Nebraska Mathematics Articulation:

Pre-Kindergarten through Postsecondary (P-16)

Table of Contents

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Dear Pre-Kindergarten through Postsecondary Nebraska Educators:

A significant challenge facing today's educational system is the need to create a seamless educational path from pre-kindergarten through postsecondary education. In Nebraska, that challenge is being addressed through the P-16 initiative.

Nebraska Mathematics Articulation: Pre-Kindergarten through Postsecondary (P-16) was created with the input and guidance of over 75 educators representing all education levels from across Nebraska. The P-16 Mathematics Alignment Task Force met to discuss the challenge and to identify the critical gateways leading to a smooth transition between education levels. The end product was shared statewide with other mathematics professionals for validation and input.

Those individuals who played a part in developing the mathematics document intended for it to be used as a resource to encourage dialogue and understanding among education partners, rather than a checklist for assuring compliance with Nebraska Mathematics Content Standards or with postsecondary admission requirements. The purpose of the resource is to help support a seamless educational path for Nebraska students.

We would like to acknowledge the leadership contributions of Gordon Woodward, Buren (Skip) Thomas and Deb Romanek throughout the development of the mathematics resource document. We hope you will find *Nebraska Mathematics Articulation: Pre-Kindergarten through Postsecondary (P-16)* helpful as you work to enhance the academic success of Nebraska students as they move through the Nebraska educational systems.

P-16 Steering Committee

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Stan Carpenter, Executive Director, Nebraska State College System
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Introduction

The Process

A series of meetings were held to discuss PreK-16 mathematics transition with educators and admissions staff representing elementary, middle school, high school, two-year and four-year colleges. Discussions at the meetings focused on mathematics skills that commonly cause difficulty for students and where those skills exist in the K-12 curriculum. Participants at these meetings worked with the Nebraska Mathematics Content Standards and Postsecondary prerequisites to map the transition between grade levels. A draft document was shared with Nebraska mathematics professionals for input prior to preparing the final product.

The Purpose

This resource was designed to define student expectations in the fundamentals of mathematics and underscore the importance of mastering these skills. This document also offers insight into the significance of the Nebraska Mathematics Content Standards and their implications for entry into postsecondary mathematics classes. This document is not intended to be a compliance checklist, but rather and articulation tool for educators who believe that Nebraska students should experience success through a well-defined, seamless educational path.

This resource document contains two sections:

I. *PreK-12 Section*
There is considerable variance in Nebraska's PreK-12 programs. This section is designed to show conceptual development of what good mathematics is for all students at four levels: pre-kindergarten, elementary, middle and high school. At each level, student expectations and sample experiences or topics correlated with the Nebraska Mathematics Content Standards are listed.

II. *Transition from PreK-12 to Postsecondary Programs Section*
Throughout the state, entry-level postsecondary course requirements are quite similar; therefore, this section is very focused. This section provides a list of skills essential for success in entry-level postsecondary mathematics courses or programs. Each skill is identified first by name, then by example as it appears in a typical problem, and followed by the associated Nebraska Mathematics Content Standard. For example, a student expecting to enroll in College Algebra should be familiar with how to solve the listed essential skills problems. If the enrolled student is unable to solve those essential skills problems, he or she will find College Algebra difficult – perhaps too difficult for success.

Most of Nebraska's postsecondary institutions require students to enroll in at least one of the five courses listed in the document, or a basic statistics course. Statistics is omitted in the document because the typical entry-level statistics course assumes that the student does not have a background in statistics other than basic algebra. It should be noted, however, that students with no basic statistics experience generally find the quantity and flow of new ideas in this one semester course to be very difficult. Therefore, one cannot overestimate the importance of the statistics component in the Nebraska Mathematics Content Standards.

Note: We acknowledge a risk in listing specific postsecondary transition skills and the tendency to use them as the design for secondary curriculum. The intent of this articulation resource is NOT to provide a basis for curriculum design. Students need exposure to a variety of mathematical topics suggested by state and national standards in order to be successful and mathematically literate. This resource does highlight some mathematics skills that students must be prepared to use in more advanced problem-solving settings.

Who should use this document?

- PreK-16 educators can use this resource to align classroom instruction with content to be sure that students master fundamental mathematics skills that are essential for success in mathematics.

- Students, counselors, and parents can use this resource to better understand the mathematical progression through the education system including the implications for preparation for entry-level, postsecondary mathematics courses. It can also emphasize the importance of high school mathematics, including continued use of mathematical skills during the students' senior year.

- PreK-12 teachers, postsecondary faculty, and administrators can use this resource to support a collaborative review of the transition through pre-kindergarten to postsecondary to assure that the educational path is seamless for Nebraska students.

- PreK-12 educators can use this resource to better understand the expectations of the Nebraska Mathematics Content Standards and the desired proficiency of the students entering postsecondary study.

PRE-KINDERGARTEN THROUGH HIGH SCHOOL STUDENT EXPECTATIONS FOR MATHEMATICS

The following PreK-12 section is divided into four parts:

- Pre-Kindergarten
- Elementary School
- Middle School
- High School

Each part lists:

I) Student Expectations for Mathematics	Essential skills and knowledge needed for success in mathematics at the next grade level.
II) Sample of Experiences for Preschool and Elementary School **OR** Sample of Topics for Middle School and High School	Sample experiences at the lower grades are described and sample topics are listed at the middle and high school levels.
III) Nebraska Mathematics Standards	The standard(s) that include the experience or topic.

What young children learn is immensely dependent on a supportive, rich learning environment, as well as being vitally linked to their health and development. The descriptors of Student Expectations for Mathematics at the pre-kindergarten level are based on what children can be expected to know and be able to do in relation to a research-based developmental continuum *and* when provided with appropriate learning opportunities and support. Assessing young children's knowledge requires teachers to use skillful observation as children represent their knowledge in a variety of ways within the context of classroom activities.

According to *Early Childhood Mathematics Education: Promoting Good Beginnings* (2002), a joint position statement of the National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC):

> "High-quality, challenging, and accessible mathematics education for 3- to 6-year-old children is a vital foundation for future mathematics learning. In every early childhood setting, children should experience effective, research-based curriculum and teaching practices. Such high-quality classroom practice requires policies, organizational supports, and adequate resources that enable teachers to do this challenging and important work."

Student Expectations for Mathematics in this section are intended to provide guidance for appropriate learning content as part of the pre-kindergarten curriculum, and should in no circumstances be construed as a measure for determining kindergarten readiness. Nebraska statute entitles all age-eligible children (age five by October 15 of the current school year) to attend kindergarten, and schools have a responsibility to support the child's learning at his/her level upon entry.

PRE-KINDERGARTEN STUDENT EXPECTATIONS

Student Expectations for Mathematics	**Sample Pre-Kindergarten Experiences**	**Nebraska Mathematics Standards / Strands** ***N – Numeration/Number Sense*** ***C/E – Computation/Estimation*** ***M – Measurement*** ***G – Geometry/Spatial Concepts*** ***D – Data Analysis, Probability, and Statistical Concepts*** ***A – Algebraic Concepts***
Count up to 10 or more objects correctly.	Count in nursery rhymes; count all types of objects; play with counting forward or backward	1.1.1 N 1.1.2 N 1.1.3 N 1.1.4 N
Arrange two sets of objects in one-to-one correspondence.	Match objects in one set to objects in a second set; recognize 10 is 10 no matter how objects are arranged in a group	1.1.2 N 1.1.3 N 1.1.4 N
Compare the numbers of things in two sets to determine "more", "fewer" or "same" number.	Use simple quantity words such as "one more cookie" or "more milk"; apply the use of numbers to daily situations	1.1.2 N 1.1.3 N 1.2.2 C/E

