



Interim Assessments

# Mathematics

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Alignment Tables



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# Introduction

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Cognia™ Interim Assessments provide information about students' academic progress toward grade-level standards, with an emphasis on critical thinking. As an organization dedicated to creating opportunity for all through equal access to knowledge, Cognia believes that any assessment should be designed, from the outset, to support teaching and learning. We have designed Cognia Interim Assessments to serve this purpose.

This document demonstrates the alignment of items to intended standards and to a taxonomy for cognitive complexity. The assessments were written to college and career readiness standards similar to the Common Core State Standards (CCSS). To evaluate the cognitive complexity of Cognia test items, we used Webb's Depth of Knowledge taxonomy, which is fully aligned to the revised version of Bloom's Taxonomy.

## Claims Regarding the Meaning of Cognia Test Scores

Cognia Interim Assessments provide measures of students' progress toward college and career readiness. We designed the assessments to ensure that reported scores are reliable, so that educators can make meaningful inferences about test scores. In other words, students are given sufficient opportunity to demonstrate their knowledge and skills so that reported scores can be trusted. Consistent with the *Standards for Educational and Psychological Testing* (AERA/NCME/APA, 2014), we have documented all design and development decisions and have a research plan for gathering evidence to support the validity of test scores.

Cognia Interim mathematics assessments evaluate mathematics **concepts and procedures** as well as mathematical **practices** (problem solving, logical and quantitative reasoning including the evaluation of the arguments of others, modeling, and patterns and structure). Within concepts and procedures, we assess mathematical domains that reflect important learning progressions in mathematics. For grades 3–5, we assess operations and algebraic thinking, whole number concepts and operations, fraction concepts and operations, measurement and data, and geometry. For grades 6–8, we assess ratios and proportional relationships (grades 6 and 7) and functions (grade 8), the rational number system, algebraic expressions and equations, geometry, and statistics and probability.

Intentional and focused assessment of mathematical practices is one of the major innovative advantages of Cognia mathematics assessments. Many of the mathematics concepts and procedures standards were written to ensure that students will apply one or more mathematical practices to demonstrate mastery of the standard. However, there are overarching practices that require integration and application of mathematical concepts and procedures in real-world and mathematical contexts. For example, mathematical modeling is applied in theoretical mathematics as well as the social sciences, earth and space science, biology, physical science, architecture, and engineering.

The ability to apply mathematics to solve real-world and mathematical problems is a critical skill after high school in post-secondary education and in careers. Logical reasoning in mathematics is prerequisite to being able to do proofs in higher-level mathematics. The vast majority of the items in Cognia mathematics assessments are designed to measure one mathematical practice fully. Most items measure a single content standard; however, where appropriate for measurement of problem solving, reasoning, and modeling, items may require application of more than one content standard.

Table 1 and Table 2 present the claims for the meaning of scores from Cognia interim mathematics assessments.

**Table 1. Claims about the Meaning of Cognia Mathematics Assessment Scores, Grades 3–5**

<b>Mathematics Claims—Grades 3–5</b> <b>Students who are At Standard or Above Standard in grades 3–5 can:</b>	
<b>Operations and Algebraic Thinking</b>	<ul style="list-style-type: none"> <li>Apply mathematical operations (addition, subtraction, multiplication, and/or division) and use algebra representations (e.g., equations) to solve problems involving whole numbers.</li> <li>Identify, explain, and extend arithmetic patterns.</li> </ul>
<b>Number &amp; Operations in Base 10 and Fractions</b>	<ul style="list-style-type: none"> <li>Understand and use whole number place values to represent and interpret numbers.</li> <li>Understand the concept of fractions, represent fractions and decimal fractions, and compare the sizes of whole numbers or fractions.</li> </ul>
<b>Measurement &amp; Data and Geometry</b>	<ul style="list-style-type: none"> <li>Understand geometric and measurement principles and apply them to describe objects and solve problems.</li> <li>Represent and analyze data in simple graphs.</li> </ul>
<b>Problem Solving, Reasoning, and Argument</b>	<ul style="list-style-type: none"> <li>Apply grade-level appropriate mathematical concepts and procedures and use quantitative and logical reasoning to solve standard and nonstandard real-world and mathematical problems.</li> <li>Construct viable arguments and critique the reasoning of others.</li> </ul>
<b>Modeling, Patterns, and Structure</b>	<ul style="list-style-type: none"> <li>Use grade-level appropriate quantitative reasoning to interpret mathematical representations, represent real-world mathematical situations using mathematical models, and use mathematical models to solve real-world and mathematical problems.</li> <li>Look for and make use of structure and repeated reasoning.</li> </ul>

