Grade 8 Mathematics

Performance Level Descriptors

Introduction

The federal government requires states to adopt and assess standards and report assessment results using three or more levels. Federal guidance specifies that state's academic performance levels must include descriptions of the content-based competencies associated with each level. The descriptions, referred to as **Performance Level Descriptors (PLDs**), convey the degree of student achievement at each level. The Maryland Comprehensive Assessment Program (MCAP) Policy, Content, and Range PLDs are included in this document.

MCAP Policy Performance Level Descriptors

The MCAP Policy PLDS provide high-level descriptions of a student's ability to apply the knowledge and skills defined by the Maryland Content Standards for English Language Arts (ELA), Mathematics, Science, and Social Studies as demonstrated by their performance on MCAP assessments. Maryland elected to use the four performance levels, described below, when reporting assessment results.

Performance Level	MCAP Policy Performance Level Descriptors
4	**Distinguished Learners** demonstrate advanced proficiency. The students are well prepared for the next grade level or course and are well prepared for college and career readiness.
3	**Proficient Learners** demonstrate proficiency. The students are prepared for the next grade level or course and are on track for college and career readiness.
2	**Developing Learners** demonstrate partial proficiency. The students need additional academic support to ensure success in the next grade level or course and to be on track for college and career readiness.
1	**Beginning Learners** do not yet demonstrate proficiency. The students need substantial academic support to be prepared for the next grade level or course and to be on track for college and career readiness.

MCAP Mathematics Content Performance Level Descriptors

The results from each MCAP Mathematics assessment are reported using four performance levels. Mathematics Content PLDs for Grade 8 provide broad descriptions of what a student performing at each level means in terms of the mathematics content for the course.

Grade 8

Performance Level	MCAP Mathematics Content Performance Level Descriptors for Grade 8
4	**Distinguished Learners** demonstrate advanced proficiency in solving complex problems involving the number system, equations or expressions, functions, geometry, statistics, and probability, and demonstrates an ability to connect multiple grade-level concepts to conceptualize and apply mathematics to model, reason through, and solve problems efficiently, and relate mathematics to the real world.
3	**Proficient Learners** demonstrate proficiency in solving problems involving the number system, equations or expressions, functions, geometry, statistics, and probability, and demonstrates an ability to conceptualize and apply mathematics to model, reason through, and solve problems efficiently, and relate mathematics to the real world.
2	**Developing Learners** demonstrate partial proficiency in solving problems involving the number system, equations or expressions, functions, geometry, statistics, and probability, and may need some support in conceptualizing and applying mathematics to model, reason through, and solve problems efficiently, and in relating mathematics to the real world.
1	**Beginning Learners** do not yet demonstrate proficiency in solving problems involving the number system, equations or expressions, functions, geometry, statistics, and probability where the required mathematics is either directly indicated or uses common grade level procedures, and typically needs support in conceptualizing and applying mathematics to model, reason through, and solve problems efficiently, and in relating mathematics to the real world.

MCAP Mathematics Range Performance Level Descriptors

Range PLDs are grade/course specific descriptors of the cognitive and content level rigor expected at each performance level. The individual grade-level/course PLD documents provide robust descriptions associated with specific content. To show proficiency of the Maryland College and Career Readiness Standards, students must demonstrate their knowledge and skills as described by the Level 3 and Level 4 PLDs.

8.NS The Number System

8.NS.A Know that there are numbers that are not rational, and approximate them by rational numbers.

8.NS.A.1 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.

8.NS.A.2 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.

Evidence Statement Code	Level 4 – Distinguished *A student performing at this level should be able to:*	Level 3 – Proficient *A student performing at this level should be able to:*	Level 2 – Developing *A student performing at this level should be able to:*	Level 1 – Beginning *A student performing at this level should be able to:*
8.NS.A.1 8.NS.A.2	**use approximations** of irrational numbers and conversions between fractions to estimate the value of an expression **involving multiple operations.**	**approximate irrational numbers** to locate them on a number line and to **make numerical comparisons or estimate the value of an expression.**	**approximate locations** of commonly used irrational numbers **on a number line and identify numbers as rational or irrational.**	identify commonly used rational and irrational numbers.
8.NS.A.1		**convert** between fractions and repeating or terminating decimals.	recognize fractions with denominators less than or equal to ten, excluding seven, and their decimal equivalents.	

8.EE Expressions and Equations

8.EE.A Work with radicals and integer exponents.

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.

8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number.

8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.