Student Expectations for Mathematics	Sample Pre-Kindergarten Experiences	Nebraska Mathematics Standards / Strands
Demonstrate the processes of addition and subtraction.	Combine and separate objects; explore possible combinations for a given number with many types of materials; identify portions when sharing	1.2.1 C/E
Measure all sorts of objects using non-standard units.	Fill and empty containers; use non-standard units (for example hands or blocks) to determine length, weight, and volume of objects	1.3.1 M
Compare measured objects.	Compare attributes like longer-shorter, heavier-lighter, bigger-smaller; compare objects using a balance scale	1.3.1 M
Use time-related words.	Make reasonable estimates of time; compare time intervals to experiences; name days of the week, birthday month, a.m. and p.m.	1.3.2 M 1.3.3 M 1.3.4 M
Sequence events according to time.	Anticipate or plan the next event in a sequences; remember and describe a series of events in the correct order	1.3.5 M
Describe positions, directions, and distances in the play space, building and neighborhood.	Observe, experience and describe relative positions of objects (over, under, behind, in front of), direction of movement (up, down, back), relative distances (closer, farther away)	1.4.1 G
Recognize, describe and create simple shapes.	Recognize and name simple shapes (squares, circles, triangles); match pictures to actual shapes; draw or paint simple representations	1.4.2 G
Collect and record data using simple tallies, lists or charts.	Collect first-hand data by counting; record information describing objects, events, or relations	1.5.1 D
Organize and display collected data.	Group objects together that are the same in some way; arrange sets of objects in one-to-one correspondence	1.5.2 D
Compare data in a display.	Read the display and compare two or more sets to determine more, fewer, or the same	1.5.3 D
Tell how data was collected and displayed.	Describe what was done to sort objects that were the same in some way and how were they represented in the display	1.5.4 D
Classify and sort objects.	Recognize common characteristic in a group or objects; group identical objects together; sort objects based upon two or more characteristics	1.6.2. A
Recognize, describe and create patterns.	Make, copy and extend patterns with actions, objects and words; insert new objects into patterns; describe similarities, differences and attributes	1.6.1 A 1.6.3 A

ELEMENTARY SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	**Sample Elementary School Experiences**	**Nebraska Mathematics Standards / Strands** ***N – Numeration/Number Sense*** ***C/E – Computation/Estimation*** ***M – Measurement*** ***G – Geometry/Spatial Concepts*** ***D – Data Analysis, Probability, and Statistical Concepts*** ***A – Algebraic Concepts***
Can you demonstrate place value and show number quantities and their relationships?	Count by multiples of 10; combine groups of 100s, 10s, and 1s to make different numbers using concrete materials, drawings and symbols; order and compare numbers up to 1,000,000; identify the place and value of digits in a given number	4.1.1 N 4.1.2 N 4.1.3 N 4.1.4 N 4.1.5 N
Can you show relationships between fractions, decimals and percents?	Draw fractional parts of a whole figure; write fractions and decimals on a number line; use a ruler to measure up to eighths; recognize, read and write amounts of money in fraction and decimal form	4.1.2 N 4.1.3 N 4.1.5 N
Can you apply estimation skills?	Explore estimation strategies; recognize when an estimation is appropriate; use estimation to check computation and reasonableness of results; apply estimation when working with quantities, measurements, computation, and problem solving	4.2.1 C/E 4.2.2 C/E 4.2.3 C/E 4.3.1 M 4.3.2 M
Can you add, subtract, multiply and divide whole numbers?	Combine and separate objects to demonstrate addition and subtraction; explore multiplication and division through addition and subtraction by creating arrays, sharing, and repeated addition or subtraction of groups; create, solve, and illustrate computation story problems	4.2.1 C/E
Can you add and subtract decimals and common fractions?	Combine and separate objects to demonstrate addition and subtraction; recognize, represent and use common fractions and decimals by drawing or sharing objects; add and subtract problems that involve sums up to $1000.00	4.2.2 C/E 4.2.3 C/E
Can you use technology to solve problems?	Use a four function calculator to explore large numbers, discover number patterns, and verify computations; use graphing software packages and Logo	4.2.1 C/E 4.2.2 C/E 4.5.1 D

ELEMENTARY SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	Sample Elementary School Experiences	Nebraska Mathematics Standards / Strands
Can you measure length, mass/weight, and capacity using metric and standard units?	See need for special measures; mark off a strip, a container, an elastic band in nonstandard units of length, capacity and weight; fill containers by repeated pouring form a single smaller container with fluid, grains and sand; compare weights by balance; use measuring tools to nearest unit in both systems; work on practical problems involving measurement	4.3.1 M 4.3.2 M
Can you determine a temperature using metric and standard units?	Record and compare temperature using a thermometer during times in a day or different seasons	4.3.1 M
Can you determine perimeter and area?	Extend linear measurements to perimeter and area; coordinate vertical and horizontal lines to help with the concept of area	4.3.4 M 4.3.1 M 4.3.2 M
Can you tell time?	Use an analog clock to determine time to the nearest half hour, nearest 5 minutes; tell time in hours and minutes	4.3.3 C/E
Can you identify, classify, create and compare the properties of two- and three-dimensional shapes?	Naming simple shapes; recognizing like shapes; identify simple shapes within complex shapes; identify attributes of 2-d and 3-d objects; sort objects by shapes; construct with 2-d, 3-d shapes; create 3-d shapes involving straight and curved lines by folding, cutting and modeling	4.4.1 G 4.4.2 G 4.4.3 G
Can you solve problems involving spatial relationships like congruence, symmetry, similarity and simple transformations?	Explore tessellations and computer designs; complete and create symmetrical figures; begin to draw objects in perspective; read and draw simple maps using graph paper	4.4.3 G 4.4.2 G
Can you collect and organize data?	Collect first-hand data by counting or measuring; organize data in a systemic order using tallies or charts; create object graphs, picture graphs, simple bar and line graphs	4.5.1 D
Can you interpret different types of graphs and charts?	Read, discuss and interpret displayed data; observe and describe data collected over a period of time; solve problems involving diagrams, tables and graphs	4.5.1 D

ELEMENTARY SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	Sample Elementary School Experiences	Nebraska Mathematics Standards / Strands
Can you recognize, describe and create a variety of patterns?	Identify geometric patterns in real life, numerical patterns in math and rhythmic patterns in music; create and extend simple patterns; describe the relationship of a sequence of numbers (may include relationships of addition/subtraction or multiplication/division)	4.6.2 A
Can you use variables and mathematical symbols to represent numerical expressions?	Identify that a letter or shape can represent a number; recognize the mathematical symbols representing the four operations and comparisons; complete or create one-step function tables like n-6= or 3n= or in/out boxes	4.6.1 A

MIDDLE SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	**Sample Middle School Topics**	**Nebraska Mathematics Standards / Strands** ***N – Numeration/Number Sense*** ***C/E – Computation/Estimation*** ***M – Measurement*** ***G – Geometry/Spatial Concepts*** ***D – Data Analysis, Probability, and Statistical Concepts*** ***A – Algebraic Concepts***
Can you add, subtract, multiply and divide effectively with whole numbers, common fractions, and decimals? Can you see the relationship between fractions, decimals and percents?	Computation	8.1.1 N 8.1.2 N 8.2.1 C/E 8.2.3 C/E
Can you use percents accurately? Do you understand that the whole equal to the sum of the parts is the basis of percent?	Percent	8.1.2 N 8.2.1 C/E 8.2.3 C/E
Do you understand the concept of ratio?	Ratio	8.1.1 N 8.2.3 C/E
Before you perform a computation, do you estimate the result for determining the reasonableness of your answer?	Estimation	8.2.5 C/E
Do you know the meaning of significant figures? Can you round numbers properly?	Rounding numbers	8.1.3 N 8.2.5 C/E
Can you operate basic technology to solve problems?	Use scientific calculators, graphing software packages, simulation programs	8.2.1 C/E 8.2.3 C/E 8.2.4 C/E 8.2.5 C/E 8.5.1 D 8.5.3 D
Do you understand signed numbers and can you use them?	Signed numbers	8.1.1 N 8.2.3 C/E
Do you understand what you are doing when you use the axioms to change the form of a formula, or when you find the value of an unknown in a simple equation?	Use the axioms	8.1.4 N 8.2.2 C/E 8.2.3 C/E 8.2.4 C/E 8.6.2 A
Can you use a variety of measuring devices, such as an ordinary ruler, meter stick, protractor, measuring tape and thermometer?	Use measuring devices	8.3.1 M
Do you know how to use the most important metric units (meter, centimeter, millimeter, kilometer, gram, kilogram)?	Metric system	8.3.1 M

