, 0)</math> and <math>(1, r)</math> where <math>r</math> is the unit rate.</b> |                                                                                                                                                                                                 |                                                                                                         |

|  |                                                                                                                                                                                    |                                                                                                                                                                                       |                                                                                                                                                    |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | Represents proportional relationships with equations and uses the equations to solve mathematical and real-world problems, including <b>multi-step</b> ratio and percent problems. | <b>Represents proportional relationships with equations and</b> uses the equations to solve mathematical and real-world problems, including <b>simple</b> ratio and percent problems. | <b>Uses equations representing proportional relationships to solve mathematical and real-world problems, including ratio and percent problems.</b> |  |
|  | <b>Determines when it is appropriate to use a unit rate and understands its limitations.</b>                                                                                       |                                                                                                                                                                                       |                                                                                                                                                    |  |

## 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.3** Solve multi-step real-world mathematical tasks involving more than one operation posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted.

- Represent these problems using equations with a letter standing for the unknown quantity.
- Assess the reasonableness of answers using mental computation and estimation strategies, including rounding.

Return to ■ [7.NOF.A.3](#)

○ **4.DM.C.7** Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts.

- Solve addition and subtraction real-world mathematical tasks to find unknown angles on a diagram, e.g., by using an equation with a letter for the unknown angle measure.

Return to ■ [7.GL.B.5](#)

## Grade 5 Standards

---

■ **5.NOF.A.1** Add and subtract fractions with unlike denominators (including mixed numbers and fractions greater than 1) by replacing given fractions with equivalent fractions to produce an equivalent equation with fractions that have like denominators. *Return to* ■ [7.NOF.A.1](#)

■ **5.NOF.B.3** Interpret a fraction as division of the numerator by the denominator ( $\frac{a}{b} = a \div b$ ). Solve real-world mathematical tasks involving division of whole numbers in the form of fractions to include fractions greater than one or mixed numbers, e.g., by using visual fraction models, number line diagrams, or equations to represent the problem. *Return to* ■ [7.NOF.A.2](#)

■ **5.NOF.B.4** Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.

- Interpret the product  $(\frac{m}{n}) \times q$  as  $m$  parts of a partition of  $q$  into  $n$  equal parts; equivalently, as the result of a sequence of operations,  $m \times q \div n$ .
- Construct or critique a precise model to develop understanding of the concept of multiplying two fractions and create a story context for the equation.

In general,  $(\frac{m}{n}) \times (\frac{c}{d}) = \frac{(mc)}{(nd)}$ .

Return to ■ [7.NOF.A.2](#), ■ [7.DA.B.3](#)

## Grade 6 Standards

---

■ **6.PF.A.2** Understand the concept of a unit rate  $a/b$  associated with a ratio  $a:b$  where  $b \neq 0$ , and use rate language in the context of a ratio relationship. Expectations for unit rates in this grade are limited to non-complex fractions. For example,

- “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is  $\frac{3}{4}$  cup of flour for each cup of sugar.”
- “We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger.”

Return to ■ [7.PF.A.1](#), ■ [7.PF.A.2](#)

■ **6.PF.A.3** Use and apply ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

- a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
- b. Solve unit rate problems, including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what unit rate were lawns being mowed?
- c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part, and the percent.
- d. Use ratio reasoning to convert measurement units within and between the U.S. customary and metric systems; manipulate and transform units appropriately when multiplying or dividing quantities.

Return to ■ [7.PF.A.2](#), ■ [7.PF.A.3](#)

■ **6.NOF.A.1** Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. For example,

- create a story context for  $(\frac{2}{3}) \div (\frac{3}{4})$  and illustrate the quotient by using a visual fraction model;
- use the relationship between multiplication and division to explain that  $(\frac{2}{3}) \div (\frac{3}{4}) = \frac{8}{9}$  because  $\frac{3}{4}$  of  $\frac{8}{9}$  is  $\frac{2}{3}$ .
- In general,  $(\frac{a}{b}) \div (\frac{c}{d}) = \frac{ad}{bc}$ .

Return to ■ [7.NOF.A.2](#), [7.DA.B.3](#)

○ **6.NOF.B.2** Fluently divide positive multi-digit whole numbers using a standard algorithm. Return to [7.NOF.A.2](#)

○ **6.NOF.B.3** Fluently add, subtract, multiply, and divide positive multi-digit decimals to the thousandths using a standard algorithm for each operation. Return to ■ [7.NOF.A.3](#)

■ **6.NOF.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. Return to ■ [7.NOF.A.1](#)

- **6.AR.A.3** Apply the properties of operations to generate equivalent expressions, identify when two expressions are equivalent, and explain why two expressions are equivalent. For example, we can apply the distributive property to the expression  $3(2 + x)$  to produce the equivalent expression  $6 + 3x$ ; apply the distributive property to the expression  $24x + 18y$  to produce the equivalent expression  $6(4x + 3y)$ ; and apply properties of operations to  $y + y + y$  to produce the equivalent expression  $3y$ . *Return to* ■ [7.AR.A.1](#)
- **6.AR.B.5** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *Return to* ■ [7.AR.B.3](#)
- **6.AR.B.6** Solve real-world and mathematical problems by writing and solving equations and inequalities of the form  $x + p = q$  and  $px = q$  for cases in which  $p$ ,  $q$ , and  $x$  are all nonnegative rational numbers. Inequalities will include  $>$ ,  $<$ ,  $\geq$  and  $\leq$ . *Return to* ■ [7.AR.B.3](#)
- **6.AR.B.7** Translate a real-world written description into an algebraic inequality in the form of  $x > c$  or  $x < c$ . Recognize, describe and interpret the infinitely many solutions for  $x > c$  or  $x < c$  and graph the solutions on a number line. *Return to* ■ [7.AR.B.3](#)
- **6.GL.A.1** Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. *Return to* ○ [7.GL.A.1](#), ○ [7.GL.B.4](#), ○ [7.GL.B.6](#)
- **6.GL.A.2** Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas  $V = Bh$  and  $V = lwh$  to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. *Return to* ○ [7.GL.B.6](#)
- **6.GL.A.4** Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. *Return to* ○ [7.GL.B.6](#)
- **6.DA.A.1** Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages. *Return to* ■ [7.PF.A.1](#), ○ [7.DA.B.3](#)
- **6.DA.A.2** Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. *Return to* ■ [7.DA.A.1](#)