

Math Performance Standards (Grade Level Expectations) Grade 9

Each PSGLE includes a bolded statement called the "stem." Each stem is the same or similar across the grades for a given PSGLE and is meant to communicate the main curriculum and instructional focus of the PSGLE across the grades.

The first row of each table includes a heading that refers to the content standard, and the second row includes a heading that refers to the performance standard. (The content standard is a broad statement of what students should know; the performance standards state what students should know and be able to do at ages 5-7, 8-10, 11-14, and 15-18.) The second box includes the complete performance standards.

The coding indicates the content strand and the PSGLE number, so PSGLE [6] N-1 is content strand Numeration, and the first PSGLE for that content strand for grade 6.

Content Standard A: Mathematical facts, concepts, principles, and theories			
Numeration: Understand and use numeration			
<p>Numeration Performance Standards that apply to grade 3: M1.1.1 Read, write, order, count, and model one-to-one correspondence with whole numbers to 100. M1.1.2 Use, model, and identify place value positions of 1's, 10's, and 100's. M1.1.3 Model and explain the processes of addition and subtraction, describing the relationship between the operations. M1.1.4 Select and use various representations of ordinal and cardinal numbers. M1.1.5 Identify, model, and label simple fractions, describing and defining them as equal parts of a whole, a region, or a set. M1.1.6 Identify, describe, and extend patterns inherent in the number system. Skip count by 2's 5's and 10's. Add and subtract by 10. Identify even and odd numbers. M1.1.7 Demonstrate the commutative and identify properties of addition.</p> <p>Numeration Performance Standards that apply to grades 4-6: M1.2.1 Read, write, model, order, and count with positive whole numbers to 1,000,000 and negative whole numbers. M1.2.2 Use, model, and identify place value positions from 0.001 to 1,000,000. M1.2.3 Model and explain the processes of multiplication and division. Describe the relationships among the four basic operations. M1.2.4 Identify and describe different uses for the same numerical representation. M1.2.5 Model and explain the process of adding and subtracting fractions with common denominators and decimals that represent money. M1.2.6 Identify and describe factors and multiples including those factors and multiples common to a pair or set of numbers. M1.2.7 Demonstrate the commutative and identify properties of multiplication.</p>			
Understanding Numbers			
Grade 3	Grade 4	Grade 5	Grade 6
<p>The student demonstrates conceptual understanding</p> <ul style="list-style-type: none"> • of whole numbers to one thousand by <p>[3] N-1 reading, writing, ordering, or [counting L] (M1.1.1)</p> <p>[3] N-2 modeling (base ten blocks) or identifying place value positions to thousands (M1.1.2)</p>	<p>The student demonstrates conceptual understanding</p> <ul style="list-style-type: none"> • of whole numbers to <u>ten thousands</u> by <p>[4] N-1 reading, writing, ordering, or [counting L] (M1.2.1)</p> <p>[4] N-2 modeling (base ten blocks) or identifying place value positions to <u>ten thousands</u> (M1.2.2)</p>	<p>The student demonstrates conceptual understanding</p> <ul style="list-style-type: none"> • of whole numbers to <u>millions</u> by <p>[5] N-1 reading, writing, ordering, or [counting L] (M1.2.1)</p> <p>[5] N-2 identifying place value positions from <u>tenths to millions</u> (M1.2.2)</p>	<p>The student demonstrates conceptual understanding</p> <ul style="list-style-type: none"> • of <u>fractions (proper or mixed numbers), decimals, percents (whole number), or integers</u> by <p>[6] N-1 reading, writing, ordering, or [counting L] (M1.2.1)</p> <p>[6] N-2 [identifying place value positions from thousandths to millions L] (M1.2.2)</p>

The number in brackets indicates the grade level.

Differences between grade levels are underlined.

The coding at the end of each PSGLE indicates the performance standard the

Some PSGLEs have been identified as Local. They are for local assessment and will not be on a state assessment.

Grade Level Expectations are written for assessment purposes. The PSGLEs should be written in a way so that it is clear what is expected of classroom instruction and/or state assessment.

Criteria for PSGLEs

1. The set of PSGLEs for each grade level should be reasonable to learn within a school year and still allow for learning additional state and local expectations.
2. PSGLEs should promote coherent, focused, developmentally appropriate instructions, as opposed to isolated instruction just on topics, facts, or individual skills.
3. Concepts, skills, and knowledge should be differentiated between adjacent grade levels.
4. PSGLEs should be of similar levels of specificity.
5. PSGLEs should show a continuum of learning. Success in one grade should be a good predictor of success the next year.