MIDDLE SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	Sample Middle School Topics	Nebraska Mathematics Standards / Strands
In measuring length, area, volume, weight/mass, time, temperature, angle, and speed, can you shift from one commonly used standard unit to another widely used standard unit; e.g., do you know the relation between yard and foot, inch and centimeter, etc?	Conversions	8.3.2 M
Do you have an understanding of point, line, angle, parallel lines, perpendicular lines, triangle (right, scalene, isosceles, and equilateral), parallelogram (including square and rectangle), trapezoid, circle, regular polygon, prism, cylinder, cone, and sphere?	Geometric concepts and two- and three- dimensional figures	8.4.1 G 8.4.2 G 8.4.6 G
Can you estimate, read, and construct an angle using a protractor?	Angles	8.4.1 G 8.4.2 G
Can you use the Pythagorean relationship in a right triangle?	The 3-4-5 relation	8.4.2 G
Do you know from memory certain widely used formulas relating to areas, volumes, and interest, and to distance, rate, and time?	Practical formulas	8.4.3 G 8.4.4 G
Do you understand the meaning of similar triangles, and do you know how to use the fact that in similar triangles the ratios of corresponding sides are equal? Can you solve a proportion?	Similar triangles and proportion	8.2.3 C/E 8.4.2 G 8.4.5 G
Do you know the main guides that one should follow in collecting and interpreting data? Can you use averages or mean, median and mode? Can you draw and interpret a graph?	Statistics	8.5.1 D
Can you read ordinary graphs: bar, line, and circle graphs? Can you interpret the graph of a formula?	Graphs	8.5.2 D 8.6.1 A 8.6.3 A
Can you analyze a statement in a newspaper and determine what is assumed, and whether the suggested conclusions really follow from the given facts or assumptions?	Proceed from hypothesis to conclusion	8.5.2 D 8.5.4 D
Can you perform simple probability simulations and predict outcomes?	Simple probability	8.5.3 D
Can you use letters to represent numbers e.g., do you understand the symbolism of algebra? Do you know the meaning of exponent and coefficient?	Algebraic symbolism	8.6.2 A

MIDDLE SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	Sample Middle School Topics	Nebraska Mathematics Standards / Strands
Do you know the meaning of a formula e.g., can you for example, write an arithmetic rule as a formula, and can you substitute given values in order to find the value for a required unknown?	Formulas and linear equations	8.6.1 A 8.6.2 A 8.6.3 A
Can you find correct values in tables; e.g., interest rates and income tax?	Tables	8.6.3 A

HIGH SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	**Sample High School Topics**	**Nebraska Mathematics Standards / Strands** ***N – Numeration/Number Sense*** ***C/E – Computation/Estimation*** ***M – Measurement*** ***G – Geometry/Spatial Concepts*** ***D – Data Analysis, Probability, and Statistical Concepts*** ***A – Algebraic Concepts***
Can you apply basic mathematical operations to solve problems involving whole numbers, decimals, fractions, radicals, exponents, absolute value, percents, ratios, averages, and proportions?	Computation with real numbers	12.1.1 N 12.1.2 N 12.2.1 C/E 12.2.3 C/E
Can you justify the reasonableness of your results?	Estimation and reasonableness of results	12.2.2 C/E 12.2.3 C/E
Can you operate basic technology to solve problems?	Use graphing calculators, data bases, spreadsheets, graphing software packages, simulation programs	12.2.3 C/E 12.3.1 M 12.5.1 D 12.5.3 D
Do you know the meaning of "a measurement is an approximation", of a standard unit, of the largest permissible error, and of tolerance?	Nature of a measurement	12.3.1 M
Can you use common international standards of measurement when solving problems?	Standard and metric units of measure and conversions	12.3.1 M 12.3.2 M
Can you apply geometric concepts to solve problems? Can you find the distance between two points?	Geometric properties and relationships including coordinates	12.4.1 G 12.4.2 G 12.4.3 G 12.4.4 G 12.4.6 G
Can you draw a geometric figure or object to scale? Can you read and interpret maps, floor plans, and mechanical drawings?	Geometric models and scale drawings	12.4.2 G
Can you apply right triangle trigonometry to solve for lengths and angles? Do you understand the concepts of tangent, sine, and cosine?	Right triangle trigonometry	12.4.5 G
Can you apply deductive reasoning to arrive at a conclusion?	Deductive reasoning	12.4.7 G
Can you analysis data and draw accurate conclusions from the results?	Data analysis and statistical concepts	12.5.1 D 12.5.2 D 12.5.4 D 12.5.5 D

HIGH SCHOOL STUDENT EXPECTATIONS

Student Expectations for Mathematics	Sample High School Topics	Nebraska Mathematics Standards / Strands
Can you apply probability to solve problems?	Probability	12.5.3 D 12.5.6 D
Can you apply algebraic operations to solve problems?	Equations, inequalities and patterns	12.5.2 D 12.6.1 A 12.6.2 A 12.6.3 A 12.6.4 A

POSTSECONDARY
STUDENT EXPECTATIONS FOR MATHEMATICS

The following postsecondary section is divided into five parts:

- Career and Technical Programs
- Intermediate Algebra
- College Algebra
- Applied/Business Calculus
- Calculus

Each part lists:

I) Student Expectations for Mathematics	Essential or prerequisite skills needed for success in that particular post secondary course or program.
II) Sample of Skills	Sample problems that illustrate how the skill is used.
III) Nebraska Mathematics Standards	The standard(s) that include the skill.

If you are a student considering postsecondary schooling, you will need to consider the mathematic skills that you now have and the skills you will need to be successful in your first postsecondary mathematics course or program.

The distinction between Essential Skills and Prerequisite Skills is as follows:

- **Essential Skills** are the skills that are necessary in order to be successful in the course or program. These skills are typically reviewed quickly in the postsecondary mathematics course or program.

- **Prerequisite Skills** are skills that are required in a particular course and are usually *not reviewed* in the course.

As you review the skills for each entry level, remember that the list *does not replace* the scope and depth of the Nebraska Mathematics Standards. Those listed here are designed to indicate skills that need continual reinforcement if you are going to have a smooth transition from high school to postsecondary school.

CAREER AND TECHNICAL PROGRAMS
STUDENT EXPECTATIONS FOR MATHEMATICS

Students pursuing studies in Career and Technical programs need a solid foundation in mathematics. The list below contains sample skills in mathematics that will be essential in many of these programs. Mathematics will be further explored throughout the technical specialization courses required. The actual mathematical problems will emphasize applications to the specialization.

(Nebraska Mathematics Standards / Strands column: N – numeration/number sense; C/E – computation/estimation; M – measurement; G – geometry/spatial concepts; D – data analysis, probability, and statistical concepts; A – algebraic concepts.)

