Introduction

Development of K-12 Louisiana Student Standards for Mathematics

The Louisiana mathematics standards were created by over one hundred Louisiana educators with input by thousands of parents and teachers from across the state. Educators envisioned what mathematically proficient students should know and be able to do to compete in our society and focused their efforts on creating standards that would allow them to do so. The new standards provide appropriate content for all grades or courses, maintain high expectations, and create a logical connection of content across and within grades.

The Role of Standards in Establishing Key Student Skills and Mathematical Proficiency

Students in Louisiana are ready for college or a career if they are able to meet college and workplace expectations without needing remediation in mathematics skills and concepts. The standards define what Louisiana students should know, understand, and be able to do mathematically and represent the steps students must take along the way to be able to meet this goal.

For example, all students should be able to recall and use math skills and concepts on a daily basis. That is, a student should know certain math facts and concepts such as how to add, subtract, multiply, and divide basic numbers with ease, how to work with simple fractions and percentages, and how to apply basic algebra and geometry principles. Additionally, students need to be able to reason mathematically, communicate with others about math through speaking and writing, and problem solve in real-world situations to be prepared mathematically for post-secondary education or to pursue a career.

The K-12 mathematics standards lay the foundation that allows students to become mathematically proficient by focusing on conceptual understanding, procedural skill and fluency, and application.

- **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. Students' ability to solve more complex application tasks is dependent on procedural skill and fluency.
- **Application** provides a valuable context for learning and the opportunity to solve problems in a relevant and a meaningful way. It is through real-world application that students learn to select an efficient method to find a solution, determine whether the solution(s) makes sense by reasoning, and develop critical thinking skills.

Structure of the Standards

There are two types of standards in the Louisiana Mathematics Standards – mathematical practice and content. A summary of each type is provided below:

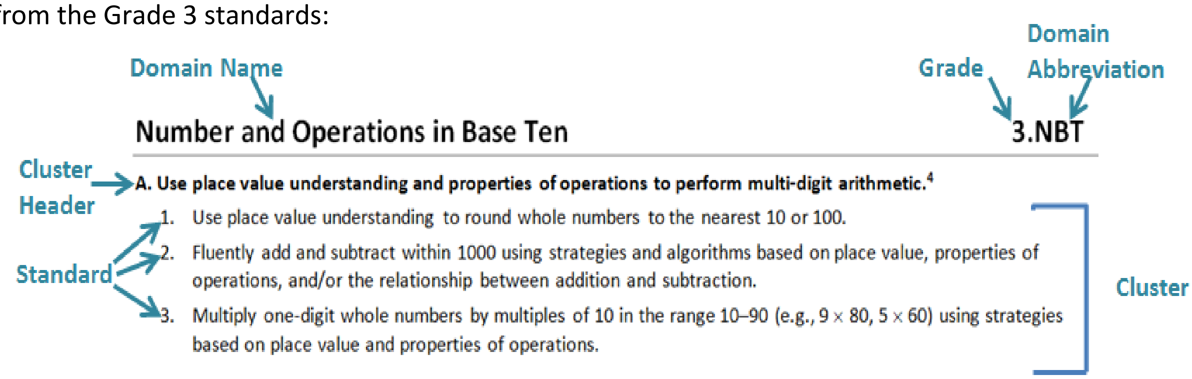
1. Standards for Mathematical Practice
   - Apply to all grade levels
   - Describe mathematically proficient students
2. Standards for Mathematical Content
   - K-8 standards presented by grade level
   - High school standards presented by high school course (Algebra I, Geometry, Algebra II), then organized by conceptual categories:
     - Number and Quantity
     - Algebra
     - Functions
     - Modeling
     - Geometry
     - Statistics and Probability

The following terms will assist in understanding how to read the content standards and their codes. Terms are defined in order from most specific to most general.

