North Carolina Department of Public Instruction
INSTRUCTIONAL SUPPORT TOOLS
FOR ACHIEVING NEW STANDARDS

This document is designed to help North Carolina educators teach the Common Core (Standard Course of Study). NCDPI staff are continually updating and improving these tools to better serve teachers.

Number and Quantity ● Unpacked Content

For the new Common Core standards that will be effective in all North Carolina schools in the 2012-13 school year.

What is the purpose of this document?
To increase student achievement by ensuring educators understand specifically what the new standards mean a student must know, understand and be able to do.

What is in the document?
Descriptions of what each standard means a student will know, understand and be able to do. The "unpacking" of the standards done in this document is an effort to answer a simple question "What does this standard mean that a student must know and be able to do?" and to ensure the description is helpful, specific and comprehensive for educators.

How do I send Feedback?
We intend the explanations and examples in this document to be helpful and specific. That said, we believe that as this document is used, teachers and educators will find ways in which the unpacking can be improved and made ever more useful. Please send feedback to us at feedback@dpi.state.nc.us and we will use your input to refine our unpacking of the standards. Thank You!

The Real Number System	**N.RN**
Common Core Cluster	
Extend the properties of exponents to rational exponents.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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 $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.	**N.RN.1** Understand that the denominator of the rational exponent is the root index and the numerator is the exponent of the radicand. For example, $5^{1/2} = \sqrt{5}$ **N.RN.1** Extend the properties of exponents to justify that $(5^{1/2})^{2} = 5$
N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	**N.RN.2** Convert from radical representation to using rational exponents and vise versa.
Instructional Expectations	
In the **traditional pathway**, for **Algebra I** in implementing the standards in curriculum, these standards should occur before discussing exponential functions with continuous domains.	

The Real Number System N.RN

Common Core Cluster

Use properties of rational and irrational numbers.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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.	**N.RN.3** Know and justify that when adding or multiplying two rational numbers the result is a rational number **N.RN.3** Know and justify that when adding a rational number and an irrational number the result is irrational. **N.RN.3** Know and justify that when multiplying of a nonzero rational number and an irrational number the result is irrational

Instructional Expectations

In both pathways, for **Algebra I** and **CCSS Mathematics II**, connect N.RN.3 to physical situations, e.g., finding the perimeter of a square of area 2.

Quantities	**N.Q**
Common Core Cluster	
Reason quantitatively and use units to solve problems.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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.	**N.Q.1** Interpret units in the context of the problem **N.Q.1** When solving a multi-step problem, use units to evaluate the appropriateness of the solution. **N.Q.1** Choose the appropriate units for a specific formula and interpret the meaning of the unit in that context. **N.Q.1** Choose and interpret both the scale and the origin in graphs and data displays
N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.	**N.Q.2** Determine and interpret appropriate quantities when useing descriptive modeling.
N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	**N.Q.3** Determine the accuracy of values based on their limitations in the context of the situation.
Instructional Expectations	
In both pathways, **Algebra I** and **CCSS Mathematics I**, working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.	

The Complex Number System N.CN

Common Core Cluster

Perform arithmetic operations with complex numbers.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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.	**N.CN.1** Know that every number is a complex number of the form a + bi, where a and b are real numbers. **N.CN.1** Know that the complex number $i^2 = -1$.
N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	**N.CN.2** Apply the fact that the complex number $i^2 = -1$. **N.CN.2** Use the associative, commutative, and distributive properties, to add, subtract, and multiply complex numbers.
N.CN.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.	**N.CN.3** Given a complex number, find it's conjugate and use it to find quotients of complex numbers. **N.CN.3** Find the magnitude(length), modulus(length) or absolute value(length), of the vector representation of a complex number.

Instructional Expectations

In the **international pathway**, **CCSS Mathematics II**, for N.RN.1 and N.RN.2, the expectation is to limit to miltiplictions that involve i^2 as the highest power of i.

The Complex Number System	N.CN
Common Core Cluster	
Represent complex numbers and their operations on the complex plane.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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.	**N.CN.4** Transform complex numbers in a complex plane from rectangular to polar form and vise versa, **N.CN.4** Know and explain why both forms, rectangular and polar, represent the same number.
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°.	**N.CN.5** Geometrically show addition, subtraction, and multiplication of complex numbers on the complex coordinate plane. **N.CN.5** Geometrically show that the conjugate of complex numbers in a complex plane is the reflection across the x-axis. **N.CN.5** Evaluate the power of a complex number, in rectangular form, using the polar form of that complex number.
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.	**N.CN.6** Calculate the distance between values in the complex plane as the magnitude, modulus, of the difference, and the midpoint of a segment as the average of the coordinates of its endpoints.
Instructional Expectations	