Student Expectations for Mathematics (Essential Skills)	**Sample of Skills**	**Nebraska Mathematics Standards/Strands**
Do you know how to compute with signed numbers?	Simplify: (a) -12+15-24 (b) $\frac{10}{-5}$ (c) (-2)(-3)(4)	12.2.1 C/E 12.2.3 C/E
Can you perform order of operations? Do you know when to add, multiply, distribute?	Simplify: (a) 3*2 + 4 - 2 *5 / 7 (b) (3x + 4) + (7x – 2) (c) (3ab)(4ac) (c) (3x + 4)(7x - 2)	12.2.1 C/E 12.2.3 C/E
Can you add and simplify fractions without calculator?	Find a common denominator and simplify $\frac{2}{32}+\frac{5}{3}$.	12.1.2 N
Can you factor and simplify expressions? Can you tell when an expression is already reduced?	Reduce if possible: (a) $\frac{6x+4}{4x-8}$ (b) $\frac{x+4}{x-5}$ (c) $\frac{x+3}{x}$ ..... Here only (a) can be further reduced.	12.1.2 N 12.2.1 C/E
Do you have a working knowledge of mathematical terminology?	Express 3.45 and 25/3 as an integer plus a positive rational number less than 1.	12.1.1 N
Can you perform percent conversions?	23 is what percent of 92? Convert 0.023 to percent. 23.4% of 90 is what number?	12.1.2 N 12.2.1 C/E
Can you translate a problem into an equation and solve?	A taxi costs $1.80 plus $.40 per mile. How much will it cost to go 12 miles?	12.2.1 C/E 12.2.2 C/E 12.6.2 A

CAREER AND TECHNICAL PROGRAMS
STUDENT EXPECTATIONS FOR MATHEMATICS

Student Expectations for Mathematics (Essential Skills)	Sample of Skills	Nebraska Mathematics Standards/Strands
Can you plot points in the plane?	Plot the points (3,5), (-2,4), (2,2).	12.4.4 G 12.6.1 A
Can you write equations of lines?	Give the equation of the line through (-2,3) and (7,15).	12.6.1 A
Do you recognize and can you solve ratio and proportion problems?	The ratio of oil to gas is 0.23. How much oil should be put in 3 gals of gas?	12.2.1 C/E
Can you solve an equation for various symbols?	Solve for R in $pV = nRT$.	12.6.2 A
Do you understand notation? Can you solve equations involving absolute value?	Solve exactly $\|3x - 2\| = x + 5$.	12.2.1 C/E 12.6.2 A
Can you apply the Pythagorean theorem? You will also need to use basic facts about triangles and similar triangles.	John leaves the veterinarian and drives 3 miles east and 2 miles north to get home. At the same time his pet bird flies straight home. How far did his bird fly?	12.4.3 G 12.4.6 G 12.6.2 A
Can you factor quadratic and simple cubic polynomials?	Factor: $x^2 + 2x - 3$, $x^2 - 5x - 6$, $2x^3 + 4x^2 - 6x$, $x^3 - 27$.	12.6.2 A
Can you recognize a quadratic equation and can you use the quadratic formula to solve it?	Solve for exact solutions: $3x^2 - 5 = 12x$.	12.6.2 A
Do you know general exponent rules?	Simplify and write in power notation: $b^{1/2}\, b^3, \frac{b^3 a}{a^{-3}}, \sqrt[3]{b}$	12.1.2 N 12.2.1 C/E
Do you recognize when to use two equations with two unknowns and can you solve them?	A movie theater sells tickets to adults for $9 and children for $7. Last night they sold 325 tickets for a total of $2,495. How many were adult tickets?	12.6.3 A
Can you use basic trigonometric and circle relationships and terminology (electronics and survey math courses)?	1. Find the angle in degrees of the circular sector that has radius 10 feet and an arc of length 9 feet. 2. A circular sector laid out in the xy-plane has center at (0,0) and vertices at (0,10) and (a,b). Find a and b if it's arc length is 9 feet.	12.4.2 G 12.4.5 G 12.4.6 G

INTERMEDIATE ALGEBRA STUDENT EXPECTATIONS

These courses typically start with the number system and develop most of the first two years of algebra. The skills emphasized below have proven to be among the biggest barriers to success in the course. These skills are often reviewed quickly in the course, but the new material in this course requires the student to be very proficient in these basic skills.

(Nebraska Mathematics Standards / Strands column: N – numeration/number sense; C/E – computation/estimation; M – measurement; G – geometry/spatial concepts; D – data analysis, probability, and statistical concepts; A – algebraic concepts.)

Student Expectations for Mathematics (Essential Skills)	**Sample of Skills**	**Nebraska Mathematics Standards/Strands**
Do you know how to compute with signed numbers?	Simplify: (a) -12+15-24 (b) $\frac{10}{-5}$ (c) (-2)(-3)(4)	12.2.1 C/E 12.2.3 C/E
Can you perform order of operations? Do you know when to add, multiply, distribute?	Simplify: (a) 3*2 + 4 - 2 *5 / 7 (b) (3x + 4) + (7x - 2) (c) (3ab)(4ac) (c) (3x + 4)(7x - 2)	12.2.1 C/E 12.2.3 C/E
Can you add, say, $\frac{2}{3}+\frac{7}{8}$ without a calculator?	Express with a common denominator and simplify: $\frac{2}{x-3}+\frac{3x-2}{x+5}$. ..... Doing this correctly depends on knowing how to add simple fractions.	12.1.2 N 12.2.1 C/E 12.2.3 C/E
Can you factor and simplify expressions? Can you tell when an expression is already reduced?	Reduce if possible: (a) $\frac{6x+4}{4x-8}$ (b) $\frac{x+4}{x-5}$ (c) $\frac{x+3}{x}$ ..... Here only (a) can be further reduced.	12.1.2 N 12.2.1 C/E
Do you have a working knowledge of mathematical terminology?	Express 3.45 and 25/3 as an integer plus a positive rational number less than 1.	12.1.1 N 12.1.2 N
Do you understand notation, how to combine terms, and solve for x both with and without the aid of a calculator?	Solve exactly 3x - 2 + 2x < x + 5 - 4x.	12.2.1 C/E 12.2.3 C/E

INTERMEDIATE ALGEBRA STUDENT EXPECTATIONS

Student Expectations for Mathematics (Essential Skills)	Sample of Skills	Nebraska Mathematics Standards/Strands
Can you perform percent conversions?	23 is what percent of 92? Convert 0.023 to percent. 23.4% of 90 is what number?	12.1.2 N 12.2.1 C/E
Can you translate a problem into an equation and solve?	A taxi costs $1.80 plus $.40 per mile. How much will it cost to go 12 miles?	12.2.1 C/E 12.2.2 C/E 12.6.2 A
Can you plot points in the plane?	Plot the points (3,5), (-2,4), (2,2).	12.4.4 G 12.6.1 A
Can you write equations of lines?	Give the equation of the line through (-2,3) and (7,15).	12.6.1 A
Do you recognize and can you solve ratio and proportion problems?	The ratio of oil to gas is 0.23. How much oil should be put in 3 gals of gas?	12.2.1 C/E
Can you solve an equation for various symbols?	Solve for R in $pV = nRT$.	12.2.1 C/E 12.6.2 A
Can you simplify fractions and factor quadratics?	Multiply and then simplify: $\frac{x^2+2x+1}{3x^2+2x-1} \cdot \frac{3x-1}{x^2-1}$	12.1.2 N 12.6.2 A
Do you know the Pythagorean theorem and can you use it?	John leaves the veterinarian and drives 3 miles east and 2 miles north to get home. At the same time his pet bird flies straight home. How far did his bird fly?	12.4.3 G 12.4.5 G 12.4.6 G 12.6.2 A

COLLEGE ALGEBRA STUDENT EXPECTATIONS

College Algebra is a course that emphasizes function terminology and applications. This includes graphing techniques, lots of word problems, exponential and logarithmic functions. It is a college version of a typical high school precalculus course without trigonometry. The primary tool is algebra. Most texts give a very brief discussion of the 2nd year algebra tools needed at the introduction of each concept, discuss the various applications and terminology associated with the concept, and then give problems. Students who are not already reasonably proficient with most of the algebra skills are usually not successful in the course. Below is a list of some algebra skills that have proven to be among the biggest barriers to success. (*) Indicates that this level of expertise is not explicitly represented in the State Standards.