**Table 2. Claims about the Meaning of Cognia Mathematics Assessment Scores, Grades 6–8**

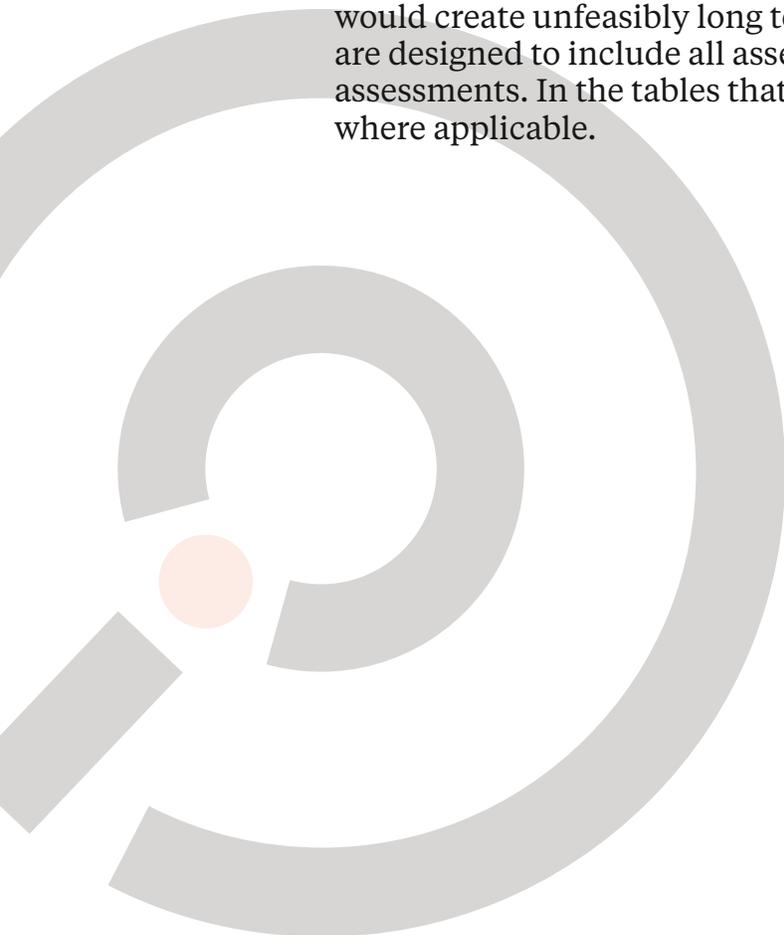
<b>Mathematics Claims—Grades 6–8</b> <b>Students who are At Standard or Above Standard in grades 6–8 can:</b>	
<b>Ratios &amp; Proportional Relationships (Grades 6–7)</b>	<ul style="list-style-type: none"> <li>Understand, represent, and interpret ratios and proportional relationships between variables (e.g., the relationship between miles driven and gallons of gasoline used) to solve problems.</li> </ul>
<b>Functions (Grade 8)</b>	<ul style="list-style-type: none"> <li>Understand the concept of functions and represent linear functions in equations, tables, and graphs.</li> <li>Compare properties of two functions and interpret linear and nonlinear functions presented in a variety of forms.</li> </ul>
<b>The Number System and Expressions &amp; Equations</b>	<ul style="list-style-type: none"> <li>Use expressions, equations, and inequalities to represent and solve mathematical and real-world problems.</li> <li>In grades 6 and 7, understand, represent, and compute with rational numbers (fractions and decimal fractions).</li> <li>In grade 8, understand and compare rational and irrational numbers.</li> </ul>
<b>Geometry</b>	<ul style="list-style-type: none"> <li>Understand and apply geometric properties related to area, surface area, volume, and angles to solve real-world and mathematical problems.</li> </ul>
<b>Statistics &amp; Probability</b>	<ul style="list-style-type: none"> <li>Represent and analyze data in a variety of plots and graphs and summarize and describe distributions using multiple measures.</li> </ul>
<b>Problem Solving, Reasoning, and Argument</b>	<ul style="list-style-type: none"> <li>Apply grade-level appropriate mathematical concepts and procedures and quantitative and logical reasoning to solve standard and nonstandard real-world and mathematical problems.</li> <li>Construct viable arguments and critique the reasoning of others.</li> </ul>
<b>Modeling, Patterns, and Structure</b>	<ul style="list-style-type: none"> <li>Use grade-level appropriate quantitative reasoning to interpret mathematical representations, represent real-world mathematical situations using mathematical models, and use mathematical models to solve real-world and mathematical problems.</li> <li>Look for and make use of structure and repeated reasoning.</li> </ul>

# Item Alignment and Cognitive Complexity Tables

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The following pages in this document present tables identifying standards alignment and DOK levels for mathematics items in representative Cognia Interim Assessment forms, by grade. These forms are similar to the content covered and item complexity in other administrations.

Please note: Some standards are broken down further into sub-standards. For example, 03.NF.01.03 is a standard, and 03.NF.01.03.b is a sub-standard. Items are written for Cognia Interim Assessments to address the standards level. Assessing every sub-standard on every assessment would create unfeasibly long tests. Cognia Interim Assessments are designed to include all assessable sub-standards over a series of assessments. In the tables that follow, the sub-standards are included, where applicable.



# Grade 3

**Table 3. Grade 3 Content Standards**

Domain	Cluster	Standard	Standard Code
Operations and Algebraic Thinking	Represent and solve problems involving multiplication and division.	Interpret products of whole numbers, e.g., interpret $5 \times 7$ as the total number of objects in 5 groups of 7 objects each. <i>For example, describe a context in which a total number of objects can be expressed as <math>5 \times 7</math>.</i>	03.OA.01.01
		Interpret whole-number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. <i>For example, describe a context in which a number of shares or a number of groups can be expressed as <math>56 \div 8</math>.</i>	03.OA.01.02
		Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.	03.OA.01.03
		Determine the unknown whole number in a multiplication or division equation relating three whole numbers. <i>For example, determine the unknown number that makes the equation true in each of the equations <math>8 \times ? = 48</math>, <math>5 = \_ \div 3</math>, <math>6 \times 6 = ?</math></i>	03.OA.01.04
	Understand properties of multiplication and the relationship between multiplication and division.	Apply properties of operations as strategies to multiply and divide.	03.OA.02.05
		Understand division as an unknown-factor problem. <i>For example, find <math>32 \div 8</math> by finding the number that makes 32 when multiplied by 8.</i>	03.OA.02.06
Operations and Algebraic Thinking	Multiply and divide within 100.	Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.	03.OA.03.07
	Solve problems involving the four operations and identify and explain patterns in arithmetic.	Solve two-step word problems using the four operations. 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.	03.OA.04.08
		Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. <i>For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.</i>	03.OA.04.09

Domain	Cluster	Standard	Standard Code
Number & Operations: Base Ten	Use place value and properties of operations to perform multi-digit arithmetic.	Use place value understanding to round whole numbers to the nearest 10 or 100.	03.NBT.01.01
		Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.	03.NBT.01.02
		Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., $9 \times 80$ , $5 \times 60$ ) using strategies based on place value and properties of operations.	03.NBT.01.03
Number & Operations: Fractions	Develop understanding of fractions as numbers.	Understand a fraction $1/b$ as the quantity formed by 1 part when a whole is partitioned into $b$ equal parts; understand a fraction $a/b$ as the quantity formed by $a$ parts of size $1/b$ .	03.NF.01.01
		Represent a fraction $1/b$ on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into $b$ equal parts. Recognize that each part has size $1/b$ and that the endpoint of the part based at 0 locates the number $1/b$ on the number line.	03.NF.01.02.a
		Recognize and generate simple equivalent fractions, e.g., $1/2 = 2/4$ , $4/6 = 2/3$ . Explain why the fractions are equivalent, e.g., by using a visual fraction model.	03.NF.01.03.b
		Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols $>$ , $=$ , or $<$ , and justify the conclusions, e.g., by using a visual fraction model.	03.NF.01.03.d

Domain	Cluster	Standard	Standard Code
Measurement & Data	Solve problems involving measurement of time, liquid volumes, and masses of objects.	Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes.	03.MD.01.01
		Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l) Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units.	03.MD.01.02
	Represent and interpret data.	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. <i>For example, draw a bar graph in which each square in the bar graph might represent 5 pets.</i>	03.MD.02.03
		Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.	03.MD.02.04
	Geometric measurement: understand concepts of area and relate area to multiplication and to addition.	Recognize area as an attribute of plane figures and understand concepts of area measurement.	03.MD.03.05
		Relate area to the operations of multiplication and addition. Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real-world problems.	03.MD.03.07.d
Geometric measurement: recognize area as an attribute of plane figures and distinguish between linear and area measures.	Solve real-world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.	03.MD.04.08	
Geometry	Reason with shapes and their attributes.	Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.	03.G.01.01
		Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. <i>For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.</i>	03.G.01.02