- **Standards -** Statements of what a student should know, understand, and be able to do.
- **Clusters -** Groups of **related** standards. Cluster headings may be considered as the big idea(s) that the group of standards they represent are addressing. Cluster headings are therefore useful as a quick summary of the progression of ideas that the standards in a domain are covering and can help teachers to determine the focus of the standards they are teaching.
- **Domains -** A **large** category of mathematics that the clusters and their respective content standards delineate and address. For example, *Number and Operations – Fractions* is a domain under which there are a number of clusters (the big ideas that will be addressed) along with their respective content standards, which give the specifics of what the student should know, understand, and be able to do when working with fractions.
- **Conceptual Categories –** The content standards, clusters, and domains in Algebra I, Geometry, and Algebra II are further organized under conceptual categories. These are very broad categories of mathematical thought and lend themselves to the organization of high school course work. For example, Algebra is a conceptual category in the high school standards under which are domains such as Seeing Structure in Expressions, Creating Equations, Arithmetic with Polynomials and Rational Expressions, etc.

Reading Standards and Interpreting their Codes in Grades K-8

Example from the Grade 3 standards:



There are four parts to the code for a mathematics standard in Kindergarten through Grade 8. The Cluster Headers are identified by an uppercase letter (A, B, C…). If a Domain has four clusters, then the letter A is assigned to the heading for the first cluster, B to the second, C to the third, and D to the fourth cluster. Each part of the code is separated by a period and has a specific meaning:

PART ONE Grade Level	●	PART TWO Domain	●	PART THREE Cluster	●	PART FOUR Standard #

Look at the example below. It is the code for the last Grade 3 standard in the above list.

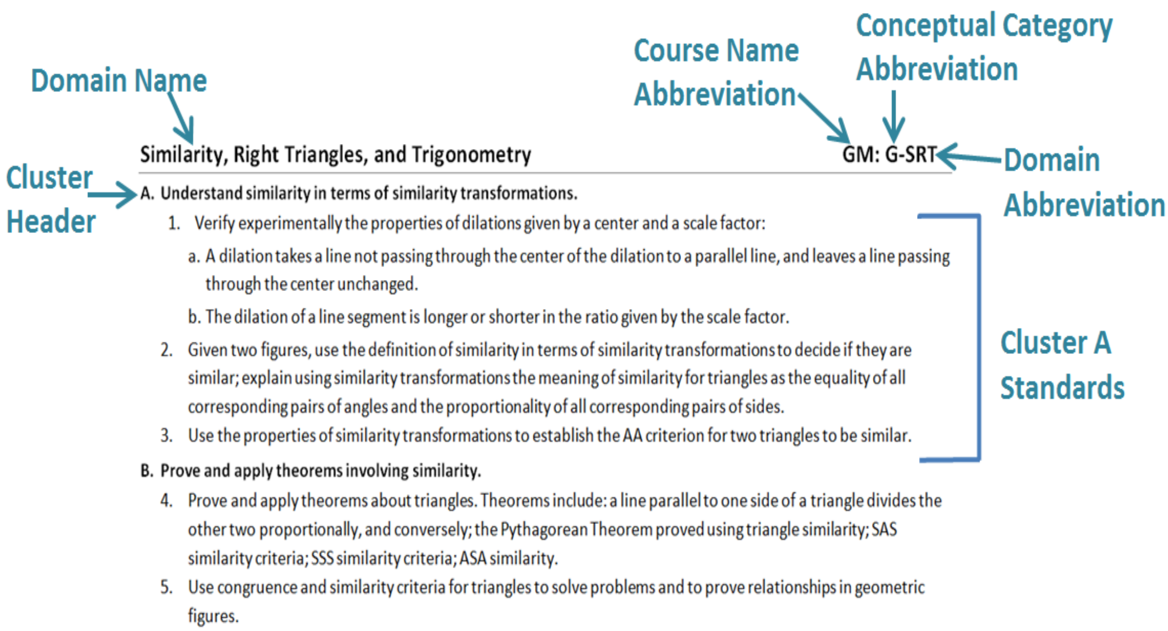
3.NBT.A.3

The grade level is 3, the domain code is NBT (Numbers and Operations in Base Ten), the cluster is A (first cluster), and the standard number is 3. The text of standard 3.NBT.A.3 is provided below.

3.NBT.A.3. *Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations.*

Reading Standards and Interpreting their Codes in High School Courses

The codes for standards in high school math courses have five parts. An excerpt of the standards for the high school Geometry course as displayed in this document is shown below.


