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# Model Proficiency Scales for Mathematics Priority Performance Indicators (Grades 9-12)

## Purpose and Background

The purpose of this document is to provide SU/SDs with model proficiency scales to accompany the [Math Proficiency-Based Graduation Hierarchy](#). This document is part of the larger [Vermont Framework for Proficiency](#). The model proficiency scales were informed by extended feedback from and work with the field, including [Participatory Action Research](#) partnerships with Central Vermont Supervisory Union, White River Valley Supervisory Union, and Orleans Southwest Supervisory Union.

## Document Overview

Each of the five Critical Proficiencies (CPs) is indicated by a separate header. Below the header for each CP (Quantitative Reasoning, Algebraic Reasoning, Functional Reasoning, Geometric Reasoning, and Statistical Reasoning) is the text of that CP. Each CP includes the Priority Performance Indicators (PPIs) that were developed for that CP, based on the [CCSS for Mathematics](#), Achieve the Core's [Widely Applicable Prerequisites High School](#), the [Essential Math for College and Careers' Essential Concepts](#), review and input from the field, and other sources. Below each CP are the proficiency scales associated with each PPI.

The first step in developing proficiency scales is determining what a student must know and do in order to demonstrate proficiency in a given PPI. This begins with unpacking the grade level standard(s) that correspond to the selected PPI. Each learning target within these proficiency scales is derived from [MetaMetrics' Quantile Skills and Concepts](#) that have been arranged in increasing levels of complexity. The Middle of Year Quantile Student Measures were used to delineate the different levels within the scale; the 25th – 50th – 75th percentile measures indicate the thresholds for moving from one level to the next. It is important to remember that the beginning and developing levels of the scales illustrate the learning trajectory of skills and/or knowledge expectations that build toward proficiency and do not indicate less rigor for a student. For more information about the unpacking process, see [Vermont Framework for Proficiency: Developing Proficiency Scales](#).