(Nebraska Mathematics Standards / Strands column: N – numeration/number sense; C/E – computation/estimation; M – measurement; G – geometry/spatial concepts; D – data analysis, probability, and statistical concepts; A – algebraic concepts.)

Student Expectations (Essential Skills)	**Sample of Skills**	**Nebraska Mathematics Standards/Strands**
Can you factor second and third degree expressions?	Factor: $x^2 + 2x - 3$, $x^2 - 5x - 6$, $2x^3 + 4x^2 - 6x$, $x^3 - 27$.	12.6.2 A
Can you recognize quadratic equations when not in standard form? Can you use the quadratic formula to solve them?	Solve for exact solutions: $3x^2 - 5 = 12x$ or $3x^2 - 5 \geq 12x$.	12.6.2 A
Can you solve variable expressions involving absolute value?	Solve for exact solutions: $\|2x - 3\| + 4x + 2 > 0$.	12.6.2 A
Can you simplify rational expressions?	Reduce to lowest terms: $\frac{x^3 - 5x^2 - 6x}{x^2 + x}$	12.1.2 N *
Can you solve rational inequalities and equalities for exact values?	Solve $\frac{2x + 5}{x + 1} > \frac{x + 1}{x - 1}$ algebraically.	12.6.2 A *
Do you know general exponent rules?	Simplify and write in power notation: $b^{1/2}\, b^3$, $\frac{b^3\, a}{a^{-3}}$, $\sqrt[3]{b}$	12.1.2 N 12.2.1 C/E
Do you understand function notation and role of "dummy" variables?	Suppose that $g(x) = \frac{3}{x + 2}$. Find g(2) and formulas for g(u) and g(1/x).	12.6.4 A
Can you work with variable expressions using fractions, roots, and terminology?	Find the inverse function, $g^{-1}(x)$, to: (a) $g(x) = \frac{2x + 3}{x - 4}$ (b) $g(x) = \sqrt[3]{r^2 - x^2}$ with domain $x \geq 0$.	12.6.1 A 12.6.4 A

COLLEGE ALGEBRA STUDENT EXPECTATIONS

Student Expectations (Essential Skills)	Sample of Skills	Nebraska Mathematics Standards/Strands
Can you translate word problems to expressions using functions with the aid of self -generated sketches? (Quadratic functions are often used. You must be able to complete the square.)	Equal squares are cut from the corners of a 2'x2' piece of cardboard and the sides are folded up to make an open box. Express the volume, V, of this box as a function of the side, s, of the cut-out squares. Find the s that maximizes this volume first algebraically and then graphically.	12.6.2 A 12.6.4 A
Can you subdivide lengthy word problems into logical pieces, create relevant sketches that display the relationships between the variables, and set up necessary algebraic expressions as functions?	The city sewer pipes end a point A. Your house is 5 miles east of A along a straight highway and then 2 miles north along an old logging road. It costs $100/mile to lay the pipe along the highway and $140/mile to lay it otherwise. Find the cost, as a function of x, to lay the pipe east from A along the highway for x miles and then straight through the country to your house. Approximate the minimum cost using your calculator. ..... The function you need to obtain is $C(x) = 100x + 140((5-x)^2 + 4)^{1/2}$.	12.4.2 G 12.6.4 A
Do you recognize when to use two equations with two unknowns and can you solve them?	A movie theater sells tickets to adults for $9 and children for $7. Last night they sold 325 tickets for a total of $2,495. How many were adult tickets?	12.6.3 A
Are you prepared to memorize terminology, formulas and write paragraphs using them? Are you able to read and understand lengthy word problems that use the terminology?	Write a polynomial that has zeros only at 1,3, and 5, is positive at 2 and 4, and is negative at 6.	*

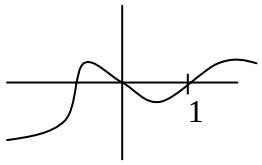
APPLIED/BUSINESS CALCULUS STUDENT EXPECTATIONS

This is not an exhaustive list of prerequisite skills. Rather it is a list of specific skills that have proven to be a significant barrier to student success in calculus. One of the most important indicators of success in calculus is too subtle to display in this format. It is mathematical maturity. This is the ability to accept and work with new concepts and new uses and views of old concepts. This comes from previous exposure to a great variety of mathematical ideas and their uses. (*) Indicates this level of expertise is not explicitly represented in the State Standards.

(Nebraska Mathematics Standards / Strands column: N – numeration/number sense; C/E – computation/estimation; M – measurement; G – geometry/spatial concepts; D – data analysis, probability, and statistical concepts; A – algebraic concepts.

Student Expectations for Mathematics (Prerequisite Skills)	**Sample Problems from Applied Calculus (and how the prerequisite skill is used)**	**Nebraska Mathematics Standards/Strands**
Do you know how to factor and reduce rational expressions?	Compute algebraically: $\lim_{x\to 2} \frac{x^2 - 4}{2x - 4}$ ……. You need to factor and reduce to get $\frac{x^2 - 4}{2x - 4} = \frac{1}{2}(x + 2)$ before you can answer the problem.	12.1.2 N *
Can you graph lines, quadratics, and piecewise defined functions with the correct domain?	Graph and indicate whether $f(x) = \begin{cases} 3x + 2 & x \le 4 \\ x^2 - 3 & x > 4 \end{cases}$ is continuous ?	12.6.1 A 12.6.4 A
Can you find horizontal and vertical asymptotes with and without calculator and work with absolute value?	Graph, showing asymptotes, $f(x) = \frac{-3x}{\lvert 1 + x \rvert}$	*
Do you understand function notation? Are you comfortable with use of symbols? Can you use a graphing calculator when it is needed?	Given $f(x) = \frac{1}{x + 3}$, graph $\frac{f(x+\Delta x)-f(x)}{\Delta x}$ for $\Delta x = 1$, 0.1, 0.01, for x in [-5,5], on the same axis system with your graphing calculator.	12.2.3 C/E 12.6.4 A *
Do you understand function notation? Can you simplify rational expressions that involve symbols?	Given $f(x) = \frac{1}{x + 3}$ find the formula for $g(x) = \lim_{\Delta x\to 0} \frac{f(x+\Delta x)-f(x)}{\Delta x}$. ……. Here you must simplify $\frac{\frac{1}{x+\Delta x+3} - \frac{1}{x+3}}{\Delta x}$ to $\frac{-1}{(x+\Delta x+3)(x+3)}$ before you can complete the problem.	12.6.1 A 12.6.4 A *

APPLIED/BUSINESS CALCULUS STUDENT EXPECTATIONS

Student Expectations for Mathematics (Prerequisite Skills)	Sample Problems from Applied Calculus (and how the prerequisite skill is used)	Nebraska Mathematics Standards/Strands
Do you understand function notation? Can you graph translations and reflections of a function?	Suppose the graph of f(x) is:  Sketch f(-x), f(x-1), 2f(x).	12.6.1 A 12.6.4 A *
Can you use function notation to express word problems that describe relationships between variables?	A company is making rectangular display boxes with a bottom but no top. The volume must be 100 cubic feet and the bottom square. It costs \$6/sq. ft. for the sides and \$8/sq.ft. for the bottom. Express the cost of the box in terms of x, the length of one edge of the bottom. Find the dimensions that minimize cost. …… You must be able to obtain the formula for the cost function in terms of x.	12.4.1 G 12.4.6 G 12.6.2 A 12.6.4 A
Can you solve linear and quadratic equations both graphically and algebraically?	Use differentiation to find the exact minimum of the cost function $C = 8x^2+2400/x$ for positive x. (This is the function from the previous example.) …… You must solve $16x-2400/x^2 = 0$ for the exact values of x.	12.6.2 A 12.6.4 A *
Do you understand that the functions ln(x) and e^x are the inverse of each other? Can you use this relationship to solve exponential and logarithmic equations exactly?	Give an exact and an approximate solution to (a) $\ln(3x + 5) = 3000$, (b) $e^{3x - 2} = \frac{1}{60}$ …… These are prerequisite skills that you need to use often in calculus. Here you must use the log and exponential properties to reduce to the linear equations: $3x + 5 = e^{3000}$ and $3x - 2 = -\ln(60)$ which include constants such as e^{3000}. (Wouldn't do to evaluate this on a calculator).	12.2.1 C/E 12.6.4 A *
Do you know the logarithm and exponential properties and can you use them to solve equations?	Give an exact and an approximate solution to (a) $(e^{3x-5})^2 e^{4x+5} = \frac{1}{50}$ (b) $\ln(x-2) + \ln(x+2) = \ln(5)$	*

