Mathematics Assessment

Mathematics High School Threshold Achievement Level Descriptors (ALD)

With Claims, Targets and Standards

This document aligns the Oregon Mathematics Assessment claims and targets with the Oregon mathematics standards. The claims and targets can be used to design classroom lessons and district assessments. In addition, the document serves as a guide in understanding the Oregon Mathematics Assessment reports.

CLAIMS AND TARGETS: Content claims are summary statements about the knowledge and skills students are expected to demonstrate on the assessment related to a particular aspect of the standards. Within each claim area, assessment targets were developed to ensure inclusion of standards, learning progressions, and the Depth of Knowledge levels.

DEPTH OF KNOWLEDGE: The DOK level assigned should reflect the level of work students are most commonly required to perform in order for the response to be deemed acceptable. The DOK level should reflect the complexity of the cognitive processes demanded by the task, rather than its difficulty. Ultimately the DOK level describes the kind of thinking required by a task, not whether or not the task is "difficult".

- **Level 1** requires students to receive or recite facts or to use simple skills or abilities.
- **Level 2** includes the engagement of some mental processing beyond recalling or reproducing a response. Includes conceptual understanding generally refers to the integration and application of concepts and other ideas within a content area. Procedural understanding denotes knowledge about skills and sequence of steps, when and how these should be used appropriately, and their efficient and accurate applications.
- **Level 3** requires strategic thinking. Students must be able to support their thinking. Includes, non-routine problem solving like in reading and determining author's purpose.
- **Level 4** requires extended thinking. Usually requires work over a period of time. They may also be asked to develop hypotheses and perform complex analyses of the connections among texts.

Developed by Terri Gibbs-Burke. Modified and updated by the Oregon Department of Education

Claim 1 Concepts and Procedures: Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.

	Targets	Content Standards	Threshold Achievement Level Descriptors (ALD) Students Entering Level (2, 3, or 4) will be able to…	Item Types	
				CAT	PT
PRIORITY CLUSTER	**Target D** Interpret the structure of expressions. (DOK 1, 2)	**A.SSE.2:** Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.	• **2** Use linear equations in one and two variables and inequalities in one variable to model a familiar situation and to solve a familiar problem. Explain solution steps for solving linear equations and solve a simple radical equation. Use properties of exponents to expand a single variable (coefficient of 1) repeated up to two times with a nonnegative integer exponent into an equivalent form and vice versa, e.g., $x^2x^3 = xxxxxxxxxx = x^{2+3}$. Solve one-step linear equations and inequalities in one variable and understand the solution steps as a process of reasoning. Represent linear equations and quadratic equations with integer coefficients in one and two variables graphically on a coordinate plane. Recognize equivalent forms of linear expressions and write a quadratic expression with integer-leading coefficients in an equivalent form by factoring. Add multi-variable polynomials made up of monomials of degree 2 or less. Graph and estimate the solution of systems of linear equations. • **3** Create and use quadratic inequalities in two variables to model a situation and to solve a problem. Write a quadratic expression in one variable with rational coefficients in an equivalent form by factoring, identify its zeros, and explain the solution steps as a process of reasoning. Use properties of exponents to write equivalent forms of exponential functions with one or more variables with integer coefficients with nonnegative integer exponents involving operations of addition, subtraction, and multiplication without requiring distribution of an exponent across parentheses. Solve a quadratic equation with integer roots in standard form. Represent polynomial and exponential functions graphically and estimate the solution of systems of equations displayed graphically. Understand that the plotted line, curve, or region represents the solution set to an equation or inequality. Add and subtract multi-variable polynomials of any degree and understand that polynomials are closed under subtraction.	2	0
	Target E Write expressions in equivalent forms to solve problems. (DOK 1, 2)	**A.SSE.3:** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.			
		A.SSE.3a: Factor a quadratic expression to reveal the zeros of the function it defines.			
		A.SSE.3b: Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.			
		A.SSE.3c: Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.			
	Target F Perform arithmetic operations on polynomials. (DOK 2)	**A.APR.1:** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.		1*	
	Target G Create equations that describe numbers or relationships. (DOK 1, 2)	**A.CED.1:** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.		4 - 5	
		A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.			
	Target H Understand solving equations as a process of reasoning and explain the reasoning. (DOK 1, 2)	**A.REI.2:** Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.			
	Target I Solve equations and inequalities in one variable. (DOK 1, 2)	**A.REI.3:** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.			
		A.REI.4: Solve quadratic equations in one variable.			
		A.REI.4a: Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2$ = q that has the same solutions. Derive the quadratic formula from this form.			
		A.REI.4b: Solve quadratic equations by inspection (e.g., for x^2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.			