Note: Items differentiated with an "i.e." indicate that statewide assessment items may only be written to the content contained within the statement in the parentheses. Items differentiated with an "e.g." do not limit assessment items to that content, but indicate examples of content that may be used in statewide assessment items.

Math Performance Standards are organized into 10 content strands and are coded as follows:

N=Numeration

MEA=Measurement

E&C=Estimation and Computation

F&R=Functions and Relationships

G=Geometry

S&P=Statistics and Probability

PS=Process Skills (The Process Skills include Problem-Solving, Communication, Reasoning, and Connections.)

NOTE: All the PSGLEs for Process Skills are for local assessment. Process Skills that would be assessed on a state assessment have been embedded in PSGLEs for other content strands. For instance, a grade level expectation for the Statistics and Probability content strand for eighth grade is, “[Designing, collecting L], organizing, displaying, or explaining the classification of data in real-world problems.” That Grade Level Expectation for Statistics and Probability incorporates one of the Grade Level Expectations for Process Skills, “representing mathematical problems numerically, graphically, and/or symbolically.”

Math Performance Standards (Grade Level Expectations)

<p>Content Standard A: Mathematical facts, concepts, principles, and theories Numeration: Understand and use numeration Measurement: Select and use systems, units, and tools of measurement</p>			
<p>Numeration Performance Standards that apply to grades 9-10: M1.4.1 Read, write, model, order, and define real numbers and subsets. M1.4.2 Add in a different base system. M1.4.3 Compare and contrast the relationship between various applications of the same operation. M1.4.4 Translate between equivalent representations of the same exponential expression. M1.4.5 Recognize, describe, and use properties of the real number system. Measurement Performance Standards that apply to grades 9-10: M2.4.1 Evaluate measurements for accuracy, precision, and error with respect to the measuring tools, methods, and the computational process. M2.4.2 Estimate and convert measurements between different systems. M2.4.3 Apply various measurement systems to describe situations and solve problems. M2.4.4 Use indirect methods, including the Pythagorean Theorem and right triangle trigonometry, to find missing dimensions.</p>			
Grade 9			
Understanding Numbers	Understanding Meaning of Operations	Number Theory	Measurable Attributes
<p>The student demonstrates understanding</p> <ul style="list-style-type: none"> • of real numbers by <p>[9] N-1 converting between a <u>rational</u> number in scientific notation and standard form (M1.4.4 & M 3.4.4)</p> <p>[9] N-2 equating different equivalent representations of the same exponential expression (e.g., $2^3 \cdot 2^5 = 2^8$) (M1.4.4 & M3.4.4)</p>	<p>The student demonstrates conceptual understanding of mathematical operations by</p> <p>[9] N-3 using models, explanations, number lines, real-life situations, describing or illustrating the effects of arithmetic operations on <u>real</u> numbers (M1.4.3)</p> <p>[9] N-4 using models, explanations, number lines, real-life situations, describing or illustrating the use of inverse operations (<u>squaring/square root</u>) (M1.4.3 & 1.4.5)</p>	<p>The student demonstrates conceptual understanding of number theory by</p> <p>[9] N-5 applying the rules for order of operations to <u>real numbers</u> and <u>variables</u> (M1.3.5)</p> <p>[9] N-6 [using distributive property with <u>variables</u> L] (M1.4.5)</p>	<p>The student demonstrates understanding of measurable attributes by</p> <p>[9] MEA-1 estimating or converting measurements <u>between the English and metric systems in real-world applications, given a conversion factor</u> (e.g., miles/kilometers) (M2.4.2)</p>

Math Performance Standards (Grade Level Expectations)