**Critical Proficiency:** Quantitative Reasoning: Reason quantitatively and use units to solve problems.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Reasoning Quantitatively</b></p> <p>Reason quantitatively and use units to solve problems. (<a href="#">HSN.Q.A</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify and utilize appropriate scales in graphical displays.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>use dimensional analysis to rename quantities or rates.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>understand, identify, and convert appropriate units of measurement when solving problems.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>express my solutions utilizing significant digits.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Algebraic Reasoning: Create, interpret, use, and analyze expressions, equations, and inequalities.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Interpreting Expressions</b></p> <p>Interpret the structure of expressions. (<a href="#">HSA.SSE.A</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify and describe the terms, base, exponents, coefficients, and factors of an expression in number and word problems.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>add, subtract, and multiply polynomials.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify the terms, base, exponents, coefficients, and factors of an expression in number and word problems and use them to rewrite expressions; and</li> <li>factor quadratics, including special products.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>simplify expressions with rational exponents or radicals.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Algebraic Reasoning: Create, interpret, use, and analyze expressions, equations, and inequalities.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Creating Equations</b></p> <p>Create equations that describe numbers or relationships. (<a href="#">HSA.CED.A</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>write a linear equation or inequality to represent a given situation.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>solve linear equations and linear inequalities using the properties of equality and inequality appropriately and justify my reasoning; and</li> <li>solve for an indicated variable in a literal equation.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>create equations and inequalities in one variable, and graph the relationship given key features (e.g., slope, y-intercept, two points); and</li> <li>use formulas to solve simple rational and exponential functions (classifying as growth or decay).</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>create exponential functions from context and identify and interpret key features; and</li> <li>create quadratic functions given key features (e.g., zeros/roots, y-intercept, vertex).</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Algebraic Reasoning: Create, interpret, use, and analyze expressions, equations, and inequalities.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Solving Equations</b></p> <p>Solve equations and inequalities in one variable. (<a href="#">HSA.REI.B</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify and collect like terms; and</li> <li>evaluate the square root of a number.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>solve a literal equation for an indicated variable; and</li> <li>use properties of equality to rewrite linear expressions.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>use properties of equality to solve linear equations;</li> <li>use properties of inequality to solve linear inequalities; and</li> <li>solve quadratic equations by factoring and evaluating square roots.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify zeroes of a quadratic function;</li> <li>solve quadratic equations by completing the square and/or using the quadratic formula; and</li> <li>solve exponential equations.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Algebraic Reasoning: Create, interpret, use, and analyze expressions, equations, and inequalities.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Graphing Equations</b></p> <p>Represent and solve equations and inequalities graphically.  <a href="#">(HSA.REI.D)</a></p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify the rule used to generate a list of ordered pairs; and</li> <li>locate all ordered pairs in a coordinate plane.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>use ordered pairs derived from tables, algebraic equations, or verbal descriptions to graph linear functions.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>represent linear equations using tables of input values and corresponding output values, algebraic equations, graphs, or verbal descriptions;</li> <li>convert between the various representations of linear equations; and</li> <li>solve and graph the solution to a system of linear inequalities.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>find the solutions algebraically and graphically for equations of the form <math>f(x) = g(x)</math>, among linear, polynomial, rational, radical, absolute value, exponential, logarithmic, or trigonometric functions.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Functional Reasoning: Use linear and non-linear functions to interpret and analyze a variety of contexts.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Function Notation</b></p> <p>Understand the concept of a function and use function notation. (<a href="#">HSF.IF.A</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify from a set of numbers which values satisfy a given rule.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>generate ordered pairs using a rule;</li> <li>recognize and extend arithmetic and geometric sequences; and</li> <li>identify the common ratio or difference.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>use and interpret function notation algebraically and verbally;</li> <li>evaluate a function given a value from the domain; and</li> <li>write a recursive sequence formula.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>distinguish between relations and functions, independent and dependent variables, and domain and range; and</li> <li>determine whether relations are functions numerically and graphically.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Functional Reasoning: Use linear and non-linear functions to interpret and analyze a variety of contexts.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Analyzing Functions</b></p> <p>Analyze functions using different representations. <a href="#">(HSF.IF.C)</a></p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify the rule used to generate a list of ordered pairs.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>use ordered pairs to graph linear functions;</li> <li>identify and interpret the intercepts of a linear function; and</li> <li>graph quadratic functions and identify key characteristics (such as minimum, maximum, and axis of symmetry).</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>solve exponential growth and Decay problems;</li> <li>find and interpret key characteristics of quadratic functions (such as minimum, maximum, intercepts, vertex, orientation, and axis of symmetry); and</li> <li>graph absolute value functions (including corresponding inequalities).</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify critical values of exponential functions including those with rational and radical exponents;</li> <li>classify and compare two or more functions represented in multiple ways (including linear, quadratic, exponential, etc.); and</li> <li>find real and complex zeros of a function.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>