APPLIED/BUSINESS CALCULUS STUDENT EXPECTATIONS

Student Expectations for Mathematics (Prerequisite Skills)	**Sample Problems from Applied Calculus (and how the prerequisite skill is used)**	**Nebraska Mathematics Standards/Strands**
Are you able to rewrite rational expressions in different forms? Do you know the laws of exponents? Are you quick at simple rational and exponent simplifications? These are easy calculus problems if the algebra is done correctly.	Find $\int \frac{x^3 + 2x + 3}{x^2}\,dx$ and $\frac{d}{dx}(5x^{-2})^{-3}$. …… To start you need to quickly rewrite $\frac{x^3 + 2x + 3}{x^2}$ as $x + 2x^{-1} + 3x^{-2}$ and $(5x^{-2})^{-3}$ as $\frac{x^6}{5^3}$.	12.1.2 N 12.2.1 C/E *
Can you combine sophisticated function manipulation with substitution and algebraic techniques?	Evaluate $\int \frac{2}{\sqrt{1 - 6x}}\,dx$. ……..… For this problem you must rewrite $\frac{2}{\sqrt{1 - 6x}}$ in terms of $u = 1 - 6x$ and then solve the expression $du = -6dx$ for the symbol dx in terms of the symbol du.	12.1.2 N *

CALCULUS STUDENT EXPECTATIONS

This is not an exhaustive list of prerequisite skills. Rather it is a list of specific skills that have proven to be a significant barrier to student success in calculus. One of the most important indicators of success in calculus is too subtle to display in this format. It is mathematical maturity. This is the ability to accept and work with new concepts and new uses and views of old concepts. This comes from previous exposure to a great variety of mathematical ideas and their uses. (*) Indicates this level of expertise is not explicitly represented in the State Standards.

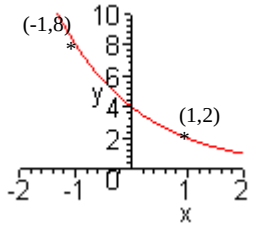
(Nebraska Mathematics Standards / Strands column: N – numeration/number sense; C/E – computation/estimation; M – measurement; G – geometry/spatial concepts; D – data analysis, probability, and statistical concepts; A – algebraic concepts.)

Student Expectations for Mathematics (Prerequisite skills needed for success in calculus.)	**Sample Problems from Calculus (and how the prerequisite skill is used)**	**Nebraska Mathematics Standards/Strands**
Are you able to rewrite rational expressions in different forms? Do you know the laws of exponents? Are you quick at simple rational and exponent simplifications? These are easy calculus problems if the algebra is done correctly.	Find $\int \frac{x^3 + 2x + 3}{x^2}\,dx$ and $\frac{d}{dx}(5x^{-2})^{-3}$. …… To start you need to quickly rewrite $\frac{x^3 + 2x + 3}{x^2}$ as $x + 2x^{-1} + 3x^{-2}$ and $(5x^{-2})^{-3}$ as $\frac{x^6}{5^3}$.	12.1.2 N 12.2.1 C/E *
Can you rewrite expressions using substitution, laws of exponents, and basic fraction simplification rules?	Evaluate $\lim_{(x,y)\to(0,0)} \frac{2x^3y^2}{-3x^5 + y^5}$, if you approach along $y = 3x$. …… To start you need to substitute $y = 3x$ into $\frac{2x^3y^2}{-3x^5 + y^5}$ to get $\frac{2x^3 3^2 x^2}{-3x^5 + 3^5x^5}$ and simplify this to $\frac{3}{40}$.	12.1.2 N 12.2.1 C/E *
Can you graph lines, quadratics, and piecewise defined functions?	Graph and indicate whether is continuous ? …… You need to graph $y = 3x + 2$ for $x \leq 4$ and $x^2 - 3$ for $x > 4$.	12.6.1 A 12.6.4 A
Do you understand function notation? Are you able to substitute with symbols? Can you add, subtract, multiply, and divide rational expressions, then factor and simplify?	Given $f(x) = \frac{1}{x + 3}$ find the formula for $g(x) = \lim_{\Delta x\to 0} \frac{f(x+\Delta x)-f(x)}{\Delta x}$. …… You must be able to write $\frac{f(x+\Delta x)-f(x)}{\Delta x}$ explicitly in terms of x and Δx using the formula for f(x).	12.6.1 A 12.6.4 A *

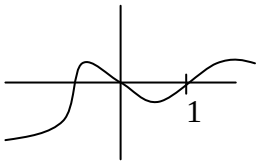
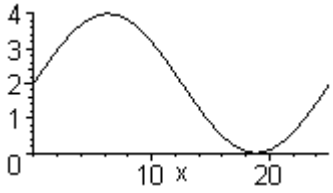
CALCULUS STUDENT EXPECTATIONS

Student Expectations for Mathematics (Prerequisite skills needed for success in calculus.)	Sample Problems from Calculus (and how the prerequisite skill is used)	Nebraska Mathematics Standards/Strands
Can you solve linear and quadratic equations both graphically and algebraically?	Use differentiation to find the exact minimum of the cost function $C = 8x^2+2400/x$ for positive x. (This is the function from the previous example.) …… You must solve $16x-2400/x^2 = 0$ for the exact values of x.	12.6.2 A 12.6.4 A *
Can you express word problems that describe variable relationships as a function?	A company is making rectangular display boxes with a bottom but no top. The volume must be 100 cubic feet and the bottom square. It costs \$6/sq. ft. for the sides and \$8/sq.ft. for the bottom. Express the cost of the box in terms of x, the length of one edge of the bottom. Find the dimensions that minimize cost. …… You must be able to obtain the formula for the cost function in terms of x.	12.4.1 G 12.4.6 G 12.6.2 A 12.6.4 A
Do you understand that the functions ln(x) and exp(x) are the inverse to each other? Can you use this relationship to solve exponential and logarithmic equations exactly?	Give an exact and an approximate solution to (a) $\ln(3x + 5) = 3000$, (b) $\exp(3x - 2) = 1/60$ …… These are prerequisite skills that you need to use often in calculus. Here you must use the log and exponential properties to reduce to the linear equations: $3x + 5 = \exp(3000)$ and $3x - 2 = -\ln(60)$ which include constants such as exp(3000). (Wouldn't do to evaluate this on a calculator).	12.2.1 C/E 12.6.4 A (inverse functions not included)
Can you combine sophisticated function manipulation with substitution and algebraic techniques?	Evaluate $\int \frac{2}{\sqrt{1 - 6x}}\,dx$. …… For this problem you must rewrite $\frac{2}{\sqrt{1 - 6x}}$ in terms of $u = 1 - 6x$ and then solve the expression $du = -6dx$ for the symbol dx in terms of the symbol du.	12.1.2 N *
Can you solve equations using the distributive property? Can you factor and simplify complex fractions? Do you understand function notation, inverse functions and the role of variable names?	1. Find the domain and range of the function $y = f(x)$ if $xy = 2(x + y)$. 2. Find the inverse of the function $f(x) = \frac{x + 3}{x - 1}$. Express it as a function of x. …… These are prerequisite skills that are used often in calculus.	*

