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:

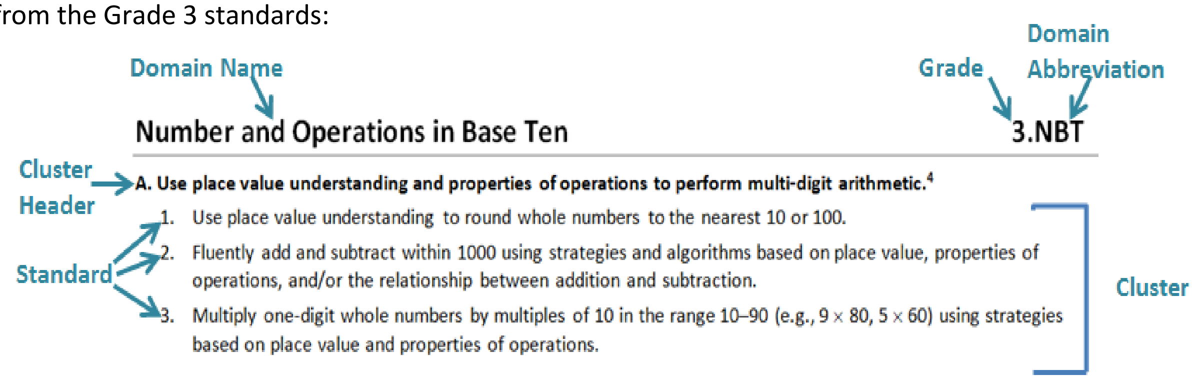
1. Standards for Mathematical Practice
   - Apply to all grade levels
   - Describe mathematically proficient students
2. Standards for Mathematical Content
   - K-8 standards presented by grade level
   - High school standards presented by high school course (Algebra I, Geometry, Algebra II), then organized 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.

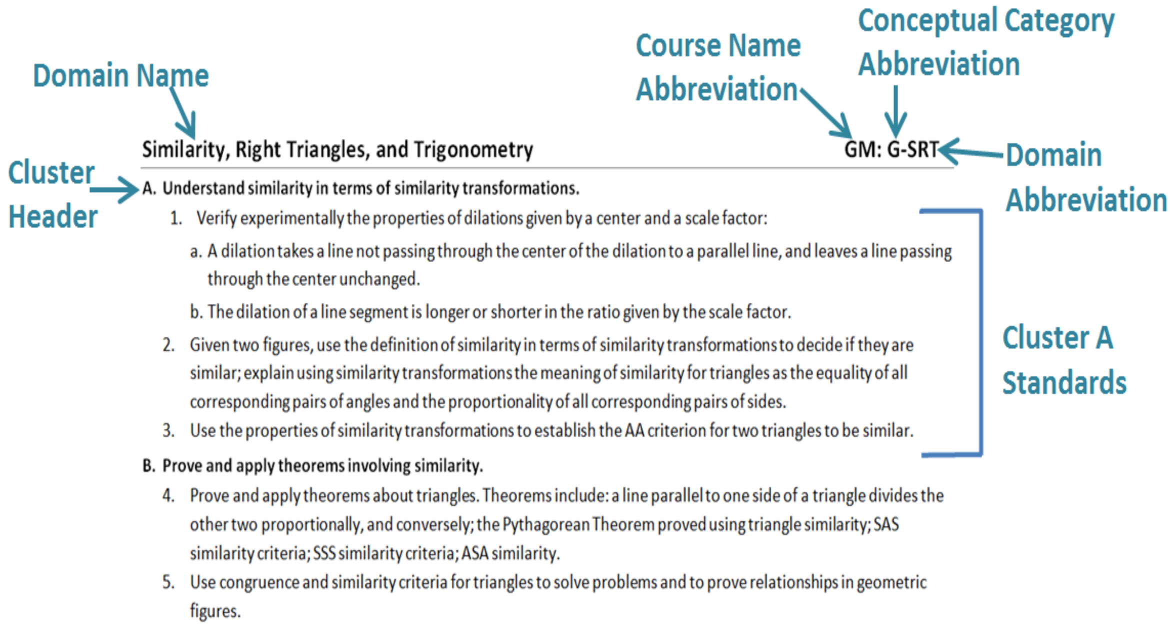
3.NBT.A.3

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.