8.EE.A.4 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.

Evidence Statement Code	Level 4 – Distinguished *A student performing at this level should be able to:*	Level 3 – Proficient *A student performing at this level should be able to:*	Level 2 – Developing *A student performing at this level should be able to:*	Level 1 – Beginning *A student performing at this level should be able to:*
8.EE.A.1	evaluate and/or generate equivalent numerical expressions using and applying properties of integer exponents for terms with potential common bases.	evaluate and/or **generate** equivalent numerical expressions using and **applying** properties of integer exponents for terms written with common bases.	evaluate a numerical expression using **properties of integer exponents for terms written with common bases**.	evaluate a numerical expression using either product of powers or power of a power with positive integer exponents.
8.EE.A.2	**analyze the solutions** of multiple quadratic and cubic monomial equations, and **represent the solutions as a square root or cube root**, respectively.	solve equations of the form $x^2 = p$, where p is **a perfect square**, or **solve equations of the form** $x^3 = p$**,** where p is **a perfect cube.**	**solve equations of the form** $x^2 = p$**,** where p is a **positive rational number** and a perfect square less than or equal to 81, by **representing only the positive solution** of the equation.	identify square roots of perfect squares up to 81.
8.EE.A.3 8.EE.A.4	**use** scientific notation and **choose units of appropriate size** for realistic measurements.	**perform operations** with numbers in scientific notation.	translate **between** standard form and scientific notation.	translate numbers from scientific notation to standard notation.

8.EE Expressions and Equations

8.EE.B Understand the connections between proportional relationships, lines, and linear equations.

8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

8.EE.B.6 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.

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8.EE.B.5		solve real-world problems by calculating and **comparing** unit rates for proportional relationships **represented in different ways**.	solve real-world and mathematical problems by calculating a unit rate for a proportional relationship.	
8.EE.B.5 8.EE.B.6	interpret and apply conceptual understanding of linear relationships in multiple forms.	graph linear relationships, in the form $y = mx + b$, interpret the unit rate as the slope of the graph of a proportional relationship and apply these concepts.	**graph** proportional relationships in the coordinate plane or **identify the slope and the *y*-intercept** of a line given a graph or an equation.	identify the graph of proportional relationship.
8.EE.B.6	**construct and use similar triangles** to demonstrate that the slope is the same between two distinct points on a non-vertical line in the coordinate plane.	use given similar triangles to **demonstrate that the slope is the same between any two distinct points** on a non-vertical line in the coordinate plane.	use any right triangle to find the slope of a line.	

8.EE Expressions and Equations

8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.

8.EE.C.7 Solve linear equations in one variable.

a. 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 $x = a$, $a = a, a = b$ results (where *a* and *b* are different numbers).

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8.EE.C.8 Analyze and solve pairs of simultaneous linear equations.

a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersections of their graphs, because points of intersection satisfy both equations simultaneously.

b. Solve systems of two linear equations in two variables algebraically and estimate solutions by graphing the equations. Solve simple cases by inspection.

c. Solve real-world and mathematical problems leading to two linear equations in two variables.

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8.EE.C.7	solve linear equations in one variable, with rational number coefficients to **evaluate claims**.	solve linear equations in one variable, with **rational number coefficients** involving distributions **and**/or combining like terms.	**solve** linear equations in one variable, with **integer** coefficients **involving distribution or combining like terms.**	verify the solution of an equation with positive integer coefficients and constants.
8.EE.C.8	produce, solve, **analyze**, and **interpret** the meaning of a solution to a system of linear equation.	**produce** and solve system of linear equations.	**solve** a system of linear equations by **graphing** or by **inspection** where equations are provided.	identify the point of intersection of a system of linear equations where the graph is provided.
8.EE.C.7 8.EE.C.8	**produce** an equation or system of equations that satisfies a particular solution type.	**identify** when an equation or system of equation has **one solution, no solution, or infinitely many solutions**.		

8.F Functions

8.F.A Define, evaluate, and compare functions.

8.F.A.1 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.

8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

8.F.A.3 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.

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8.F.A.1 8.F.A.2 8.F.A.3	**compare** multiple properties of linear functions represented in different ways.	**define** and **evaluate** linear functions represented in different ways.	**compare** properties of two functions represented in the same way and **classify** functions as linear or nonlinear.	define a function as a rule that assigns each input to exactly one output.
8.F.A.2		**compare** a single property of linear functions represented in different ways.		
8.F.A.3		**classify** functions as linear or nonlinear in different representations.		