<p>Content Standard A: Mathematical facts, concepts, principles, and theories Measurement: Select and use systems, units, and tools of measurement Estimation and Computation: Perform basic arithmetic functions, make reasoned estimates, and select and use appropriate methods or tools Functions and Relationships: Represent, analyze, and use patterns, relations, and function</p>			
<p>Measurement Performance Standards that apply to grades 9-10: M2.4.1 Evaluate measurements for accuracy, precision, and error with respect to the measuring tools, methods, and the computational process. M2.4.2 Estimate and convert measurements between different systems. M2.4.3 Apply various measurement systems to describe situations and solve problems. M2.4.4 Use indirect methods, including the Pythagorean Theorem and right triangle trigonometry, to find missing dimensions Estimation and Computation Performance Standards that apply to grades 9-10: M3.4.1 Use estimation to solve problems and to check the accuracy of solutions; state whether the estimation is greater or less than the exact answer. M3.4.2 Add and subtract real numbers using scientific notation, powers, and roots. M3.4.3 Multiply and divide real numbers in various forms including scientific notation, powers, and roots. M3.4.4 Select, convert, and apply an equivalent representation of a number for a specified situation. M3.4.5 Use ratios and proportions to model and solve fraction and percent problems with variables. Functions and Relationships Performance Standards that apply to grades 9-10: M4.4.1 Identify, graph, and describe the graphs of basic families of functions including linear, absolute value, quadratic, and exponential using a graphing calculator. M4.4.2 Create and solve linear and quadratic equations and inequalities. M4.4.3 Create and solve simple systems of equations, algebraically and graphically, using a graphing calculator. M4.4.4 Use discrete structures, such as networks, matrices, sequences, and iterations as tools to analyze patterns, expressions, and equations. M4.4.5 Add, subtract, multiply, divide, and simplify rational expressions; add, subtract, and multiply polynomials.</p>			
Grade 9			
Measurement Techniques	Estimation	Computation	Describing Patterns and Functions
<p>The student uses measurement techniques by</p> <p>[9] MEA-2 <u>applying indirect methods, such as the Pythagorean theorem</u> to find missing dimensions, <u>in real-world applications</u> (M2.4.4)</p>	<p>The student solves problems (including real-world situations) using estimation by</p> <p>[9] E&C-1 judging <u>whether</u> the strategy will result in an answer greater or less than the exact answer (M3.4.1)</p>	<p>The student accurately solves problems (including real-world situations) involving</p> <p>[9] E&C-2 adding or subtracting rational numbers <u>including integers with whole number exponents</u> (M3.4.2)</p> <p>[9] E&C-3 <u>multiplying</u> or dividing rational numbers <u>including integers with whole number exponents</u> (M3.4.3)</p> <p>[9] E&C-4 <u>determining rate by using ratio and proportion</u> (M3.4.5)</p> <p>[9] E&C-5 [<u>multiplying</u> or dividing numbers in scientific notation L] (M3.4.3)</p>	<p>The student demonstrates conceptual understanding of functions, patterns, or sequences including those represented in real-world situations by</p> <p>[9] F&R-1 describing or extending patterns (families of functions: linear <u>quadratic, absolute value,</u>), up to the nth term, represented in tables, sequences, graphs, or in problem situations (M4.4.1)</p> <p>[9] F&R-2 generalizing relationships (linear, <u>quadratic, absolute value,</u>) using a table of ordered pairs, a graph, or an equation (M4.4.4)</p> <p>[9] F&R-3 describing in words how a change in one variable in a formula affects the remaining variables (e.g., how changing the <u>radius affects the volume of a cylinder</u>) (M4.3.2)</p> <p>[9] F&R-4 [using a calculator as a tool when describing, extending, representing, or <u>graphing patterns or linear equations L</u>] (M4.4.2)</p>

Math Performance Standards (Grade Level Expectations)