	Target J Represent and solve equations and inequalities graphically. (DOK 1, 2)	**A.REI.10:** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	• **4** Choose an appropriate equivalent form of an expression in order to reveal a property of interest when solving problems. Solve a formula for any variable in the formula. Provide an example that would lead to an extraneous solution when solving linear, quadratic, radical, and rational equations. Use a variety of methods such as factoring, completing the square, quadratic formula, etc., to solve equations and to find minimum and maximum values of quadratic equations.	2	0
		A.REI.11: Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.			
		A.REI.12: Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.			
	Target K Understand the concept of a function and use function notation. (DOK 1, 2)	**F.IF.1:** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).	• **2** Understand the concept of a function in order to distinguish a relation as a function or not a function. Interpret quadratic functions in context, and given the key features of a graph, the student should be able to identify the appropriate graph. Graph quadratic functions by hand or by using technology. Identify properties of two linear or two quadratic functions. Understand equivalent forms of linear and quadratic functions. Build an explicit function to describe or model a relationship between two quantities. Add, subtract, and multiply linear functions. • **3** Identify the domain and range of linear, quadratic, and exponential functions presented in any form. Use function notation to evaluate a function for numerical or monomial inputs. Appropriately graph and interpret key features of linear, quadratic, and exponential functions in familiar or scaffolded contexts and specify the average rate of change of a function on a given domain from its equation or approximate the average rate of change of a function from its graph. Graph linear, quadratic, logarithmic, and exponential functions by hand and by using technology. Analyze and compare properties of a linear function to properties of another function of any type. Build a recursive function to describe or model a relationship between two quantities. Divide linear functions.	2**	
		F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.			
	Target L Interpret functions that arise in applications in terms of a context. (DOK 1, 2)	**F.IF.4:** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.		3 - 4***	
		F.IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.			
		F.IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.			
	Target M Analyze functions using different representations. (DOK 1, 2, 3)	**F.IF.7:** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.			
		F.IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.			
		F.IF.7b: Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.			
		F.IF.7c: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.			
		F.IF.7e: Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.			
		F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.			
		F.IF.8a: Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.			

	Target M: Continued	**F.IF.8b:** Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02^t), y = $(0.97)^t$, y = $(1.10)^{12t}$, y = $(1.2)^{t/10}$, and classify them as representing exponential growth or decay.	• **4** Find the input of a function when given the function in function notation and the output, or find the output when given the input. Describe complex features such as holes, symmetries, and end behavior of the graph of a function. Graph functions both by hand and by using technology.	3 - 4***	
		F.IF.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.			
	Target N Build a function that models a relationship between two quantities. (DOK 2)	**F.BF.1:** Write a function that describes a relationship between two quantities.			
		F.BF.1a: Determine an explicit expression, a recursive process, or steps for calculation from a context.			
		F.BF.2: Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.			
Supporting Cluster	**Target O Define** trigonometric ratios and solve problems involving right triangles. (DOK 1, 2)	**G.SRT.6:** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	• **2** Use the Pythagorean Theorem in unfamiliar problems to solve for the missing side in a right triangle with some scaffolding. • **3** Use trigonometric ratios and the sine and cosine of complementary angles to find missing angles or sides of a given right triangle with minimal scaffolding. • **4** Solve right triangle problems with multiple stages and in compound figures without scaffolding.	2	0
		G.SRT.7: Explain and use the relationship between the sine and cosine of complementary angles.			
		G.SRT.8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.			
	Target P Summarize, represent, and interpret data on a single count or measurement variable. (DOK 2)	**S.ID.1:** Represent data with plots on the real number line (dot plots, histograms, and box plots).	• **2** Describe the differences in shape, center, and spread of two or more different data sets representing familiar contexts. • **3** Select the appropriate choice of spread as interquartile range or standard deviation based on the selection of the measure of center. • **4** Interpret data to explain why a data value is an outlier.	1 - 2	
		S.ID.2: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.			
		S.ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).			

	Target A Extend the properties of exponents to rational exponents. (DOK 1, 2)	**N.RN.2:** Rewrite expressions involving radicals and rational exponents using the properties of exponents.	• **2** Extend the properties of integer exponents to multiply expressions with rational exponents that have common denominators. Perform operations on rational numbers and familiar irrational numbers. Understand that rational numbers are closed under addition and multiplication. • **3** Apply all laws of exponents on expressions with exponents that have common denominators. Rewrite expressions with rational exponents of the form (*m*/*n*) to radical form and vice versa. Use repeated reasoning to recognize that the sums and products of a rational number and a nonzero irrational number are irrational. • **4** Explain the relationship between properties of integer exponents and properties of rational exponents.	1	0
	Target B Use properties of rational and irrational numbers. (DOK 1, 2)	**N.RN.3:** Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.			
	Target C Reason quantitatively and use units to solve problems. (DOK 1, 2)	**N.Q.1:** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	• **2** Choose and interpret the correct units in a formula given in a familiar context, including making measurement conversions between simple units. • **3** Reason quantitatively to choose and interpret the units in a formula given in an unfamiliar context, including making compound measurement conversions. Define appropriate quantities or measurements in familiar contexts with some scaffolding to construct a model. Choose the scale and origin of a graph or data display. • **4** Define appropriate quantities or measurements in unfamiliar contexts with some scaffolding to construct a model.	1	
			Total Items for Claim #1	**19 - 22**	**0**

* Indicates 1 item total in Math CAT for Target F
** Indicates 2 items total in Math CAT for Target K.
***Indicates 4 – 5 items total in Math CAT for Target L, M, and N.