The Complex Number System	**N.CN**
Common Core Cluster	
Use complex numbers in polynomial identities and equations.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.	**N.CN.7** Solve quadratic equations with real coefficients that have solutions of the form a + bi and a – bi.
N.CN.8 (+) Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as (x + 2i)(x – 2i).	**N.CN.8** Use polynomial identities to write equivalent expressions in the form of complex numbers
N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.	**N.CN.9** Understand The Fundamental Theorem of Algebra, which says that the number of complex solutions to a polynomial equation is the same as the degree of the polynomial. Show that this is true for a quadratic polynomial.
Instructional Expectations	
In the **traditional pathway**, **Algebra II** limits to polynomials with real coefficients. In the **international pathway**, **CCSS Mathematics II** limits to quadratics with real coefficients while **CCSS Mathematics III** builds on the work with quadratics equations in Mathematics II. Limit to polynomials with real coefficients here.	

Vector and Matrix Quantities N.VM

Common Core Cluster

Represent and model with vector quantities.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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).	**N.VM.1** Know that a vector is a directed line segment representing magnitude and direction. **N.VM.1** Use the appropriate symbol representation for vectors and their magnitude.
N.VM.2 (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	**N.VM.2** Find the component form of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point, therefore placing the initial point of the vector at the origin.
N.VM.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.	**N.VM.3** Solve problems such as velocity and other quantities that can be represented using vectors.

Instructional Expectations

Vector and Matrix Quantities N.VM

Common Core Cluster

Perform operations on vectors.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
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	**N.VM.4a** Know how to add vectors head to tail, using the horizontal and vertical components, and by finding the diagonal formed by the parallelogram. **N.VM.4b** Understand that the magnitude of a sum of two vectors is not the sum of the magnitudes unless the vectors have the same heading or direction. **N.VM.4c** Know how to subtract vectors and that vector subtraction is defined much like subtraction of real numbers, in that v – w is the same as v + (–w), where –w is the additive inverse of w. The opposite of w, -w, has the same magnitude, but the direction of the angle differs by 180°. **N.VM.4c** Represent vector subtraction on a graph by connecting the vectors head to tail in the correct order and using the components of those vectors to find the difference.

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.	
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(vx, vy) = (cvx, cvy). b. Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).	**N.VM.5a** Represent scalar multiplication of vectors on a graph by increasing or decreasing the magnitude of the vector by the factor of the given scalar. If the scalar is less than zero, the new vector's direction is opposite the original vector's direction. **N.VM.5a** Represent scalar multiplication of vectors using the component form, such as c(vx, vy) = (cvx, cvy). **N.VM.5b** Find the magnitude of a scalar multiple, cv, is the magnitude of v multiplied by the factor of the |c|. Know when c > 0, the direction is the same, and when c < 0, then the direction of the vector is opposite the direction of the original vector.
Instructional Expectations	

Vector and Matrix Quantities N.VM

Common Core Cluster

Perform operations on matrices and use matrices in applications.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
N.VM.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.	**N.VM.6** Represent and manipulate data using matrices, e.g., to organize merchandise, keep total sales, costs, and using graph theory and adjacency matrices to make predictions.
N.VM.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.	**N.VM.7** Multiply matrices by a scalar, e.g., when the inventory of jeans for July is twice that for January.
N.VM.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.	**N.VM.8** Know that the dimensions of a matrix are based on the number of rows and columns. **N.VM.8** Add, subtract, and multiply matrices of appropriate dimensions.
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.	**N.VM.9** Understand that matrix multiplication is not commutative, $AB \neq BA$, however it is associative and satisfies the distributive properties.

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.	**N.VM.10** Identify a zero matrix and understand that it behaves in matrix addition, subtraction, and multiplication, much like 0 in the real numbers system. **N.VM.10** Identify an identity matrix for a square matrix and understand that it behaves in matrix multiplication much like the number 1 in the real number system. **N.VM.10** Find the determinant of a square matrix, and know that it is a nonzero value if the matrix has an inverse. **N.VM.10** Know that if a matrix has an inverse, then the determinant of a square matrix is a nonzero value.
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.	**N.VM.11** To translate the vector $\overrightarrow{AB}$, where A(1,3) and B(4,9), 2 units to the right and 5 units up, perform the following matrix multiplication. $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 4 \\ 3 & 9 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 6 \\ 8 & 14 \\ 1 & 1 \end{bmatrix}$
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.	**N.VM.12** Given the coordinates of the vertices of a parallelogram in the coordinate plane, find the vector representation for two adjacent sides with the same initial point. Write the components of the vectors in a 2x2 matrix and find the determinant of the 2x2 matrix. The absolute value of the determinant is the area of the parallelogram. (This is called the dot product of the two vectors.)
Instructional Expectations	