**Table 4. Grade 3 Process Standards**

<b>Practice Number</b>	<b>Mathematical Practice</b>	<b>Description</b>
1	Problem Solving	<p><u>Make sense of problems and persevere in solving them.</u></p> <p>Mathematically proficient students consider problems carefully before beginning the solution pathway. They analyze the givens, constraints, relationships and goals and then plan a solution pathway. Proficient students may try several different pathways or strategies to determine the best course of action. They use models, representations (e.g., diagrams, graphs, equations), and transformations between different representations to assist them in framing and solving problems. They evaluate their work as they proceed, and check their work once they think they've solved the problem. Proficient students can compare and contrast different strategies for solving the same problem and determine commonalities among different strategies.</p>
2	Quantitative Reasoning	<p><u>Reason abstractly and quantitatively.</u></p> <p>Mathematically proficient students consider the meanings of numbers as they solve problems. They can abstract numeric values from a situation and use operations flexibly on the symbolic representations of numbers to find solutions to problems; however, they keep in mind the contexts in which numbers are situated and the meanings of quantities and measures, in order to evaluate the viability of solutions.</p>
3	Argument	<p><u>Construct viable arguments and critique the reasoning of others.</u></p> <p>Mathematically proficient students understand and use assumptions, definitions, and results to construct mathematical arguments and to evaluate and respond to the mathematical arguments of others. They can reason inductively about data to draw conclusions within a given context. They can compare two plausible arguments, ask questions to clarify or improve their understanding of other's arguments, decide if other's arguments make sense, and identify flaws in other's arguments.</p>
4	Modeling	<p><u>Model with mathematics.</u></p> <p>Mathematically proficient students use models to develop designs, predict outcomes, describe phenomena, solve problems, and explain causes and effects. Their models reflect important quantities and relationships between quantities; their models can be used to draw conclusions within a mathematical situation and in arguments they develop to support claims. Proficient students improve models when models don't accurately represent a situation and adjust models when a situation changes.</p>
7	Structure	<p><u>Look for and make use of structure.</u></p> <p>Mathematically proficient students can abstract patterns and structures from mathematical representations and real-world mathematical situations by breaking complicated mathematical information down into smaller parts as well as stepping back to the bigger picture to find consistent patterns and structures.</p>
8	Patterns	<p><u>Look for and express regularity in repeated reasoning.</u></p> <p>Mathematically proficient students can abstract general principles (e.g., linear equations, formulas) from repeated phenomena; abstract repeated patterns in numbers.</p>

**Table 5. Grade 3 Cognitive Complexity**

<b>DOK Level Number</b>	<b>Depth of Knowledge Level</b>	<b>Description</b>
<b>1</b>	Recall & Reproduction	Level 1 items involve basic tasks that require students to recall or reproduce knowledge and/or rote skills; one-step, well defined, and straight algorithmic procedures; simple descriptions or explanations. Key verbs include identify, recall, recognize, use, and measure.
<b>2</b>	Skill/Concept	Level 2 items generally require students to make some decisions as to how to approach the problem or activity; compare and/or differentiate; apply multiple concepts when responding; classify information into meaningful categories, describe or explain relationships, provide and explain examples and non-examples; collect and display data; and/or interpret information read from a simple representation such as an equation or graph. Key verbs include solve, apply, classify, describe, explain, display, demonstrate, and construct.
<b>3</b>	Strategic Thinking & Reasoning	Level 3 items and tasks require the use of planning, reasoning, using evidence, justifying responses, and higher order thinking processes, such as analysis and evaluation, to solve real-world problems or explore questions with multiple possible outcomes, drawing conclusions from observations, citing evidence, and developing a logical argument, explaining phenomena. Some verbs relevant to Level 3 include: develop a logical argument, construct, apprise, compare, investigate, critique, formulate, hypothesize, cite evidence, differentiate, draw conclusions, solve non-routine problems, and investigate.

# Grade 4

**Table 6. Grade 4 Content Standards**

Domain	Cluster	Standard	Standard Code
Operations and Algebraic Thinking	Use the four operations with whole numbers to solve problems.	Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.	04.OA.01.01
		Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.	04.OA.01.02
		Solve multistep word problems 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.	04.OA.01.03
	Gain familiarity with factors and multiples.	Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite.	04.OA.02.04
	Generate and analyze patterns.	Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. <i>For example, given the rule “Add 3” and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.</i>	04.OA.03.05
	Number & Operations: Base Ten	Generalize place value understanding for multi-digit whole numbers.	Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. <i>For example, recognize that <math>700 \div 70 = 10</math> by applying concepts of place value and division.</i>
Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using $>$ , $=$ , and $<$ symbols to record the results of comparisons.			04.NBT.01.02
Use place value understanding to round multi-digit whole numbers to any place.			04.NBT.01.03
Use place value understanding and properties of operations to perform multi-digit arithmetic.		Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	04.NBT.02.05
		Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	04.NBT.02.06

Domain	Cluster	Standard	Standard Code
Number & Operations: Fractions	Extend understanding of fraction equivalence and ordering.	Explain why a fraction $a/b$ is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.	04.NF.01.01
		Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as $1/2$ . Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols $>$ , $=$ , or $<$ , and justify the conclusions, e.g., by using a visual fraction model.	04.NF.01.02
	Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.	Understand a fraction $a/b$ with $a > 1$ as a sum of fractions $1/b$ . Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.	04.NF.02.03
		Understand a multiple of $a/b$ as a multiple of $1/b$ , and use this understanding to multiply a fraction by a whole number. <i>For example, use a visual fraction model to express <math>3 \times (2/5)</math> as <math>6 \times (1/5)</math>, recognizing this product as <math>6/5</math>. (In general, <math>n \times (a/b) = (n \times a)/b</math>.)</i>	04.NF.02.04.b
	Understand decimal notation for fractions, and compare decimal fractions.	Use decimal notation for fractions with denominators 10 or 100. <i>For example, rewrite 0.62 as <math>62/100</math>; describe a length as 0.62 meters; locate 0.62 on a number line diagram.</i>	04.NF.03.06
		Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols $>$ , $=$ , or $<$ , and justify the conclusions, e.g., by using a visual model.	04.NF.03.07