CALCULUS STUDENT EXPECTATIONS

Student Expectations for Mathematics (Prerequisite skills needed for success in calculus.)	**Sample Problems from Calculus (and how the prerequisite skill is used)**	**Nebraska Mathematics Standards/Strands**
Do you recognize when an equation is linear or quadratic in symbols other than x or y and can you solve such equations?	y is a differentiable function of x and $x \ln(y) + y^3 = \ln(x)$. Find $\frac{dy}{dx}$ in terms of x and y. …… This problem produces $\ln(y) + \frac{x}{y}\frac{dy}{dx} + 3y^2\frac{dy}{dx} = \frac{1}{x}$ which you must recognize as a linear equation in the symbol $\frac{dy}{dx}$ and then solve for the symbol $\frac{dy}{dx}$.	*
Can you solve simple systems of equations that involve products, powers, and roots?	Find a formula for the exponential function with graph  …… You need to find a and b so that $f(x) = a\,b^x$ matches the graph. That is, solve $8 = a\,b^{-1}$, $2 = a\,b$ for a and b.	12.6.3 A *
Can you solve other basic non-linear systems of equations?	Find the critical points of the function $z = 2x^2 - xy^2 + y^2 + 3$. …… This problem leads quickly to the system $4x - y^2 = 0$, $2y - 2xy = 0$, which you must solve.	12.6.3 A *
Can you translate verbal statement to a function? Make a sketch showing constants and variable relationships? Use properties of similar triangles? Use basic formulas from geometry?	A right circular cylinder is inscribed in a right circular cone of radius 6" and height 12". Find the dimensions of the cyinder that will maximize its volume. …… You must first express the volume of this cylinder as a function of its radius. This requires use of similar triangle relationships learned in geometry.	12.4.3 G 12.6.4 A

CALCULUS STUDENT EXPECTATIONS

Student Expectations for Mathematics (Prerequisite skills needed for success in calculus.)	**Sample Problems from Calculus (and how the prerequisite skill is used)**	**Nebraska Mathematics Standards/Strands**
Can you translate a verbal statement to a function when trigonometric relationships are involved and make a sketch showing how the variables relate?	An airplane flying at 450 km/hr at a constant altitude of 5 km along a straight line is approaching a camera mounted on the ground. How fast does the camera have to rotate in order to keep the plane in view when the angle is $\pi/3$? …… You need to write an equation that takes the right triangle with vertices the camera, the plane, and the point on the ground directly below the plane and express the camera angle as a funtion of the horizontal leg length.	12.4.5 G 12.6.4 A
Do you understand function notation? Can you graph translations and reflections of a function?	Suppose the graph of f(x) is:  Sketch f(-x), f(x-1), 2f(x).	12.6.1 A 12.6.4 A *
Do you understand the graphs of the trigonometric functions? Understand period, horizontal shift, vertical shift, and amplitude?	Find a possible formula for the graph:  …… This prerequisite skill typifies the function sense needed to set up problems before you can use the methods of calculus.	*
Do you understand that ln(x) and e^x are inverse functions to each other? Can you use this and the properties of logarithms and exponentials to solve equations?	Find exact and approximate solution to: (a) $\ln(3x + 5) = 3000$ (b) $e^{3x-2} = \frac{1}{60}$ (c) $\frac{3x+5}{2x-7} = e^{16}$ (d) $10x - 5 = -\ln(50)$	12.2.1 C/E 12.6.4 A (inverse functions not included)

Appendices

Appendix A

P-16 Mathematics Alignment Task Force Member List

Beth Anderson
Brownell Talbot High School

Ed Ankrom
Sterling Public Schools

Steve Bahrij
St. Mary's O'Neill

Helen Banzhaf
Seward High School

Elizabeth Behrens
Hastings College

Charlotte Beran
St. Anthony Elementary

Bruce Broberg
Central Community College

Phillip Cary
Chadron Senior High School

Mary Chochon
Palmer High School

Susan Christensen
Sunrise Middle School

Fred Condos
Hastings College

David Cooke
Hastings College

Marcia Corr
Nebraska Department of Education

Marcia Crofutt
Grant Elementary

Michelle Dodd
Schuyler Central High School

Linda Drinkwalter
Chadron Senior High School

Griff Elder
University of Nebraska at Omaha

Patience Fisher
University of Nebraska – Lincoln

Ruth Good
Wallace High School

Bonnie Grams
Sandy Creek Schools

Steve Hamersky
Daniel Gross High School

Leatta Hand
Pleasanton Public Schools

Marge Harouff
Nebraska Department of Education

Jim Harrington
Omaha Public Schools

Doug Hartman
Midland Lutheran College

Linda Hayek
Ralston High School

Paul Hinrichs
Peru State College

Bonnie Hiykel
Millard North High School

Julie Hoagland
Brady High School

Sandeep Holay
Southeast Community College

Michelle Homp
Concordia University

Lynne Houtz
Creighton University

Roger Hovey
Western Nebraska Community College

Jim Johnson
Doane College

Allen Johnson
North Platte High School

Arlene Jordan
Metropolitan Community College

Margaret Kaiser-Woodward
Blessed Sacrament Middle School

Sharon Katt
Nebraska Department of Education

Lynn Kaufman
Hillside Elementary School

Penny Kowall
Millard Public Schools

Nancy Kunkel
Hebron Elementary

Matt Larson
Lincoln Public Schools

Dennis Micek
Lakeview High School

John Miller
Northeast Community College

Karen Miller
McCook High School

Shirley Mills
Oshkosh Elementary

Linda Moore
Lexington Middle School

Janice Nelson
Mary Lynch Elementary

Mary Nielsen
Potter-Dix Public Schools

Donald Niemann
University of Nebraska at Kearney

Mary Piernicky
Metropolitan Community College

Maureen Preble
Millard North High School

Tom Price
Norris High School

Arlene Rea
Lux Middle School

Janice Rech
University of Nebraska at Omaha

Ed Reinke
Concordia University

Michele Richards
Southeast Community College

William Rogge
Lincoln Northeast High School

Deb Romanek
Nebraska Department of Education

Richard Ross
Southeast Community College

Kim Schipporeit
University of Nebraska at Kearney

Sheila Schmeits
St. Agnes Elementary

Christine Schnieders
Dana College

Sandy Scofield
University of Nebraska – Lincoln

Tom Shield
Kearney High School

Richard Simon
Omaha Northwest High School

Rachael Smith
University of Nebraska

Mary Smith
Morton Elementary

Dot Snesrud
Osceola Elementary School

Curt Snowden
Western Nebraska Community College

Sandi Snyder
Shickley High School

Robert Stack
Chadron State College

Jamalee Stone
Rushville High School

Robert Sweetland
Wayne State College

Buren "Skip" Thomas
Lincoln Northeast High-Retired
University of Nebraska -Lincoln

Deloris Tonack
LPS Science Focus School

Leonard VerMaas
Norris High School

Andrea Volf
Irving Middle School

Dianne Vorderstrasse
St. Paul High School

Rich Wergin
Seward Middle School

Kathleen Wheeler
York College

Al Widrowicz
Nebraska Indian Community College

Gordon Woodward
University of Nebraska–Lincoln

Appendix B

Resources

Beckmann, Dr. Milton W., "How Much Mathematics Does it Take to be "Mathematically Literate?", University of Nebraska-Lincoln.

"Mathematical Requirements Associated with Academic Programs at Nebraska Post-Secondary Institutions," 3rd Edition, 1999. Copies may be obtained from: JUMP Program, 126 Morrill Hall, UNL, Lincoln, NE 68588-0350. <jump@math.unl.edu >.

"Nebraska Mathematics Content Standards, Grades K-12," Academic Standards, Nebraska Department of Education, 6 Feb.1998 <www.nde.state.ne.us>.

