Number and Quantity Mathematics Standards

Comparison Tool for Standards Transition

Updated June 2012

This document can be used to assist educators in analyzing the commonalities differences between the new Alaska mathematics standards and the Fourth Edition (Grade Level Expectations). This document is a first start toward a transition and districts may choose to augment with more detail.

The first column contains the new math standards. The second column shows the Grade Level Expectations (GLEs) that align to the new standards. The third column provides comments, usually highlighting differences between the new standards and GLEs that align in higher grades. Additionally, the comments may include a notation about an increase in rigor. Rigor may be defined as a standard that requires deeper understanding, higher-order thinking, expanded analytical processes, or simply a skill introduced at an earlier grade.

Note that some GLEs are coded with an L. This signifies that the GLE was not assessed on the statewide assessment; it was to be assessed at the local level. No new standards are identified as being for local assessment. Students advancing through the grades are expected to meet each year’s grade-specific standards and retain or further develop skills and understandings mastered in preceding grades.

In most cases there are not complete matches between the two sets of standards, and it should not be assumed that either the content or skills found in one set of standards will match completely with those of the other set.

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| 6.RP.2. Understand the concept of a unit rate (*a*/*b* associated with a ratio *a:b* with *b ≠* 0, and use rate language in the context of a ratio relationship) and apply it to solve real world problems (e.g., unit pricing, constant speed).  *For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar.” “We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger.”* | **[6] E&C-5** developing and interpreting scale models  Any aligned GLE found in the higher grades will need to be absorbed in the lower grade as part of the transition. | Grade 6 GLE provides a specific real-world model for understanding unit rate.  **[7] E&C-6** solving proportions using a given scale  **[8] E&C-5** using ratio and proportion |

The new standards represent a shift in the purpose of the standards. They are more instructional in nature, intended to guide classroom curriculum. The new standards do not serve as an assessment document, unlike the GLEs. The Department with the support of stakeholders will prepare an assessment framework that will guide the development of the new assessments. The new standards will be assessed starting spring 2016. Until then, all districts will continue administering the Standards Based Assessments aligned to the GLEs through spring 2015.

**The GLEs that are not matched to the new standards can be found in a separate document, HS Math GLEs.** The comment column indicates where the GLE may be matched to a new standard in a lower or higher grade. Although some GLEs will be taught at other grade levels, teachers must provide opportunities for these GLEs to be reviewed in preparation for the spring Standards Based Assessments through spring 2015.

| **Grade 6 Math GLEs not matched by new standards** | **Comments** |
| --- | --- |
| **The student demonstrates conceptual understanding of fractions (proper or mixed numbers), decimals, percents (whole number), or integers by**  **[6] N-2** identifying place value positions from thousandths to millions (L) | Grade 4 and 5 Standards  **(4.NF.6, 4.NF.7, 5.NBT.3)** |

This GLE must be reviewed prior to the SBA through spring 2015.

Finally, the new standards for each grade level define what students should understand and be able to do by the end of each grade which includes the Standards for Mathematical Practice. The Standards for Mathematical Practice describe characteristics and traits that mathematics educators at all levels should seek to develop in their students. They describe ways that students should be engaging with mathematics as they progress through school. The integration of these standards into classroom instruction is a key strategy for increasing cognitive demand and conceptual learning. The Standards for Mathematical Practice are included in the separate document, HS Math GLEs.

The next page provides an overview of this conceptual category.

**Number and Quantity Overview**

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| **The Real Number System**   * Extend the properties of exponents to rational exponents. * Use properties of rational and irrational numbers.   **Quantities\***   * Reason quantitatively and use units to solve problems.   **The Complex Number System**   * Perform arithmetic operations with complex numbers. * Represent complex numbers and their operations on the complex plane. + * Use complex numbers in polynomial identities and equations.   **Vector and Matrix Quantities**   * Represent and model with vector quantities. + * Perform operations on vectors. + * Perform operations on matrices and use matrices in applications. +   \*Standards with connections to modeling. If asterisk appears on the category, domain, or cluster for a group of standards, it should be understood to apply to all standards in that group. There may be individual standards within clusters with connections to modeling.  + Standards include additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics. | **In High School, students:**   * Build on and informally extend their understanding of integer exponents to consider exponential functions; * Reason with the units in which those quantities are measured when functions describe relationships between quantities arising from a context; * Explore distinctions between rational and irrational numbersin preparation for work with quadratic relationships; * Identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations; and * Work with quantities and the relationships between them to provide grounding for work with expressions, equations, and functions. |
| **Mathematical Practices (MP)**   1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning |

**The Real Number System - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Extend the properties of exponents to rational exponents.** |  |  |
| N-RN.1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5.* | **[10] N-2** simplifying expressions with positive and negative exponents  **[10] N-3** expressing square roots in simplest radical form  **[10] N-5** describing or illustrating the use of inverse operations(cubing/cube root) | GLEs do not specifically address explaining the definition of rational exponents. |
| N-RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. *For example: Write equivalent representations that utilize both positive and negative exponents.* | **[9] N-2** equating different equivalent representations of the same exponential expression (e.g., )  **[10] N-2** simplifying expressions with positive and negative exponents | GLEs do not specifically address rational exponents. |
| **Use properties of rational and irrational numbers.** |  |  |
| 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. |  | GLEs do not specifically address closure properties.  **[10] N-4** addresses arithmetic operations on real numbers. Other GLEs that lead up to **[10] N-4** include specific properties such as commutative, associative, and identity but not closure.  **[10] N-7** identifying or applying commutative, identity, associative, inverse, or distributive properties to real numbers and variables |

**Quantities\* - Alaska New Mathematics Standards**

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| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| **Reason quantitatively and use units to solve problems.** |  |  |
| 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. | **[9] PS-1** selecting, modifying, and applying a variety of problem-solving strategies (e.g., charts, graphing, inductive and deductive reasoning, Venn diagrams) and verifying the results  **[10] PS-1** applying multi-step, integrated, mathematical problem-solving strategies | GLEs do not specifically reference using units. |
| N-Q.2. Define appropriate quantities for the purpose of descriptive modeling. | NEW – not addressed in the GLEs | There are problem solving GLEs and GLEs involving rates (**[9] E&C-4**) but no specific reference to using units in modeling situations. |
| N-Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | NEW – not addressed in the GLEs |  |

**The Complex Number System - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
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| **Perform arithmetic operations with complex numbers.** |  | No GLEs address complex numbers. |
| N-CN.1. Know there is a complex number *i* such that *i*2 = –1, and every complex number has the form *a* + *bi* with *a* and *b* real. | NEW – not addressed in the GLEs |  |
| N-CN.2. Use the relation *i*2 = –1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. | NEW – not addressed in the GLEs |  |
| N-CN.3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. | NEW – not addressed in the GLEs |  |
| **Represent complex numbers and their operations on the complex plane.** |  |  |
| N-CN.4. (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. | NEW – not addressed in the GLEs |  |
| N-CN.5. (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example,* (1 – √3i)3 = 8 *because* (1 – √3i) *has modulus* 2 *and argument* 120°. | NEW – not addressed in the GLEs |  |

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| N-CN.6. (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints. | NEW – not addressed in the GLEs |  |
| **Use complex numbers in polynomial identities and equations.** |  |  |
| N-CN.7. Solve quadratic equations with real coefficients that have complex solutions. | **[10] F&R-6** selecting and using the quadratic formula to solve problems | The GLE is broad enough to include complex solutions but is not specified. |
| N-CN.8. (+) Extend polynomial identities to the complex numbers. *For example, rewrite x*2 + 4 *as* (*x* + 2*i*)(*x* – 2*i*). | NEW – not addressed in the GLEs |  |
| N-CN.9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. | NEW – not addressed in the GLEs |  |

**Vector and Matrix Quantities - Alaska New Mathematics Standards**

| **New Math Standards** | **Grade Level Expectations** | **Comment** |
| --- | --- | --- |
| **Represent and model with vector quantities.** |  |  |
| N-VM.1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., ***v***, |***v***|, ||***v***||, ***v***). | NEW – not addressed in the GLEs |  |
| N-VM.2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. | NEW – not addressed in the GLEs |  |
| N-VM.3. (+) Solve problems involving velocity and other quantities that can be represented by vectors. | NEW – not addressed in the GLEs |  |
| **Perform operations on vectors.** |  |  |
| N-VM.4. (+) Add and subtract vectors.  a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.  b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.  c. Understand vector subtraction ***v*** – ***w*** as ***v*** + (–***w***), where –***w*** is the additive inverse of ***w***, with the same magnitude as ***w*** and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. | NEW – not addressed in the GLEs |  |
| N-VM.5. (+) Multiply a vector by a scalar.  a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as *c*(*v*x, *v*y) = (*cv*x, *cv*y).  b. Compute the magnitude of a scalar multiple *c****v*** using ||*c****v***|| = |*c*|***v***. Compute the direction of *c****v*** knowing that when |*c*|***v*** ≠ 0, the direction of *c****v*** is either along ***v*** (for *c* > 0) or against ***v*** (for *c* < 0). | NEW – not addressed in the GLEs |  |
| **Perform operations on matrices and use matrices in applications.** |  |  |
| N-VM.6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. | NEW – not addressed in the GLEs |  |
| N-VM.7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. | NEW – not addressed in the GLEs |  |
| N-VM.8. (+) Add, subtract, and multiply matrices of appropriate dimensions. | NEW – not addressed in the GLEs |  |
| N-VM.9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. | NEW – not addressed in the GLEs |  |
| N-VM.10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse. | NEW – not addressed in the GLEs |  |
| N-VM.11. (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. | NEW – not addressed in the GLEs |  |
| N-VM.12. (+) Work with 2 × 2 matrices as a transformations of the plane, and interpret the absolute value of the determinant in terms of area. | NEW – not addressed in the GLEs |  |