Similarity, Right Triangles, and Trigonometry — GM: G-SRT

A. Understand similarity in terms of similarity transformations.

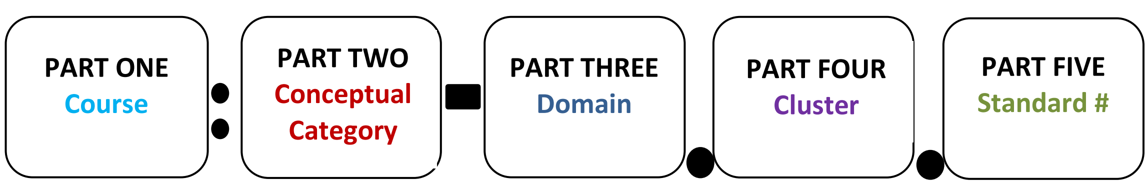
1. Verify experimentally the properties of dilations given by a center and a scale factor:
   a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
   b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

B. Prove and apply theorems involving similarity.

4. Prove and apply theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity; SAS similarity criteria; SSS similarity criteria; ASA similarity.
5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

As indicated in the excerpt, the abbreviation used for the high school Geometry course is GM. The abbreviations used for Algebra I and Algebra II are A1 and A2, respectively. The course name abbreviation is followed by abbreviations for the Conceptual Category and the Domain, the letter of the Cluster Header, and then the standard number. High school Conceptual Categories and their abbreviations are located in the table of the next section (Progressions).

The code for standard 5 in the list above is **GM: G-SRT.B.5** with the meaning of each part noted in the graphic below.



Algebra I Example A1: N-Q.A.2

Quantities* — A1: N-Q

A. Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Algebra II Example A2: F-LE.B.4

Linear, Quadratic, and Exponential Models* **A2: F-LE**

A. **Construct and compare linear, quadratic, and exponential models and solve problems.**
   2. Given a graph, a description of a relationship, or two input-output pairs (include reading these from a table), construct linear and exponential functions, including arithmetic and geometric sequences, to solve multi-step problems
   4. For exponential models, express as a logarithm the solution to $a\,b^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

B. **Interpret expressions for functions in terms of the situation they model.**
   5. Interpret the parameters in a linear, quadratic, or exponential function in terms of a context.

Note: There is not an error in the Algebra II listing of standards above. Standards 1 and 3 in the Linear, Quadratic, and Exponential Models domain are in the Algebra I standard with codes of A1: F-LE.A.1 and A1:F-LE.A.3.

Companion Documents for Teachers

Companion documents for teachers are designed to assist educators in interpreting and implementing the new Louisiana Student Standards for Mathematics by providing descriptions and examples for each standard in a grade level or course. The companion documents are linked in the Resources section and the grade level listings of this document. Access the companion document for a specific grade or course by clicking an icon similar to the one to the right which links to the Grade 5 Teachers Companion document.

GRADE 5 TEACHERS COMPANION DOCUMENT

Progressions in the Math Standards

The standards for each grade should not be considered a checklist or taught in isolation. There is a flow or progression that creates coherence within a grade and from one grade to the next. The progressions are organized using domains in grades K -8 and conceptual categories in high school. The color-coded table shows the domains, categories, and their abbreviations, and identifies the five progressions present in the Louisiana Student Standards for Mathematics. Each of the progressions begins in Kindergarten and indicates a constant movement toward the high school standards. Progressions guarantee a steady, age-appropriate development of each topic and also ensure that gaps are not created in the mathematical education of Louisiana's students. The table is designed to allow teachers to see the coherence and connections among the mathematical topics in the standards.

<table>
<tr><th>Kindergarten</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>High School</th></tr>
<tr><td colspan="9">Domains and Abbreviations</td><td>Categories and Abbreviations</td></tr>
<tr><td>Counting and Cardinality (CC)</td><td colspan="8"></td><td rowspan="3">Number and Quantity (N)</td></tr>
<tr><td colspan="6">Numbers and Operations in Base Ten (NBT)</td><td colspan="2">Ratios and Proportional Relationships (RP)</td><td></td></tr>
<tr><td colspan="3"></td><td colspan="3">Number and Operations – Fractions (NF)</td><td colspan="3">The Number System (NS)</td></tr>
<tr><td colspan="6" rowspan="2">Operations and Algebraic Thinking (OA)</td><td colspan="3">Expressions and Equations (EE)</td><td>Algebra (A)</td></tr>
<tr><td colspan="2"></td><td>Functions (F)</td><td>Functions (F)</td></tr>
<tr><td colspan="6">Geometry (G)</td><td colspan="3">Geometry (G)</td><td>Geometry (G)</td></tr>
<tr><td colspan="6">Measurement and Data (MD)</td><td colspan="3">Statistics and Probability (SP)</td><td>Statistics and Probability (S)</td></tr>
</table>

Mathematics | Standards for Mathematical Practice

Being successful in mathematics requires that development of approaches, practices, and habits of mind are implemented as one strives to develop mathematical fluency, procedural skills, and conceptual understanding. The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education.