Claim 2. Problem Solving and 4. Modeling and Data Analysis: Students can solve a range of complex well posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies. Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

	Targets	Content Standards	Threshold Achievement Level Descriptors (ALD) Students Entering Level (2, 3, or 4) will be able to…	Item Types CAT	Item Types PT	Total Items
Claim 2: Problem Solving Claim 4: Modeling and Data Analysis	**Claim 2** **Target A** Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. (DOK 2, 3) **Target B** Select and use appropriate tools strategically. (DOK 1, 2, 3) **Target C** Interpret results in the context of a situation. (DOK 1, 2, 3) **Target D**. Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas. (DOK 1, 2, 3)	**See content standards for High School** **N-Q.A** **A-SSE.A, A-SSE.B** **A-CED.A** **A-REI.2, A-REI.B** **A-REI.C, A-REI.D** **F-IF.A, F-IF.B** **F-IF.C** **F-BF.A** **G-SRT.C** **S-ID.C** **S-CP.A**	• **2** Select tools to solve a familiar and moderately scaffolded problem and apply them with partial accuracy. Use the necessary elements given in a problem situation to solve a problem. Apply mathematics to propose solutions by identifying important quantities and by locating missing information from relevant external resources. • **3** Use appropriate tools to accurately solve problems arising in everyday life, society, and the workplace. Apply mathematics to solve problems by identifying important quantities and mapping their relationship and by stating and using logical assumptions. • **4** Analyze and interpret the context of an unfamiliar situation for problems of increasing complexity. Begin to solve problems optimally. Construct multiple plausible solutions and approaches.	**Target A** 2 **Target B, C, D** 1	1 - 2	**8-10**
	Claim 4 **Target A**: Apply problems arising in everyday life, society, and the workplace. (DOK 2, 3) **Target B:** Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. (DOK 2, 3, 4) **Target C:** State logical assumptions being used. (DOK 1, 2, 3) **Target D:** Interpret results in the context of a situation. (DOK 2, 3) **Target E:** Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. (DOK 2, 3, 4) **Target F:** Identify important quantities I a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or (formulas). (DOK 1, 2, 3) **Target G*:** Identify, analyze, and synthesize relevant external resources to pose or solve problems. (DOK 2, 3)	**See content standards for High School** **N-Q.A** **A-SSE.B** **A-CED.A** **A-REI.A, A-REI.B** **A-REI.C** **F-IF.B, F-IF.C** **F-BF.A** **S-ID.A, S-ID.B** **S-IC.1, S-IC.B** **F-LE.A, F-LE.B** **F-TF.5** **G-GMD.3** **G-MG**		**Target A, D** 1 **Target B, E** 1 **Target C, F** 1 **Target G** 0	1 - 3	

Claim 3 Communicating Reasoning: Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.

	Targets	Content Standards	Threshold Achievement Level Descriptors (ALD) Students Entering Level (2, 3, or 4) will be able to…	Item Types		Total Items
				CAT	PT	
Claim 3: Communicating Reasoning	**Claim 3** **Target A:** Test propositions or conjectures with specific examples. (DOK 2, 3) **Target B.** Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures. (DOK 2, 3, 4) **Target C.** State logical assumptions being used. (DOK 2, 3) **Target D.** Use the technique of breaking an argument into cases. (DOK 2, 3) **Target E.** Distinguish correct logic or reasoning from that which is flawed and —if there is a flaw in the argument—explain what it is. (DOK 2, 3, 4) **Target F.** Base arguments on concrete references such as objects, drawings, diagrams, and actions. (DOK 2, 3) **Target G**. At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.) (DOK 2, 3)	**See content standards for High School:** **N-RN.A, N-RN.B** **N-RN.3** **A-SSE.2** **A-APR.1, A-APR.B** **A-APR.R, A-APR.6** **A-REI.A, A-REI.1,** **A-REI.2, A-REI.C** **A-REI.10, A-REI.11** **F-IF.1, F-IF.5** **F-IF.9** **F-BF.3, F-BF.4a** **G-CO.A, G-CO.B** **G-CO.C, G.CO.9** **G-CO.10, G-CO.11** **G.SRT.A, G.SRT.B** **F-TF.1, F-TF.2** **F-TF.8**	• **2** Find and identify the flaw in an argument. • **3** Use stated assumptions, definitions, and previously established results and examples to identify and repair a flawed argument. Use previous information to support his or her own reasoning on a routine problem. • **4** Begin to construct chains of logic about abstract concepts autonomously.	**Target A, D** 3 **Target B, E** 3 **Target C, F, G** 2	**0 - 2**	**8 - 10**