Domain	Cluster	Standard	Standard Code
Measurement & Data	Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. <i>For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...</i>	04.MD.01.01
		Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.	04.MD.01.02
		Apply the area and perimeter formulas for rectangles in real-world and mathematical problems. <i>For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.</i>	04.MD.01.03
	Represent and interpret data.	Make a line plot to display a data set of measurements in fractions of a unit ( $\frac{1}{2}$ , $\frac{1}{4}$ , $\frac{1}{8}$ ). Solve problems involving addition and subtraction of fractions by using information presented in line plots. <i>For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.</i>	04.MD.02.04
	Geometric measurement: understand concepts of angle and measure angles.	Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.	04.MD.03.06
		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 problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.	04.MD.03.07
Geometry	Draw and identify lines and angles, and classify shapes by properties of their lines and angles.	Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.	04.G.01.01
		Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.	04.G.01.02
		Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.	04.G.01.03

**Table 7. Grade 4 Process Standards**

<b>Practice Number</b>	<b>Mathematical Practice</b>	<b>Description</b>
1	Problem Solving	<p><u>Make sense of problems and persevere in solving them.</u></p> <p>Mathematically proficient students consider problems carefully before beginning the solution pathway. They analyze the givens, constraints, relationships and goals and then plan a solution pathway. Proficient students may try several different pathways or strategies to determine the best course of action. They use models, representations (e.g., diagrams, graphs, equations), and transformations between different representations to assist them in framing and solving problems. They evaluate their work as they proceed, and check their work once they think they've solved the problem. Proficient students can compare and contrast different strategies for solving the same problem and determine commonalities among different strategies.</p>
2	Quantitative Reasoning	<p><u>Reason abstractly and quantitatively.</u></p> <p>Mathematically proficient students consider the meanings of numbers as they solve problems. They can abstract numeric values from a situation and use operations flexibly on the symbolic representations of numbers to find solutions to problems; however, they keep in mind the contexts in which numbers are situated and the meanings of quantities and measures, in order to evaluate the viability of solutions.</p>
3	Argument	<p><u>Construct viable arguments and critique the reasoning of others.</u></p> <p>Mathematically proficient students understand and use assumptions, definitions, and results to construct mathematical arguments and to evaluate and respond to the mathematical arguments of others. They can reason inductively about data to draw conclusions within a given context. They can compare two plausible arguments, ask questions to clarify or improve their understanding of other's arguments, decide if other's arguments make sense, and identify flaws in other's arguments.</p>
4	Modeling	<p><u>Model with mathematics.</u></p> <p>Mathematically proficient students use models to develop designs, predict outcomes, describe phenomena, solve problems, and explain causes and effects. Their models reflect important quantities and relationships between quantities; their models can be used to draw conclusions within a mathematical situation and in arguments they develop to support claims. Proficient students improve models when models don't accurately represent a situation and adjust models when a situation changes.</p>
7	Structure	<p><u>Look for and make use of structure.</u></p> <p>Mathematically proficient students can abstract patterns and structures from mathematical representations and real-world mathematical situations by breaking complicated mathematical information down into smaller parts as well as stepping back to the bigger picture to find consistent patterns and structures.</p>
8	Patterns	<p><u>Look for and express regularity in repeated reasoning.</u></p> <p>Mathematically proficient students can abstract general principles (e.g., linear equations, formulas) from repeated phenomena; abstract repeated patterns in numbers.</p>

**Table 8. Grade 4 Cognitive Complexity**

<b>DOK Level Number</b>	<b>Depth of Knowledge Level</b>	<b>Description</b>
<b>1</b>	Recall & Reproduction	Level 1 items involve basic tasks that require students to recall or reproduce knowledge and/or rote skills; one-step, well defined, and straight algorithmic procedures; simple descriptions or explanations. Key verbs include identify, recall, recognize, use, and measure.
<b>2</b>	Skill/Concept	Level 2 items generally require students to make some decisions as to how to approach the problem or activity; compare and/or differentiate; apply multiple concepts when responding; classify information into meaningful categories, describe or explain relationships, provide and explain examples and non-examples; collect and display data; and/or interpret information read from a simple representation such as an equation or graph. Key verbs include solve, apply, classify, describe, explain, display, demonstrate, and construct.
<b>3</b>	Strategic Thinking & Reasoning	Level 3 items and tasks require the use of planning, reasoning, using evidence, justifying responses, and higher order thinking processes, such as analysis and evaluation, to solve real-world problems or explore questions with multiple possible outcomes, drawing conclusions from observations, citing evidence, and developing a logical argument, explaining phenomena. Some verbs relevant to Level 3 include: develop a logical argument, construct, apprise, compare, investigate, critique, formulate, hypothesize, cite evidence, differentiate, draw conclusions, solve non-routine problems, and investigate.

# Grade 5

**Table 9. Grade 5 Content Standards**

Domain	Cluster	Standard	Standard Code
Operations and Algebraic Thinking	Write and interpret numerical expressions.	Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.	05.OA.01.01
		Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. <i>For example, express the calculation “add 8 and 7, then multiply by 2” as <math>2 \times (8 + 7)</math>. Recognize that <math>3 \times (18932 + 921)</math> is three times as large as <math>18932 + 921</math>, without having to calculate the indicated sum or product.</i>	05.OA.01.02
	Analyze patterns and relationships.	Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. <i>For example, given the rule Add 3 and the starting number 0, and given the rule Add 6 and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.</i>	05.OA.02.03
Number & Operations: Base Ten	Understand the place value system.	Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.	05.NBT.01.01
		Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.	05.NBT.01.02
	Perform operations with multi-digit whole numbers and with decimals to hundredths.	Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	05.NBT.02.06
		Add, subtract, multiply, and divide decimals to hundredths, 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.	05.NBT.02.07

Domain	Cluster	Standard	Standard Code
Number & Operations: Fractions	Use equivalent fractions as a strategy to add and subtract fractions.	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. <i>For example, <math>\frac{2}{3} + \frac{5}{4} = \frac{8}{12} + \frac{15}{12} = \frac{23}{12}</math>. (In general, <math>\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}</math>.)</i>	05.NF.01.01
		Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. <i>For example, recognize an incorrect result <math>\frac{2}{5} + \frac{1}{2} = \frac{3}{7}</math>, by observing that <math>\frac{3}{7} &lt; \frac{1}{2}</math>.</i>	05.NF.01.02
	Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.	05.NF.02.04.b
		Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $\frac{a}{b} = \frac{n \times a}{n \times b}$ to the effect of multiplying $\frac{a}{b}$ by 1.	05.NF.02.05.b
		Solve real-world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.	05.NF.02.06
		Solve real-world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. <i>For example, how much chocolate will each person get if 3 people share <math>\frac{1}{2}</math> lb of chocolate equally? How many <math>\frac{1}{3}</math>-cup servings are in 2 cups of raisins?</i>	05.NF.02.07.c