8.F Functions

8.F.B Use functions to model relationships between quantities.

8.F.B.4 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.

8.F.B.5 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.

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8.F.B.4		**construct** and **interpret** an appropriate model that represents the relationship between two quantities.	**identify** the appropriate model that represents **the relationship between two quantities**.	identify the rate of change or initial value of a linear function in terms of its graph or a table of values.
8.F.B.5	analyze and **describe** the **functional relationship** between two quantities.	analyze a graph of a linear or **nonlinear** function to qualitatively describe it.	analyze a graph of a linear function to qualitatively describe it.	

8.G Geometry

8.G.A Understand congruence and similarity using physical models, transparencies, or geometry software.

8.G.A.1 Verify experimentally the properties of rotations, reflections, and translations
- a. Lines are taken to lines, and line segments to line segments of the same length.
- b. Angles are taken to angles of the same measure.
- c. Parallel lines are taken to parallel lines.

8.G.A.2 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.

8.G.A.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

8.G.A.4 Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

8.G.A.5 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.

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8.G.A.1 8.G.A.2 8.G.A.3 8.G.A.4	**justify**, by identifying the precise scale factor or degrees of rotation, the congruence or similarity between figures after a sequence of transformations.	**apply** properties of rigid transformations and dilations of figures in a coordinate plane, with or without coordinates specified, to **describe the impact** of a transformation or sequence of transformations on a figure and its component parts.	**describe** a reflection or translation of a figure in a coordinate plane or **identify** a **dilation** and the **results** of a dilation on a figure.	identify a reflection, rotation, or a translation and the result of these rigid transformations on a figure based solely on appearances.
8.G.A.5	**justify** the angle relationships that lead to congruent or similar figures.	**use** angle relationships in figures to **solve problems**.	identify the **angle relationships** in parallel lines cut by a transversal or in triangles.	identify congruent angles in parallel lines cut by a transversal or the measure of a missing angle in a triangle.

8.G Geometry

8.G.B Understand and apply the Pythagorean Theorem

8.G.B.6 Explain a proof of the Pythagorean Theorem and its converse.

8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two dimensions.

8.G.B.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

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8.G.B.7 8.G.B.8	apply the Pythagorean theorem to find the distance between two points in **multi-step problems**.	**apply** the Pythagorean Theorem to determine the unknown side lengths of right triangles and to find the distance between two points.	**calculate** the length of the hypotenuse of a right triangle given the length of the two other legs.	identify the hypotenuse and the legs of a right triangle given the side lengths or an image of a right triangle.
8.G.B.6	**justify** Euclid's **proof** of the Pythagorean theorem.	determine whether a given triangle is a right triangle, given its side lengths.		

8.G Geometry

8.G.C Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

8.G.C.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

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8.G.C.9	**solve multi-step problems** involving volume or apply volume formulas to **composite** solids.	**calculate** the volume of a solid in mathematical and **real-world** problems.	identify the **appropriate formula** for the volumes of a cone, a cylinder, and a sphere and **connect the key dimensions** to the appropriate locations in the formula.	identify the key dimensions (i.e., radii, heights, circumferences, and diameters) of cones, cylinders, and spheres.

8.SP Statistics and Probability

8.SP.A Investigate patterns of association in bivariate data.

8.SP.A.1: 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.

8.SP.A.2: 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.

8.SP.A.3: Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

8.SP.A.4: 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.

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8.SP.A.1 8.SP.A.2 8.SP.A.4	**use** scatter plots, trend lines, and associations between variables and two-way frequency tables to **make predictions** in real-world situations.	**analyze** and **describe patterns of association** by interpreting scatter plots and two-way tables.	informally **fit a straight line** to a scatter plot that suggests a linear association.	describe the patterns of association that can be seen in data by interpreting scatter plots and two-way tables.
8.SP.A.2 8.SP.A.3		use an equation or the parts of an equation of a linear model to solve problems in context or to **reveal a real world meaning**.	use a given equation of a linear model to solve problems in context.	
8.SP.A.4		**interpret and use** relative frequencies from a two-way table to **describe possible association** between two variables.	calculate frequencies from categorical data in a two-way frequency table.	

Reasoning Performance Level Descriptors

All reasoning assessment items connect to both the Grade 8 reasoning evidence statements and the content evidence statements.

Students must provide evidence of their ability to reason mathematically by responding to:

- one-point machine scored items. For one-point reasoning items, refer to the associated content PLDs.
- four-point constructed response items. For four-point reasoning items, refer to both the reasoning PLDs below and the associated content PLDs.

