



NEW HAMPSHIRE Common Core State Standards-Aligned MATHEMATICS MODEL GRADUATION COMPETENCIES

9-12	
<p>1. Competency Statement for Symbolic Expression</p> <p><i>“I can statements” are examples of what educators may see in performance tasks when students demonstrate their increasing understanding and use of the competencies.</i></p>	<p>Students will reason abstractly and manipulate symbolic expressions and models to represent relationships and interpret expressions, equations, and inequalities in terms of a given context (including real-world phenomena) for determining unknown values.</p> <ul style="list-style-type: none"> • I can write, apply, and provide a rational for a mathematical model representing a given situation (e.g., linear, quadratic, exponential, trigonometric) • I can analyze and symbolically represent complex numbers (both real and imaginary numbers) • I can interpret and use symbols to express relationships and justify reasoning when solving problems (e.g., evaluating expressions; modeling equations, inequalities, systems of equations/ inequalities). • I can apply properties of arithmetic and algebra to simplify and manipulate symbolic expressions or models involving real/imaginary numbers • I can analyze and use the structure of expressions to generate equivalent forms which emphasize different properties of the quantity represented by the expression (e.g., factoring, completing the square, various linear/nonlinear forms) • I can analyze, symbolically represent, and use vector and matrix quantities in problem solving (+)¹
<p>Aligned National standards</p>	<p>F-LE 1-5, N-CN 1-2, A-SSE1, A-REI1, A-REI5, A-SSE 2-3, A-APR1, A-SSE3, A-APR 6, N-VM3, N-VM6 Math Practices 1, 2, 8</p>

*See GLOSSARY

Competencies statements above are aligned with **Foundations of Math - Symbolic Expression* (SE)**: The use and manipulation of symbols and expressions provide a variety of representations for solving problems and expressing mathematical concepts, relationships, and reasoning. This definition is from the organizational structure of the Learning Progressions Framework Designed for Use with the Common Core State Standards in Mathematics (Hess, et al., 2011).

¹ “I can ...” statements and Common Core standards with this symbol (+) represent additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics (*Common Core State Standards for Mathematics*, p. 57).



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2. Competency Statement for Numbers and Number Systems	<p>Students will expand their understanding of number systems, thinking flexibly and attending to precision and reasonableness, when solving problems using complex numbers.</p> <ul style="list-style-type: none"> I can justify how I apply properties of complex number systems (including real and imaginary numbers) in a variety of contexts (e.g., arithmetic operations, polynomials, rational exponents).
Aligned National standards	N-RN 1, N-RN 2 Math Practices 7, 8
3. Competency Statement for Reasoning and Computational Strategies	<p>Students will expand the use of computational strategies and algorithms, using evidence to support authentic application.</p> <ul style="list-style-type: none"> I can use computational strategies and algorithms, with complex numbers and (+) matrix quantities and provide rationales for their use.
Aligned National standards	N-RN 3 Math Practices 4, 7
4. Competency Statement for Metacognitive Skills* And Communication	<p>Students will use reasoning and metacognitive skills to develop mathematical arguments to justify the reasonableness of conjectures and outcomes and to support formal proofs.</p> <ul style="list-style-type: none"> I can reason quantitatively when analyzing, representing, and solving problems (e.g., algebraic or statistical models). I can compare the effectiveness or logic of two plausible arguments or models I can prove geometric theorems (e.g., triangles, circles, lines, angles).
Aligned National standards	A-REI 10 – 12, G-CO 9 – 11 Math Practices 2, 3, 5

*See GLOSSARY

Competencies statements above are aligned with **Numbers and Operations (NO)**: Understandings of number (“how many” or “how much”) and number types extend applications of arithmetic properties, operations, and number systems and guide the use of computational strategies and algorithms. This definition is from the organizational structure of the Learning Progressions Framework Designed for Use with the Common Core State Standards in Mathematics (Hess, et al., 2011).



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5. Competency Statement for Measurement	<p>Students will explain reasoning when applying and modeling geometric measurement formulas.</p> <ul style="list-style-type: none"> I can create informal arguments that support geometric formulas (e.g., circumference and area of circles or sectors of circles; volume of cylinder, pyramid, cone, sphere; surface area of 2-D and 3-D figures). I can provide rationales for solving measurement problems that require making conversions among various units and measurement systems, visualizing relationships between 2- and 3-dimensional objects (e.g., identifying shapes of cross-sections or 3-dimensional objects generated by rotations of two-dimensional objects), or applying the effect of a scale factor on area or volume.
Aligned National standards	G-GMD 1 – 3, N-Q 2 – 3, G-GMD 4, G-MG 1 – 3 Math Practices 2, 3, 6, 8

Competencies statements above are aligned with **Measurement (ME)**: Measurement attributes, processes, and tools help us quantify, compare, and solve problems involving objects, situations, and events. This definition is from the organizational structure of the Learning Progressions Framework Designed for Use with the Common Core State Standards in Mathematics (Hess, et al., 2011).