Domain	Cluster	Standard	Standard Code
Measurement & Data	Convert like measurement units within a given measurement system.	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.	05.MD.01.01
	Represent and interpret data.	Make a line plot to display a data set of measurements in fractions of a unit ( $\frac{1}{2}$ , $\frac{1}{4}$ , $\frac{1}{8}$ ). Use operations on fractions for this grade to solve problems involving information presented in line plots. <i>For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.</i>	05.MD.02.02
	Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.	05.MD.03.03.a
		Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.	05.MD.03.04
		Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole number edge lengths in the context of solving real-world and mathematical problems.	05.MD.03.05.b
	Geometry	Graph points on the coordinate plane to solve real-world and mathematical problems.	Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).
Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.			05.G.01.02
Classify two-dimensional figures into categories based on their properties.		Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. <i>For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.</i>	05.G.02.03
		Classify two-dimensional figures in a hierarchy based on properties.	05.G.02.04

**Table 10. Grade 5 Process Standards**

<b>Practice Number</b>	<b>Mathematical Practice</b>	<b>Description</b>
1	Problem Solving	<p><u>Make sense of problems and persevere in solving them.</u></p> <p>Mathematically proficient students consider problems carefully before beginning the solution pathway. They analyze the givens, constraints, relationships and goals and then plan a solution pathway. Proficient students may try several different pathways or strategies to determine the best course of action. They use models, representations (e.g., diagrams, graphs, equations), and transformations between different representations to assist them in framing and solving problems. They evaluate their work as they proceed, and check their work once they think they've solved the problem. Proficient students can compare and contrast different strategies for solving the same problem and determine commonalities among different strategies.</p>
2	Quantitative Reasoning	<p><u>Reason abstractly and quantitatively.</u></p> <p>Mathematically proficient students consider the meanings of numbers as they solve problems. They can abstract numeric values from a situation and use operations flexibly on the symbolic representations of numbers to find solutions to problems; however, they keep in mind the contexts in which numbers are situated and the meanings of quantities and measures, in order to evaluate the viability of solutions.</p>
3	Argument	<p><u>Construct viable arguments and critique the reasoning of others.</u></p> <p>Mathematically proficient students understand and use assumptions, definitions, and results to construct mathematical arguments and to evaluate and respond to the mathematical arguments of others. They can reason inductively about data to draw conclusions within a given context. They can compare two plausible arguments, ask questions to clarify or improve their understanding of other's arguments, decide if other's arguments make sense, and identify flaws in other's arguments.</p>
4	Modeling	<p><u>Model with mathematics.</u></p> <p>Mathematically proficient students use models to develop designs, predict outcomes, describe phenomena, solve problems, and explain causes and effects. Their models reflect important quantities and relationships between quantities; their models can be used to draw conclusions within a mathematical situation and in arguments they develop to support claims. Proficient students improve models when models don't accurately represent a situation and adjust models when a situation changes.</p>
7	Structure	<p><u>Look for and make use of structure.</u></p> <p>Mathematically proficient students can abstract patterns and structures from mathematical representations and real-world mathematical situations by breaking complicated mathematical information down into smaller parts as well as stepping back to the bigger picture to find consistent patterns and structures.</p>
8	Patterns	<p><u>Look for and express regularity in repeated reasoning.</u></p> <p>Mathematically proficient students can abstract general principles (e.g., linear equations, formulas) from repeated phenomena; abstract repeated patterns in numbers.</p>

**Table 11. Grade 5 Cognitive Complexity**

<b>DOK Level Number</b>	<b>Depth of Knowledge Level</b>	<b>Description</b>
<b>1</b>	Recall & Reproduction	Level 1 items involve basic tasks that require students to recall or reproduce knowledge and/or rote skills; one-step, well defined, and straight algorithmic procedures; simple descriptions or explanations. Key verbs include identify, recall, recognize, use, and measure.
<b>2</b>	Skill/Concept	Level 2 items generally require students to make some decisions as to how to approach the problem or activity; compare and/or differentiate; apply multiple concepts when responding; classify information into meaningful categories, describe or explain relationships, provide and explain examples and non-examples; collect and display data; and/or interpret information read from a simple representation such as an equation or graph. Key verbs include solve, apply, classify, describe, explain, display, demonstrate, and construct.
<b>3</b>	Strategic Thinking & Reasoning	Level 3 items and tasks require the use of planning, reasoning, using evidence, justifying responses, and higher order thinking processes, such as analysis and evaluation, to solve real-world problems or explore questions with multiple possible outcomes, drawing conclusions from observations, citing evidence, and developing a logical argument, explaining phenomena. Some verbs relevant to Level 3 include: develop a logical argument, construct, apprise, compare, investigate, critique, formulate, hypothesize, cite evidence, differentiate, draw conclusions, solve non-routine problems, and investigate.

# Grade 6

**Table 12. Grade 6 Content Standards**

Domain	Cluster	Standard	Standard Code
Ratios & Proportional Relationships	Understand ratio concepts and use ratio reasoning to solve problems.	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. <i>For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.”</i> “For every vote candidate A received, candidate C received nearly three votes.”	06.RP.01.01
		Understand the concept of a unit rate $a/b$ associated with a ratio $a:b$ with $b \neq 0$ , and use rate language in the context of a ratio relationship. <i>For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is <math>3/4</math> cup of flour for each cup of sugar.” “We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger.”</i>	06.RP.01.02
		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.	06.RP.01.03.a
		Solve unit rate problems including those involving unit pricing and constant speed. <i>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 rate were lawns being mowed?</i>	06.RP.01.03.b
		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.	06.RP.01.03.c
		Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.	06.RP.01.03.d