<p>Content Standard A: Mathematical facts, concepts, principles, and theories Functions and Relationships: Represent, analyze, and use patterns, relations, and function Geometry: Construct, transform, and analyze geometric figures</p>			
<p>Functions and Relationships Performance Standards that apply to grades 9-10: M4.4.1 Identify, graph, and describe the graphs of basic families of functions including linear, absolute value, quadratic, and exponential using a graphing calculator. M4.4.2 Create and solve linear and quadratic equations and inequalities. M4.4.3 Create and solve simple systems of equations, algebraically and graphically, using a graphing calculator. M4.4.4 Use discrete structures, such as networks, matrices, sequences, and iterations as tools to analyze patterns, expressions, and equations. M4.4.5 Add, subtract, multiply, divide, and simplify rational expressions; add, subtract, and multiply polynomials. Geometry Performance Standards that apply to grades 9-10: M5.4.1 Identify and use the properties of polygons, including interior and exterior angles, and circles (including angles, arcs, chord, secants, and tangents) to solve problems. M5.4.2 Create 2-dimensional representations of 3-dimensional objects. M5.4.3 Identify congruent and similar figures using Euclidean and coordinate geometries; apply this information to solve problems. M5.4.4 Use transformations to demonstrate geometric properties. M5.4.5 Use coordinate geometry to graph linear equations, determine slopes of lines, identify parallel and perpendicular lines, and to find possible solutions to sets of equations. M5.4.6 Construct geometric models, transformations, and scale drawings using a variety of methods including paper folding, compass, straight edge, protractor, and technology.</p>			
Grade 9			
Modeling and Solving Equations and Inequalities	Geometric Relationships	Transformation of Shapes	Perimeter, Area, and Volume
<p>The student demonstrates algebraic thinking by</p> <p>[9] F&R-5 modeling (graphically or algebraically) or solving situations (including real-world applications) using systems of linear equations (M4.4.3)</p> <p>[9] F&R-6 solving or identifying solutions to multi-step linear equations of the form $ax \pm b = cx \pm d$, where a, b, c and d are rational numbers and $a \neq 0$, $c \neq 0$ (M4.4.2)</p> <p>[9] F&R-7 solving literal equations or formulas for a variable involving one step (e.g. solve for t when $d = rt$) (M4.4.2)</p>	<p>The student demonstrates an understanding of geometric relationships by</p> <p>[9] G-1 identifying, analyzing, comparing, or using properties of angles (including supplementary or complementary) or circles (degrees in a circle) (M5.4.1)</p>	<p>The student demonstrates conceptual understanding of similarity, congruence, symmetry, or transformations of shapes by</p> <p>[9] G-2 using a <u>coordinate plane</u> to solve problems involving congruent or similar shapes (M5.4.3)</p> <p>[9] G-3 [<u>drawing or describing</u> the results of applying transformations (translations, rotations, reflections, or dilations) to figures on a coordinate plane L] (M5.4.4)</p>	<p>The student solves problems (including real-world situations) by</p> <p>[9] G-4 determining the volume or surface area of prisms, <u>cylinders</u>, <u>cones</u> or <u>pyramids</u> (M5.3.4)</p>

Math Performance Standards (Grade Level Expectations)

<p>Content Standard A: Mathematical facts, concepts, principles, and theories Geometry: Construct, transform, and analyze geometric figures Statistics and Probability: Formulate questions, gather and interpret data, and make predictions</p>			
<p>Geometry Performance Standards that apply to grades 9-10: M5.4.1 Identify and use the properties of polygons, including interior and exterior angles, and circles (including angles, arcs, chord, secants, and tangents) to solve problems. M5.4.2 Create 2-dimensional representations of 3-dimensional objects. M5.4.3 Identify congruent and similar figures using Euclidean and coordinate geometries; apply this information to solve problems. M5.4.4 Use transformations to demonstrate geometric properties. M5.4.5 Use coordinate geometry to graph linear equations, determine slopes of lines, identify parallel and perpendicular lines, and to find possible solutions to sets of equations. M5.4.6 Construct geometric models, transformations, and scale drawings using a variety of methods including paper folding, compass, straight edge, protractor, and technology. Statistics and Probability Performance Standards that apply to grades 9-10: M6.4.1 Analyze and draw inferences from a wide variety of data sources that summarize data; constructing graphical displays with and without technology. M6.4.2 Determine the line of best fit and use it to predict unknown data values. M6.4.3 Describe data, selecting measures of central tendencies and distribution, to convey information in the data. M6.4.4 Analyze the validity of statistical conclusions and the use, misuse, and abuse of data caused by a wide variety of factors including choices of scale, inappropriate choices of measures of center, incorrect curve fitting, and inappropriate uses of controls or sample groups. M6.4.5 Analyze data from multiple events and predict theoretical probability; find and compare experimental and theoretical probability for a simple situation, discussing possible differences between two results. M6.4.6 Design, conduct, analyze, and communicate the results of multi-stage probability experiments.</p>			
Grade 9			
Position and Direction	Construction	Analysis and Central Tendency	Probability
<p>The student demonstrates understanding of position and direction when solving problems (including real-world situations) by</p> <p>[9] G-5 graphing or identifying (using equations or formulas to determine the slope of line segments on a coordinate plane) (M5.4.5)</p>	<p>The student demonstrates a conceptual understanding of geometric drawings or constructions by</p> <p>[9] G-6 [drawing, measuring, or constructing geometric models of plane figures (containing parallel and/or perpendicular lines) L] (M5.4.6)</p> <hr/> <p style="text-align: center;">Data Display</p> <p>The student demonstrates an ability to classify and organize data by</p> <p>[9] S&P-1 [designing, collecting L], organizing, displaying, or explaining the classification of data in real-world problems (e.g., science or humanities, peers, community, or careers) using information from tables or graphs that display two sets of data [or with technology L] (M6.4.1)</p>	<p>The student demonstrates an ability to analyze data (comparing, explaining, interpreting, evaluating, making predictions, or, describing trends; or drawing, formulating, or justifying conclusions) by</p> <p>[9] S&P-2 using information from a variety of displays or analyzing the validity of statistical conclusions found in the media (M6.4.1)</p> <p>[9] S&P-3 using range and measures of central tendency to determine the best representation of the data for a practical situation (M6.4.3)</p> <p>[9] S&P-4 identifying and/or showing the meaning of a best fit line (M6.4.2)</p>	<p>The student demonstrates a conceptual understanding of probability and counting techniques by</p> <p>[9] S&P-5 determining or comparing the experimental and/or theoretical probability of independent or <u>dependent</u> events (M6.4.5)</p> <p>[9] S&P-6 making predictions about the probability of independent <u>or dependent</u> events and using the information to solve problems (M6.4.5)</p> <p>[9] S&P 7 [designing, conducting, analyzing, and communicating the results of a probability experiment L] (M6.4.6)</p>