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6. Competency Statement for Algebraic Functions Patterns, And Relations*	<p>Students will make use of patterns, relations, and functions to interpret, compare, and analyze pure and applied situations, using the information to make conjectures and support conclusions.</p> <ul style="list-style-type: none"> • I can write and apply an algebraic model to represent and answer questions about a given situation (e.g., linear, quadratic, polynomial, exponential, trigonometric) and justify my conclusions. • I can interpret, analyze, and use relations and functions applied in a variety of contexts, including real- world phenomena. • I can analyze relations and functions, using multiple representations (e.g., verbal, numerical, graphical, algebraic) and justify my reasoning • I can identify, build, and perform operations on relations and functions (e.g., compose functions, inverse) and justify my reasoning.
Aligned National standards	F-IF 1 – 3, A-CED 1 – 4, A-SSE4, F-IF 4-6, A-APR 3, A-REI 5 – 7, F-IF 7 -9, A-REI 2 – 4, A-APR 2, F-BF 1 - 4 Math Practices 3, 7

*See GLOSSARY

Competencies statements above are aligned **with Algebraic Functions, Patterns, and Relations* (AFPR)**: Patterns, relations, and functions are used to represent and analyze change in various contexts, make predictions and generalizations, and provide models and explanations for real-world phenomena. This definition is from the organizational structure of the Learning Progressions Framework Designed for Use with the Common Core State Standards in Mathematics (Hess, et al., 2011).



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7. Competency Statement for Geometry	<p>Students will solve problems involving spatial reasoning using properties of 2- and 3- dimensional figures to analyze, represent, and model geometric relationships in pure/theoretical and authentic, applied contexts.</p> <ul style="list-style-type: none"> • I can use algebraic properties and geometric theorems and postulates to construct and apply viable arguments involving congruence and similarity (e.g., coordinate geometry, indirect/direct proofs, circles, polygons). • I can apply geometric theorems and postulates, sometimes using algebraic properties, to solve problems (e.g., using angles, triangles, trigonometry, circles, polygons). • I can support my reasoning when answering questions about perimeter, area, and volume of complex objects. • I can apply properties of right triangles and circles on the coordinate plane to extend the concepts of trigonometry (e.g., unit circle, Pythagorean Identity, radian measure). • I can create and use a formal geometric construction, using appropriate tools, to illustrate geometric properties (e.g., model a real-world situation).
Aligned National standards	<p>G-CO 1 – 8, G-C 1 -2, G-GPE 1 -2, G-SRT 3, G-SRT 6 – 7, G-GPE 4 – 7, F-TF 1 -2, G-GMD 1, G-GMD 3, G-SRT 4-5, S-SRT 8, G-C 5, F-TF 5, F-TF 8, G-CO 12 – 13, G-C 3, G-MG 1 – 3, G-SRT 1 – 2 Math Practices 4, 5, 6</p>

*See GLOSSARY

Competencies statements above are aligned with **Geometry (GM)**: Visualizations, spatial reasoning, and properties of 2- and 3-dimensional figures can be used to analyze, represent, and model geometric concepts and relationships. This definition is from the organizational structure of the Learning Progressions Framework Designed for Use with the Common Core State Standards in Mathematics (Hess, et al., 2011).



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8. Competency Statement for Data Analysis, Probability, And Statistics	<p>Students will apply statistical methods and reasoning to summarize, represent, analyze, and interpret categorical and quantitative data, including addressing authentic*, applied scenarios. Students will apply the rules of probability to determine the likelihood of a given outcome or to make decisions.</p> <ul style="list-style-type: none"> • I can formulate questions to clarify the problem at hand and formulate one (or more) questions that can be answered with data. • I can design and implement a plan to collect the appropriate data to answer the statistical question. • I can summarize data using appropriate statistics (e.g., describe or compare measures of center, spread, association). • I can select appropriate graphical and numerical methods and use these methods to represent the data in a way that supports interpretation (e.g., dot plots, histograms, scatter plots). • I can interpret descriptive statistics and linear models within the context of the data and the original question. • I can design and conduct probability experiments for given authentic situations. • I can compute probabilities, including conditional probabilities, of compound events in a uniform probability model. • I can apply probability concepts to analyze and evaluate potential decisions and strategies. (+)
Aligned National standards	S-IC 3, S-IC 1 -2, S-ID 2, S-IC 4 – 6, N-Q1, S-ID 1, S-ID 3 – 9, S-CP 1 – 7, S-MD 5 – 7 Math Practices 1, 2, 7

*See GLOSSARY

Competencies statements above are aligned with **Data Analysis, Probability, and Statistics (DPS)**: Questions are posed and investigated by collecting data or retrieving existing data, and representing, analyzing, and interpreting data. Investigations, inferences, and predictions are used to make critical and informed decisions. This definition is from the organizational structure of the Learning Progressions Framework Designed for Use with the Common Core State Standards in Mathematics (Hess, et al., 2011).



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GLOSSARY:

Symbolic Expression: Symbolic Expression is foundational to all areas of mathematics and includes the use and manipulation of symbols and representations. Foundations of math also include the math practices, such as reasoning, representation, and communication.

Metacognitive skills are evidenced when students reflect on their own learning and frame and monitor their own learning and goals. They seek out and use evidence of their own progress from one or more sources to improve their performance. They act on feedback from formative assessments.

Authentic Applied Contexts: an instructional approach that allows students to explore, discuss, and meaningfully construct concepts and relationships in contexts that involve real-world problems and projects that are relevant to the learner.

Relations (Geometric and Arithmetic): A *relation* "maps" elements of one set to another set.