PART ONE Course	:	PART TWO Conceptual Category	-	PART THREE Domain	.	PART FOUR Cluster	.	PART FIVE Standard #

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.

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><th colspan="9">Domains and Abbreviations</th><th>Categories and Abbreviations</th></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 1

GRADE 1 TEACHERS COMPANION DOCUMENT

Grade Level Overview

(1) Students develop strategies for adding and subtracting whole numbers based on their prior work with small numbers. They use a variety of models, including discrete objects and length-based models (e.g., cubes connected to form lengths), to model add-to, take-from, put-together, take-apart, and compare situations to develop meaning for the operations of addition and subtraction, and to develop strategies to solve arithmetic problems with these operations. Students understand connections between counting and addition and subtraction (e.g., adding two is the same as counting on two). They use properties of addition to add whole numbers and to create and use increasingly sophisticated strategies based on these properties (e.g., "making tens") to solve addition and subtraction problems within 20. By comparing a variety of solution strategies, children build their understanding of the relationship between addition and subtraction.

(2) Students develop, discuss, and use efficient, accurate, and generalizable methods to add within 100 and subtract multiples of 10. They compare whole numbers (at least to 100) to develop understanding of and solve problems involving their relative sizes. They think of whole numbers between 10 and 100 in terms of tens and ones (especially recognizing the numbers 11 to 19 as composed of a ten and some ones). Through activities that build number sense, they understand the order of the counting numbers and their relative magnitudes.

(3) Students develop an understanding of the meaning and processes of measurement, including underlying concepts such as iterating (the mental activity of building up the length of an object with equal-sized units) and the transitivity principle for indirect measurement.[1]

(4) Students compose and decompose plane or solid figures (e.g., put two triangles together to make a quadrilateral) and build understanding of part-whole relationships as well as the properties of the original and composite shapes. As they combine shapes, they recognize them from different perspectives and orientations, describe their geometric attributes, and determine how they are alike and different, to develop the background for measurement and for initial understandings of properties such as congruence and symmetry.

Operations and Algebraic Thinking 1.OA

A. Represent and solve problems involving addition and subtraction.

1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem).[2]
2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

B. Understand and apply properties of operations and the relationship between addition and subtraction.

3. Apply properties of operations to add and subtract.[3] *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*
4. Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.*

C. Add and subtract within 20.

[1] Students should apply the principle of transitivity of measurement to make indirect comparisons, but they need not use this technical term.
[2] See Glossary, Table 1.
[3] Students need not use formal terms for these properties.

5. Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
6. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use mental strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

D. Work with addition and subtraction equations.

7. Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.*
8. Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = □ – 3, 6 + 6 = □.*

Number and Operations in Base Ten 1.NBT

A. Extend the counting sequence.

1. Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral.

B. Understand place value.

2. Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases:
   a. 10 can be thought of as a bundle of ten ones—called a "ten."
   b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.
   c. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones).
3. Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <.

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

4. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10.
   a. Use concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a number sentence; justify the reasoning used with a written explanation.
   b. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.
5. Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.
6. Subtract multiples of 10 in the range 10–90 from multiples of 10 in the range 10–90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Measurement and Data 1.MD

A. Measure lengths indirectly and by iterating length units.

1. Order three objects by length; compare the lengths of two objects indirectly by using a third object.
2. Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps*.

B. Tell and write time.

3. Tell and write time in hours and half-hours using analog and digital clocks.

C. Represent and interpret data.

4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

D. Work with money.

5. Determine the value of a collection of coins up to 50 cents. (Pennies, nickels, dimes, and quarters in isolation; not to include a combination of different coins.)

Geometry 1.G

A. Reason with shapes and their attributes.

1. Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes that possess defining attributes.
2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) and three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.[4]
3. Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters,* and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.

[4] Students do not need to learn formal names such as "right rectangular prism."