Reasoning Evidence Statements

8.R.1 Reasoning with Expressions and Equations

8.R.1a Base reasoning on the principle that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

8.R.1b Base reasoning on the principle that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

8.R.1c Given an equation or system of equations, present the solution steps as a logical argument that concludes with the set of solutions, if any.

8.R.1d Present or validate solutions to multi-step problems in the form of valid chains of reasoning, adhering to precision.

8.R.1e Apply geometric reasoning in a coordinate setting and use coordinates to draw geometric conclusions. Demonstrate reasoning and understanding regarding the necessary conditions under which two segments have the same slope.

8.R.2 Reasoning with Functions

8.R.2a Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures.

8.R.3 Reasoning with Geometry

8.R.3a Form chains of reasoning that will justify or refute propositions or conjectures.

8.R.3b Form chains of reasoning that will justify or refute propositions or conjectures.

8.R.3c Apply geometric reasoning in a coordinate setting and use coordinates to draw geometric conclusions.

8.R.3d Apply geometric reasoning in a coordinate setting and use coordinates to draw geometric conclusions.

Level 4 – Distinguished *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*	**Level 3 – Proficient** *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*	**Level 2 – Developing** *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*	**Level 1 – Beginning** *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*
a sophisticated chain of reasoning.	a well-developed chain of reasoning.	a partially developed, valid chain of reasoning.	the beginning of a chain of reasoning.
a precise, logical solution pathway.	a logical solution pathway that may contain minor flaws.	a solution pathway that contains some correct processes yielding an incorrect solution.	an attempted solution pathway.
an extensive command of mathematical representations and vocabulary.	a proficient command of mathematical representations and vocabulary.	an understanding of some mathematical representations and vocabulary.	a developing understanding of some mathematical representations and vocabulary.

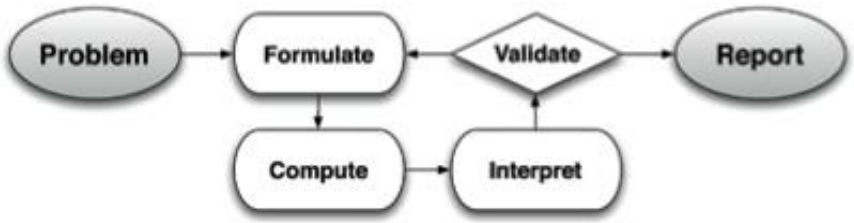
Modeling Performance Level Descriptors

All modeling assessment items connect to both the Grade 8 modeling evidence statements and the content evidence statements.

Students must provide responding to:

- one-point machine scored items. For one-point modeling items, refer to the associated content PLDs.
- four-point constructed response items. For four-point modeling items, refer to both the modeling PLDs below and the associated content PLDs.

Modeling Cycle



Modeling Evidence Statements

8.M Modeling with Mathematics in Grade 8

8.M.1 Choose and produce appropriate mathematics to model quantities and mathematical relationships in order to analyze situations, make predictions, solve multi-step problems, and draw conclusions.

- 8.M.1a Given a real-world situation, identify the problem that needs to be solved, make necessary assumptions, and identify important information.
- 8.M.1b Given a real-world situation, formulate a mathematical representation of the problem.
- 8.M.1c Given a real-world situation, use mathematical models to compute and draw conclusions.
- 8.M.1d Given a real-world situation, interpret what a solution means within the context of the situation.
- 8.M.1e Given a real-world situation, evaluate and/or validate a partial or complete solution.

Level 4 – Distinguished *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*	**Level 3 - Proficient** *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*	**Level 2 - Developing** *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*	**Level 1 - Beginning** *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*
determining the information or mathematics needed to solve a problem that requires connecting multiple grade-level concepts.	determining needed information or mathematics.	identifying needed information or mathematics.	identifying some needed information or mathematics.
communicating an accurate, organized solution path aligned to the problem using appropriate, effective, and precise representations.	communicating an accurate, organized solution path aligned to the problem using appropriate, effective, and precise representations that may contain minor flaws.	communicating a partial solution path that may contain mathematical errors.	communicating the beginning of a solution path, containing mathematical errors.
evaluating or validating a solution path or showing how to improve a model or correct a given solution.	evaluating or validating a solution path or showing how to improve a model, but work may include minor flaws.	partially validating a solution path or incorrectly improving the model.	attempting to validate a solution path.