**Critical Proficiency:** Functional Reasoning: Use linear and non-linear functions to interpret and analyze a variety of contexts.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Building Functions</b></p> <p>Build a function that models a relationship between two quantities. (<a href="#">HSF.BF.A</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>write an equation to describe a relationship between two defined variables; and</li> <li>recognize the dependent variable in number and word problems.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify the common difference or ratio in a sequence and extend the pattern; and</li> <li>use an appropriate model to estimate and solve problems.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>write a function that describes a relationship between two quantities;</li> <li>model situations involving arithmetic and geometric sequences; and</li> <li>use a variety of representations to describe a sequence and translate between representations.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>write functions that describe relationships between two quantities that are non-linear; and</li> <li>describe real-world phenomena as functions and identify constraints on the domain and range.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Geometric Reasoning: Apply geometric concepts to solve problems in a variety of contexts.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Geometric Theorems</b></p> <p>Prove geometric theorems.  <a href="#">(HSG.CO.C)</a></p>	<p>I can:</p> <ul style="list-style-type: none"> <li>draw and measure angles using a protractor, knowing that a circle measures 360 degrees;</li> <li>use the distance formula to find the distance between two points; and</li> <li>use the midpoint formula to find the coordinates of the midpoint of a segment.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>define and identify complementary and supplementary angles;</li> <li>identify congruent and supplementary angles formed when a transversal crosses parallel lines;</li> <li>solve problems related to bisectors of angles and segments (including perpendicular bisectors); and</li> <li>solve problems related to altitudes, perpendicular bisectors, angle bisectors, and medians.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>interpret key characteristics of angles formed by intersecting lines and those formed when a transversal crosses parallel lines;</li> <li>solve problems using properties, definitions, and theorems of lines, angles, and polygons; and</li> <li>solve problems involving congruent triangles and their corresponding parts.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>solve problems using properties, definitions, and theorems of polygons related to interior and exterior angles of a convex polygon; and</li> <li>solve problems related to the segments parallel to one side of a triangle, including segments joining the midpoints of two sides of a triangle.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Geometric Reasoning: Apply geometric concepts to solve problems in a variety of contexts.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Right Triangle Trigonometry</b></p> <p>Define trigonometric ratios and solve problems involving right triangles. (<a href="#">HSG.SRT.C</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify the legs and hypotenuse in a right triangle; and</li> <li>use the Pythagorean Theorem to solve for a missing side of a right triangle.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>apply the Pythagorean Theorem to classify a triangle as acute, right, or obtuse; and</li> <li>apply the Pythagorean Theorem to find the distance between two points.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>use the properties of triangles to solve problems involving similar right triangles; and</li> <li>use trigonometric ratios to solve right triangles.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>apply the Law of Sines and the Law of Cosines to solve non-right triangles; and</li> <li>find the area of any triangle.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Statistical Reasoning: Interpret and apply statistics and probability to analyze data, justify conclusions, and make inferences.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Single Count Data</b></p> <p>Summarize, represent, and interpret data on a single count or measurement variable. (<a href="#">HSS.ID.A</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>organize, display, and interpret information in histograms; and</li> <li>identify and use appropriate scales and intervals in graphs and data displays.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>organize, display, and interpret information in box-and-whisker plots; and</li> <li>describe how the mean, frequency distribution, and interquartile range of a set of data affect its graph.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>identify outliers and determine their effect on the mean, median, and range of a set of data;</li> <li>use mean, median, and range to compare data and distributions of data, both numeric and contextual; and</li> <li>draw conclusions that consider measures of center and measures of variability.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>define and use the normal distribution curve to model a set of data; and</li> <li>determine measures of spread (standard deviation).</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>

**Critical Proficiency:** Statistical Reasoning: Interpret and apply statistics and probability to analyze data, justify conclusions, and make inferences.

Priority Performance Indicator	Beginning	Developing	Proficient	Expanding
<p><b>Data Inferences</b></p> <p>Summarize, represent, and interpret data on two categorical and quantitative variables. (<a href="#">HSS.ID.B</a>)</p>	<p>I can:</p> <ul style="list-style-type: none"> <li>construct a two-way data table; and</li> <li>interpret the association between two categories of data.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>represent data on two quantitative variables in a scatter plot; and</li> <li>approximate a line of best fit to a set of data.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>describe how the variables in a scatter plot are related;</li> <li>use technology to derive the line of best fit; and</li> <li>make predictions on a set of data using the line of best fit.</li> </ul>	<p>I can:</p> <ul style="list-style-type: none"> <li>calculate basic and conditional probabilities from a two-way data table; and</li> <li>use technology to fit quadratic and exponential functions to best approximate data in a scatterplot.</li> </ul> <p style="text-align: center;">- or -</p> <p>I can create alternative evidence that expands upon proficient.</p>