Domain	Cluster	Standard	Standard Code
The Number System	Apply and extend previous understandings of multiplication and division to divide fractions by fractions.	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. <i>For example, create a story context for <math>(2/3) \div (3/4)</math> and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that <math>(2/3) \div (3/4) = 8/9</math> because <math>3/4</math> of <math>8/9</math> is <math>2/3</math>. (In general, <math>(a/b) \div (c/d) = ad/bc</math>.) How much chocolate will each person get if 3 people share <math>1/2</math> lb of chocolate equally? How many <math>3/4</math>-cup servings are in <math>2/3</math> of a cup of yogurt? How wide is a rectangular strip of land with length <math>3/4</math> mi and area <math>1/2</math> square mi?</i>	06.NS.01.01
	Compute fluently with multi-digit numbers and find common factors and multiples.	Fluently divide multi-digit numbers using the standard algorithm.	06.NS.02.02
		Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. <i>For example, express <math>36 + 8</math> as <math>4(9 + 2)</math>.</i>	06.NS.02.04
	Apply and extend previous understandings of numbers to the system of rational numbers.	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.	06.NS.03.05
		Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.	06.NS.03.06.c
		Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. <i>For example, interpret <math>-3 &gt; -7</math> as a statement that <math>-3</math> is located to the right of <math>-7</math> on a number line oriented from left to right.</i>	06.NS.03.07.a
		Write, interpret, and explain statements of order for rational numbers in real-world contexts. <i>For example, write <math>-3^{\circ}\text{C} &gt; -7^{\circ}\text{C}</math> to express the fact that <math>-3^{\circ}\text{C}</math> is warmer than <math>-7^{\circ}\text{C}</math>.</i>	06.NS.03.07.b
		Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.	06.NS.03.08

Domain	Cluster	Standard	Standard Code
Expressions & Equations	Apply and extend previous understandings of arithmetic to algebraic expressions.	Write and evaluate numerical expressions involving whole-number exponents.	06.EE.01.01
		Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. <i>For example, describe the expression <math>2(8 + 7)</math> as a product of two factors; view <math>(8 + 7)</math> as both a single entity and a sum of two terms.</i>	06.EE.01.02.b
		Apply the properties of operations to generate equivalent expressions. <i>For example, apply the distributive property to the expression <math>3(2 + x)</math> to produce the equivalent expression <math>6 + 3x</math>; apply the distributive property to the expression <math>24x + 18y</math> to produce the equivalent expression <math>6(4x + 3y)</math>; apply properties of operations to <math>y + y + y</math> to produce the equivalent expression <math>3y</math>.</i>	06.EE.01.03
	Reason about and solve one-variable equations and inequalities.	Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.	06.EE.02.05
		Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which $p$ , $q$ , and $x$ are all nonnegative rational numbers.	06.EE.02.07
		Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.	06.EE.02.08
	Represent and analyze quantitative relationships between dependent and independent variables.	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. <i>For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation <math>d = 65t</math> to represent the relationship between distance and time.</i>	06.EE.03.09

Domain	Cluster	Standard	Standard Code
Geometry	Solve real-world and mathematical problems involving area, surface area, and volume.	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.	06.G.01.01
		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 $V = lwh$ and $V = bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	06.G.01.02
		Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.	06.G.01.03
		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.	06.G.01.04
Statistics & Probability	Develop understanding of statistical variability.	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. <i>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.</i>	06.SP.01.01
		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.	06.SP.01.02
		Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.	06.SP.01.03
	Summarize and describe distributions.	Summarize numerical data sets in relation to their context.	06.SP.02.05
		Summarize numerical data sets in relation to their context, such as by: Giving 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.	06.SP.02.05.c

**Table 13. Grade 6 Process Standards**

<b>Practice Number</b>	<b>Mathematical Practice</b>	<b>Description</b>
1	Problem Solving	<p><u>Make sense of problems and persevere in solving them.</u></p> <p>Mathematically proficient students consider problems carefully before beginning the solution pathway. They analyze the givens, constraints, relationships and goals and then plan a solution pathway. Proficient students may try several different pathways or strategies to determine the best course of action. They use models, representations (e.g., diagrams, graphs, equations), and transformations between different representations to assist them in framing and solving problems. They evaluate their work as they proceed, and check their work once they think they've solved the problem. Proficient students can compare and contrast different strategies for solving the same problem and determine commonalities among different strategies.</p>
2	Quantitative Reasoning	<p><u>Reason abstractly and quantitatively.</u></p> <p>Mathematically proficient students consider the meanings of numbers as they solve problems. They can abstract numeric values from a situation and use operations flexibly on the symbolic representations of numbers to find solutions to problems; however, they keep in mind the contexts in which numbers are situated and the meanings of quantities and measures, in order to evaluate the viability of solutions.</p>
3	Argument	<p><u>Construct viable arguments and critique the reasoning of others.</u></p> <p>Mathematically proficient students understand and use assumptions, definitions, and results to construct mathematical arguments and to evaluate and respond to the mathematical arguments of others. They can reason inductively about data to draw conclusions within a given context. They can compare two plausible arguments, ask questions to clarify or improve their understanding of other's arguments, decide if other's arguments make sense, and identify flaws in other's arguments.</p>
4	Modeling	<p><u>Model with mathematics.</u></p> <p>Mathematically proficient students use models to develop designs, predict outcomes, describe phenomena, solve problems, and explain causes and effects. Their models reflect important quantities and relationships between quantities; their models can be used to draw conclusions within a mathematical situation and in arguments they develop to support claims. Proficient students improve models when models don't accurately represent a situation and adjust models when a situation changes.</p>
7	Structure	<p><u>Look for and make use of structure.</u></p> <p>Mathematically proficient students can abstract patterns and structures from mathematical representations and real-world mathematical situations by breaking complicated mathematical information down into smaller parts as well as stepping back to the bigger picture to find consistent patterns and structures.</p>
8	Patterns	<p><u>Look for and express regularity in repeated reasoning.</u></p> <p>Mathematically proficient students can abstract general principles (e.g., linear equations, formulas) from repeated phenomena; abstract repeated patterns in numbers.</p>

**Table 14. Grade 6 Cognitive Complexity**

<b>DOK Level Number</b>	<b>Depth of Knowledge Level</b>	<b>Description</b>
<b>1</b>	Recall & Reproduction	Level 1 items involve basic tasks that require students to recall or reproduce knowledge and/or rote skills; one-step, well defined, and straight algorithmic procedures; simple descriptions or explanations. Key verbs include identify, recall, recognize, use, and measure.
<b>2</b>	Skill/Concept	Level 2 items generally require students to make some decisions as to how to approach the problem or activity; compare and/or differentiate; apply multiple concepts when responding; classify information into meaningful categories, describe or explain relationships, provide and explain examples and non-examples; collect and display data; and/or interpret information read from a simple representation such as an equation or graph. Key verbs include solve, apply, classify, describe, explain, display, demonstrate, and construct.
<b>3</b>	Strategic Thinking & Reasoning	Level 3 items and tasks require the use of planning, reasoning, using evidence, justifying responses, and higher order thinking processes, such as analysis and evaluation, to solve real-world problems or explore questions with multiple possible outcomes, drawing conclusions from observations, citing evidence, and developing a logical argument, explaining phenomena. Some verbs relevant to Level 3 include: develop a logical argument, construct, apprise, compare, investigate, critique, formulate, hypothesize, cite evidence, differentiate, draw conclusions, solve non-routine problems, and investigate.