The Standards for Mathematical Practice are typically developed as students solve high-level mathematical tasks that support approaches, practices, and habits of mind which are called for within these standards.

The following are the eight Standards for Mathematical Practice and their descriptions.

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

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

3 **Construct viable arguments and critique the reasoning of others.**
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to

Mathematics | Grade 2

GRADE 2 TEACHERS COMPANION DOCUMENT

Grade Level Overview

(1) Students extend their understanding of the base-ten system. This includes ideas of counting in fives, tens, and multiples of hundreds, tens, and ones, as well as number relationships involving these units, including comparing. Students understand multi-digit numbers (up to 1000) written in base-ten notation, recognizing that the digits in each place represent amounts of thousands, hundreds, tens, or ones (e.g., 853 is 8 hundreds + 5 tens + 3 ones).

(2) Students use their understanding of addition to develop fluency with addition and subtraction within 100. They solve problems within 1000 by applying their understanding of models for addition and subtraction, and they develop, discuss, and use efficient, accurate, and generalizable methods to compute sums and differences of whole numbers in base-ten notation, using their understanding of place value and the properties of operations. They select and accurately apply methods that are appropriate for the context and the numbers involved to mentally calculate sums and differences for numbers with only tens or only hundreds.

(3) Students recognize the need for standard units of measure (centimeter and inch) and they use rulers and other measurement tools with the understanding that linear measure involves an iteration of units. They recognize that the smaller the unit, the more iterations they need to cover a given length.

(4) Students describe and analyze shapes by examining their sides and angles. Students investigate, describe, and reason about decomposing and combining shapes to make other shapes. Through building, drawing, and analyzing two- and three-dimensional shapes, students develop a foundation for understanding area, volume, congruence, similarity, and symmetry in later grades.

Operations and Algebraic Thinking 2.OA

A. Represent and solve problems involving addition and subtraction.

1. Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.[1]

B. Add and subtract within 20.

2. Fluently add and subtract within 20 using mental strategies.[2] By the end of Grade 2, know from memory all sums of two one-digit numbers.

C. Work with equal groups of objects to gain foundations for multiplication.

3. Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.
4. Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.

[1] See Glossary, Table 1.
[2] See standard 1.OA.6 for a list of mental strategies.

Number and Operations in Base Ten 2.NBT

A. Understand place value.

1. Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:
    a. 100 can be thought of as a bundle of ten tens—called a "hundred."
    b. The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones).
2. Count within 1000; skip-count by 5s, 10s, and 100s.
3. Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.
4. Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons.

B. Use place value understanding and properties of operations to add and subtract.

5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.
6. Add up to four two-digit numbers using strategies based on place value and properties of operations.
7. Add and subtract within 1000 using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; justify the reasoning used with a written explanation. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.
8. Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.
9. Explain why addition and subtraction strategies work, using place value and the properties of operations.[3]

Measurement and Data 2.MD

A. Measure and estimate lengths in standard units.

1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2. Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen.
3. Estimate lengths using units of inches, feet, centimeters, and meters.
4. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

B. Relate addition and subtraction to length.

5. Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.
6. Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, …, and represent whole-number sums and differences within 100 on a number line diagram.

[3] Explanations may be supported by drawings or objects.

C. Work with time and money.

7. Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.
8. Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. *Example: If you have 2 dimes and 3 pennies, how many cents do you have?*

D. Represent and interpret data.

9. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units.
10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems[4] using information presented in a bar graph.

Geometry 2.G

A. Reason with shapes and their attributes.

1. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.[5] Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.
2. Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.
3. Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves*, *thirds*, *half of*, *a third of*, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.

[4] See Glossary, Table 1.
[5] Sizes are compared directly or visually, not compared by measuring.