Math Performance Standards (Grade Level Expectations)

<p>Content Standards B, C, D, and E: Process skills and abilities Applying conceptual knowledge and skills designated in all strands of Content Standard A by problem solving, communicating, reasoning, and making connections</p>			
<p>Problem-Solving Performance Standards that apply to grades 9-10: M7.4.1 Recognize and formulate mathematical problems from within and outside the field of mathematics. M7.4.2 Apply multi-step, integrated, mathematical problem-solving strategies, persisting until a solution is found or it is clear no solution exists. M7.4.3 Verify the answer by using an alternative strategy. Communication Performance Standards that apply to grades 9-10: M8.4.1 Use appropriate technology to represent the information and ideas in a problem. M8.4.2 Use numerical, graphic, and symbolic representations to support oral and written communication about math ideas. M8.4.3 Explain, justify, and defend mathematical ideas, solutions, and methods to various audiences. Reasoning Performance Standards that apply to grades 9-10: M9.4.1 Follow and evaluate an argument, judging its validity using inductive or deductive reasoning and logic. M9.4.2 Make and test conjectures. M9.4.3 Use methods of proofs including direct, indirect, and counterexamples, to validate conjectures. Connections Performance Standards that apply to grades 9-10: M10.4.1 Apply mathematical skills and processes to global issues. M10.4.2 Describe how mathematics can be used in knowing how to prepare for careers.</p>			
Grade 9			
<p>Problem solving: Understand and be able to select and use a variety of problem-solving strategies</p>	<p>Communication: Form and use appropriate methods to define and explain mathematical relationships</p>	<p>Reasoning: Use logic and reason to solve mathematical problems</p>	<p>Connections: Apply mathematical concepts and processes to situations within and outside of school</p>
<p>The student demonstrates an ability to problem solve by</p> <p>[9] PS-1 selecting, modifying, and applying a variety of problem-solving strategies (e.g., <u>charts</u>, <u>graphing</u>, inductive and deductive reasoning, Venn diagrams) and verifying the results (M7.4.2)</p> <p>[9] PS-2 evaluating, interpreting, and justifying solutions to problems by using an alternative strategy (M7.4.3)</p>	<p>The student communicates his or her mathematical thinking by</p> <p>[9] PS-3 representing mathematical problems numerically, graphically, and/or symbolically, translating among these alternative representations; or using appropriate vocabulary, symbols, or technology to explain, justify, and defend strategies and solutions (M8.4.1, M8.4.2, & M8.4.3)</p>	<p>The student demonstrates an ability to use logic and reason by</p> <p>[9] PS-4 following and evaluating an argument, judging its validity using inductive, or deductive reasoning and logic; or making and testing conjectures (M9.4.1 & M9.4.2)</p>	<p>The student understands and applies mathematical skills and processes across the content strands by</p> <p>[9] PS-5 using real-world contexts such as science, humanities, peers, community, careers, and <u>national issues</u> (M10.4.1 & M10.4.2)</p>