# Grade 7

**Table 15. Grade 7 Content Standards**

Domain	Cluster	Standard	Standard Code
Ratios & Proportional Relationships	Analyze proportional relationships and use them to solve real-world and mathematical problems.	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. <i>For example, if a person walks <math>1/2</math> mile in each <math>1/4</math> hour, compute the unit rate as the complex fraction <math>1/2/1/4</math> miles per hour, equivalently 2 miles per hour.</i>	07.RP.01.01
		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.	07.RP.01.02.a
		Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.	07.RP.01.02.b
		Represent proportional relationships by equations. <i>For example, if total cost <math>t</math> is proportional to the number <math>n</math> of items purchased at a constant price <math>p</math>, the relationship between the total cost and the number of items can be expressed as <math>t = pn</math>.</i>	07.RP.01.02.c
		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.	07.RP.01.02.d
		Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.	07.RP.01.03
The Number System	Apply and extend previous understandings of operations with fractions.	Describe situations in which opposite quantities combine to make 0. <i>For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.</i>	07.NS.01.01.a
		Apply properties of operations as strategies to add and subtract rational numbers.	07.NS.01.01.d
		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.	07.NS.01.02.a
		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.	07.NS.01.02.d
		Solve real-world and mathematical problems involving the four operations with rational numbers.	07.NS.01.03

Domain	Cluster	Standard	Standard Code
Expressions & Equations	Use properties of operations to generate equivalent expressions.	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.	07.EE.01.01
		Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. <i>For example, <math>a + 0.05a = 1.05a</math> means that “increase by 5%” is the same as “multiply by 1.05.”</i>	07.EE.01.02
	Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	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. <i>For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 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 <math>9\frac{3}{4}</math> inches long in the center of a door that is <math>27\frac{1}{2}</math> 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.</i>	07.EE.02.03
	Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	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. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</i>	07.EE.02.04.a
		Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$ , 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. <i>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.</i>	07.EE.02.04.b

<b>Domain</b>	<b>Cluster</b>	<b>Standard</b>	<b>Standard Code</b>
<b>Geometry</b>	Draw, construct, and describe geometrical figures and describe the relationships between them.	Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	07.G.01.01
		Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.	07.G.01.02
	Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.	07.G.02.04
		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.	07.G.02.05
		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.	07.G.02.06

Domain	Cluster	Standard	Standard Code
Statistics & Probability	Use random sampling to draw inferences about a population.	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.	07.SP.01.01
		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. <i>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. Gauge how far off the estimate or prediction might be.</i>	07.SP.01.02
	Draw informal comparative inferences about two populations.	Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. <i>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.</i>	07.SP.02.04
	Investigate chance processes and develop, use, and evaluate probability models.	Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	07.SP.03.05
		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.	07.SP.03.07
		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 which compose the event.	07.SP.03.08.b
		Design and use a simulation to generate frequencies for compound events. <i>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?</i>	07.SP.03.08.c

**Table 16. Grade 7 Process Standards**

<b>Practice Number</b>	<b>Mathematical Practice</b>	<b>Description</b>
1	Problem Solving	<p><u>Make sense of problems and persevere in solving them.</u></p> <p>Mathematically proficient students consider problems carefully before beginning the solution pathway. They analyze the givens, constraints, relationships and goals and then plan a solution pathway. Proficient students may try several different pathways or strategies to determine the best course of action. They use models, representations (e.g., diagrams, graphs, equations), and transformations between different representations to assist them in framing and solving problems. They evaluate their work as they proceed, and check their work once they think they've solved the problem. Proficient students can compare and contrast different strategies for solving the same problem and determine commonalities among different strategies.</p>
2	Quantitative Reasoning	<p><u>Reason abstractly and quantitatively.</u></p> <p>Mathematically proficient students consider the meanings of numbers as they solve problems. They can abstract numeric values from a situation and use operations flexibly on the symbolic representations of numbers to find solutions to problems; however, they keep in mind the contexts in which numbers are situated and the meanings of quantities and measures, in order to evaluate the viability of solutions.</p>
3	Argument	<p><u>Construct viable arguments and critique the reasoning of others.</u></p> <p>Mathematically proficient students understand and use assumptions, definitions, and results to construct mathematical arguments and to evaluate and respond to the mathematical arguments of others. They can reason inductively about data to draw conclusions within a given context. They can compare two plausible arguments, ask questions to clarify or improve their understanding of other's arguments, decide if other's arguments make sense, and identify flaws in other's arguments.</p>
4	Modeling	<p><u>Model with mathematics.</u></p> <p>Mathematically proficient students use models to develop designs, predict outcomes, describe phenomena, solve problems, and explain causes and effects. Their models reflect important quantities and relationships between quantities; their models can be used to draw conclusions within a mathematical situation and in arguments they develop to support claims. Proficient students improve models when models don't accurately represent a situation and adjust models when a situation changes.</p>
7	Structure	<p><u>Look for and make use of structure.</u></p> <p>Mathematically proficient students can abstract patterns and structures from mathematical representations and real-world mathematical situations by breaking complicated mathematical information down into smaller parts as well as stepping back to the bigger picture to find consistent patterns and structures.</p>
8	Patterns	<p><u>Look for and express regularity in repeated reasoning.</u></p> <p>Mathematically proficient students can abstract general principles (e.g., linear equations, formulas) from repeated phenomena; abstract repeated patterns in numbers.</p>

**Table 17. Grade 7 Cognitive Complexity**

<b>DOK Level Number</b>	<b>Depth of Knowledge Level</b>	<b>Description</b>
<b>1</b>	Recall & Reproduction	Level 1 items involve basic tasks that require students to recall or reproduce knowledge and/or rote skills; one-step, well defined, and straight algorithmic procedures; simple descriptions or explanations. Key verbs include identify, recall, recognize, use, and measure.
<b>2</b>	Skill/Concept	Level 2 items generally require students to make some decisions as to how to approach the problem or activity; compare and/or differentiate; apply multiple concepts when responding; classify information into meaningful categories, describe or explain relationships, provide and explain examples and non-examples; collect and display data; and/or interpret information read from a simple representation such as an equation or graph. Key verbs include solve, apply, classify, describe, explain, display, demonstrate, and construct.
<b>3</b>	Strategic Thinking & Reasoning	Level 3 items and tasks require the use of planning, reasoning, using evidence, justifying responses, and higher order thinking processes, such as analysis and evaluation, to solve real-world problems or explore questions with multiple possible outcomes, drawing conclusions from observations, citing evidence, and developing a logical argument, explaining phenomena. Some verbs relevant to Level 3 include: develop a logical argument, construct, apprise, compare, investigate, critique, formulate, hypothesize, cite evidence, differentiate, draw conclusions, solve non-routine problems, and investigate.

# Grade 8

**Table 18. Grade 8 Content Standards**

Domain	Cluster	Standard	Standard Code
The Number System	Know that there are numbers that are not rational, and approximate them by rational numbers.	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.	08.NS.01.01
		Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., $\pi^2$ ). <i>For example, by truncating the decimal expansion of <math>\sqrt{2}</math>, show that <math>\sqrt{2}</math> is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.</i>	08.NS.01.02
Expressions & Equations	Work with radicals and integer exponents.	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.	08.EE.01.04
	Understand the connections between proportional relationships, lines, and linear equations.	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. <i>For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.</i>	08.EE.02.05
		Use similar triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ .	08.EE.02.06
	Analyze and solve linear equations and pairs of simultaneous linear equations.	Solve linear equations in one variable.	08.EE.03.07
		Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$ , $a = a$ , or $a = b$ results (where $a$ and $b$ are different numbers).	08.EE.03.07.a
		Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.	08.EE.03.08.a
		Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. <i>For example, <math>3x + 2y = 5</math> and <math>3x + 2y = 6</math> have no solution because <math>3x + 2y</math> cannot simultaneously be 5 and 6.</i>	08.EE.03.08.b

Domain	Cluster	Standard	Standard Code
Functions	Define, evaluate, and compare functions.	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	08.F.01.01
		Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.</i>	08.F.01.02
		Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. <i>For example, the function <math>A = s^2</math> giving the area of a square as a function of its side length is not linear because its graph contains the points <math>(1,1)</math>, <math>(2,4)</math> and <math>(3,9)</math>, which are not on a straight line.</i>	08.F.01.03
	Use functions to model relationships between quantities.	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two $(x, y)$ values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	08.F.02.04
		Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	08.F.02.05
Geometry	Understand congruence and similarity using physical models, transparencies, or geometry software.	Verify experimentally the properties of rotations, reflections, and translations: Angles are taken to angles of the same measure.	08.G.01.01.b
		Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.	08.G.01.02
		Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	08.G.01.03
		Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. <i>For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.</i>	08.G.01.05

Domain	Cluster	Standard	Standard Code
Geometry	Understand and apply the Pythagorean Theorem.	Explain a proof of the Pythagorean Theorem and its converse.	08.G.02.06
		Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.	08.G.02.07
	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	08.G.03.09
Statistics & Probability	Investigate patterns of association in bivariate data.	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	08.SP.01.01
		Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.	08.SP.01.02
		Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. <i>For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.</i>	08.SP.01.03
		Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. <i>For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?</i>	08.SP.01.04

**Table 19. Grade 8 Process Standards**

<b>Practice Number</b>	<b>Mathematical Practice</b>	<b>Description</b>
1	Problem Solving	<p><u>Make sense of problems and persevere in solving them.</u></p> <p>Mathematically proficient students consider problems carefully before beginning the solution pathway. They analyze the givens, constraints, relationships and goals and then plan a solution pathway. Proficient students may try several different pathways or strategies to determine the best course of action. They use models, representations (e.g., diagrams, graphs, equations), and transformations between different representations to assist them in framing and solving problems. They evaluate their work as they proceed, and check their work once they think they've solved the problem. Proficient students can compare and contrast different strategies for solving the same problem and determine commonalities among different strategies.</p>
2	Quantitative Reasoning	<p><u>Reason abstractly and quantitatively.</u></p> <p>Mathematically proficient students consider the meanings of numbers as they solve problems. They can abstract numeric values from a situation and use operations flexibly on the symbolic representations of numbers to find solutions to problems; however, they keep in mind the contexts in which numbers are situated and the meanings of quantities and measures, in order to evaluate the viability of solutions.</p>
3	Argument	<p><u>Construct viable arguments and critique the reasoning of others.</u></p> <p>Mathematically proficient students understand and use assumptions, definitions, and results to construct mathematical arguments and to evaluate and respond to the mathematical arguments of others. They can reason inductively about data to draw conclusions within a given context. They can compare two plausible arguments, ask questions to clarify or improve their understanding of other's arguments, decide if other's arguments make sense, and identify flaws in other's arguments.</p>
4	Modeling	<p><u>Model with mathematics.</u></p> <p>Mathematically proficient students use models to develop designs, predict outcomes, describe phenomena, solve problems, and explain causes and effects. Their models reflect important quantities and relationships between quantities; their models can be used to draw conclusions within a mathematical situation and in arguments they develop to support claims. Proficient students improve models when models don't accurately represent a situation and adjust models when a situation changes.</p>
7	Structure	<p><u>Look for and make use of structure.</u></p> <p>Mathematically proficient students can abstract patterns and structures from mathematical representations and real-world mathematical situations by breaking complicated mathematical information down into smaller parts as well as stepping back to the bigger picture to find consistent patterns and structures.</p>
8	Patterns	<p><u>Look for and express regularity in repeated reasoning.</u></p> <p>Mathematically proficient students can abstract general principles (e.g., linear equations, formulas) from repeated phenomena; abstract repeated patterns in numbers.</p>

**Table 20. Grade 8 Cognitive Complexity**

<b>DOK Level Number</b>	<b>Depth of Knowledge Level</b>	<b>Description</b>
<b>1</b>	Recall & Reproduction	Level 1 items involve basic tasks that require students to recall or reproduce knowledge and/or rote skills; one-step, well defined, and straight algorithmic procedures; simple descriptions or explanations. Key verbs include identify, recall, recognize, use, and measure.
<b>2</b>	Skill/Concept	Level 2 items generally require students to make some decisions as to how to approach the problem or activity; compare and/or differentiate; apply multiple concepts when responding; classify information into meaningful categories, describe or explain relationships, provide and explain examples and non-examples; collect and display data; and/or interpret information read from a simple representation such as an equation or graph. Key verbs include solve, apply, classify, describe, explain, display, demonstrate, and construct.
<b>3</b>	Strategic Thinking & Reasoning	Level 3 items and tasks require the use of planning, reasoning, using evidence, justifying responses, and higher order thinking processes, such as analysis and evaluation, to solve real-world problems or explore questions with multiple possible outcomes, drawing conclusions from observations, citing evidence, and developing a logical argument, explaining phenomena. Some verbs relevant to Level 3 include: develop a logical argument, construct, apprise, compare, investigate, critique, formulate, hypothesize, cite evidence, differentiate, draw conclusions, solve non-routine problems, and investigate.



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