"Principles and Standards for School Mathematics," NCTM Standards, National Council of Teachers of Mathematics, 2000 <www.ntcm.org>.

"Raising Our Sights: No High School Senior Left Behind," Reports, National Commission on the High School Senior Year, 4 Oct. 2001 <www.commissionontheseniоryear.org>. Copies available online (requires Adobe Acrobat Reader).

"STARS (School-Based Teacher-led Assessment and Reporting System) Assessment Toolkit, Early Childhood/Primary Grades Assessment,"
Alignment of *Work Sampling System* Guidelines,
Alignment of *High/Scope Preschool and Elementary Key Experiences*,
Alignment of Nebraska/Iowa Program *Widely Held Expectations*,
STARS, Office of Children and Families, Nebraska Department of Education, Jan. 2000 <www.nde.state.ne.us>.

"Ticket to Nowhere", [TK9902], Fall 1999 and "Youth at Crossroads", [TK0101], Winter 2001. Thinking K-16, Education Trust <www.edtrust.org/main/reports.asp>. These two issues may be viewed on line with Adobe PDF viewer by selecting "download".

Appendix C

Nebraska Mathematics Standards
Approved December 2000
By State Board of Education

GRADE 1

1.1 NUMERATION/NUMBER SENSE

1.1.1 By the end of first grade, students will recognize, write, and orally express the sequential order of the number system.

Example Indicators:

- Recognize and write numerals from 0-100.
- Count forward by 1s, 2s, 5s and 10s up to 100.
- Count backward from 10 to 0 by 1s.
- Identify ordinal positions of first, second, third, through tenth.

1.1.2 By the end of first grade, students will demonstrate ways of representing numbers and compare relations among numbers.

Example Indicators:

- Count objects to demonstrate one-to-one correspondence.
- Use comparison vocabulary **(**bigger, smaller, more, less, equal, higher, and lower**)**.
- Identify and represent wholes into equal parts for the fractions of one-half and one-fourth.
- Connect number words and numerals to the quantities they represent.
- Demonstrate place value in the base-ten number system using models.

1.1.3 By the end of first grade, students will identify numbers and applications in everyday situations.

Example Indicators:

- Identify how numbers are used in counting situations **(**setting the table and passing out candy treats**)**.
- Identify how numbers are used for identification **(**room numbers and phone numbers**)**.
- Recognize and demonstrate the value of a collection of pennies, nickels, dimes, and quarters whose total value is 100 cents or less.

1.1.4 By the end of first grade, students will demonstrate the value of numbers (0-20) using concrete objects.

1.2 COMPUTATION/ESTIMATION

1.2.1 By the end of first grade, students will demonstrate the concepts of addition and subtraction up to 10.

Example Indicators:

- Demonstrate the value of basic facts using concrete objects.
- Recognize the symbols + and - as representing the operations of addition and subtraction.
- Recognize the symbol = represents equal quantities.
- Solve problems involving one-step solutions related to children's experiences.
- Demonstrate strategies for whole number computation.
- Compute efficiently and accurately basic number facts for addition and subtraction.

1.2.2 By the end of first grade, students will justify estimations to mathematical problems.

Example Indicator:

- Make estimations and comparisons to actual results.

1.3 MEASUREMENT

1.3.1 By the end of first grade, students will measure two or more items or sets using nonstandard units of measure and compare attributes.

Example Indicators:

- Compare attributes of items (length-shorter/longer, height-taller/shorter, weight-heavier/lighter, and temperature-hotter/colder).
- Measure items using nonstandard units (human foot, hand span, new pencil, toothpick, block, and paper clip).

1.3.2 By the end of first grade, students will identify tools of measurement and their appropriate use (clocks, calendar, ruler, balance scale, and thermometer).

1.3.3 By the end of first grade, students will tell time to the half-hour using an analog and digital clock.

1.3.4 By the end of first grade, students will identify the different units of measurement used in their environment (cents, dollars, pounds, gallons, liters, meters, miles, minutes, and hours).

1.3.5 By the end of first grade, students will identify past, present, and future as orientations in time.

1.4 GEOMETRY/SPATIAL CONCEPTS

1.4.1 By the end of first grade, students will compare relative position (left/right, above/below, over/under, up/down, and near/far).

1.4.2 By the end of first grade, students will identify, describe, and create circles, squares, triangles, and rectangles.

Example Indicators:

- Construct congruent shapes and designs using manipulatives.
- Identify and describe common geometric shapes in their environment.

1.5 DATA ANALYSIS, PROBABILITY, AND STATISTICAL CONCEPTS

1.5.1 By the end of first grade, students will collect information about objects and events in their environment (favorite candy bar, number of siblings, and number of pets).

1.5.2 By the end of first grade, students will organize and display collected information using objects and pictures.

1.5.3 By the end of first grade, students will compare and interpret information from displayed data (more, less, and fewer).

1.5.4 By the end of first grade, students will describe the process used in data collection and analysis.

1.6 ALGEBRAIC CONCEPTS

1.6.1 By the end of first grade, students will identify, describe, extend, and create patterns (objects, sounds, movements, shapes, numbers, and colors).

1.6.2 By the end of first grade, students will sort and classify objects according to one or more attributes (size, shape, color, and thickness).

1.6.3 By the end of first grade, students will identify and describe patterns in their environment.

GRADE 4

4.1 NUMERATION/NUMBER SENSE

4.1.1 By the end of fourth grade, students will demonstrate place value of whole numbers through the millions and decimals to the hundredth place.

Example Indicators:

- Read and write numerals (in digits and words) through the one millions place and decimals to the hundredth place.
- Order and compare whole numbers through the one millions place and decimals to the hundredths place using the symbols <, >, and =.
- Round whole numbers to the nearest named place, such as rounding 1,234 to the nearest hundred would be 1,200.

4.1.2 By the end of fourth grade, students will write and illustrate equivalences of whole numbers in expanded form, decimals, and fractions.

Example Indicators:

- Write numbers in expanded form, such as 432 = 400 + 30 + 2.
- Represent equivalent fractions with denominators of 2, 4, 5, 8 and 10 (1/2 = 2/4) using concrete objects.
- Write equivalent decimals (.4 = .40).
- Write decimals as fractions using denominators of 10 and 100 (.68 =68/100).

4.1.3 By the end of fourth grade, students will describe and apply relationships between whole numbers, decimals, and fractions by order, comparison, and operation.

Example Indicators:

- Order and compare whole numbers, common fractions, and decimals using the symbols < , >, and =.
- Illustrate mathematical concepts by using objects and drawing pictures or diagrams **(**subtraction as the opposite of addition and multiplication as repeated addition**)**.
- Solve and check a mathematical problem by using the related facts.

4.1.4 By the end of fourth grade, students will identify examples of positive and negative numbers and zero.

Example Indicator:

- Demonstrate simple concepts of positive and negative numbers (a thermometer for temperature or distances to the right or left of zero on a number line.)

4.1.5 By the end of fourth grade, students will make change and count out in amounts up to $20.00.

Example Indicators:

- Count back change from purchase price to amount given using fewest coins possible.
- Calculate change through subtraction and choose correct bills and coins to make this amount.

4.2 COMPUTATION/ESTIMATION

4.2.1 By the end of fourth grade, students will estimate, add, subtract, multiply, and divide whole numbers without and with calculators and solve word problems.

Example Indicators:

- Demonstrate with accuracy and reasonable speed the basic facts of addition (1-20), subtraction (1-20), multiplication (1-144), and division (1-144).
- Add and subtract accurately five-digit numbers including columns of numbers.
- Multiply up to a three-digit number by a two-digit number.
- Divide up to a three-digit number by a one-digit divisor.
- Choose correct operation and solve word problems.

4.2.2 By the end of fourth grade, students will estimate, add, and subtract decimals without and with calculators and solve word problems.

Example Indicator:

- Add and subtract decimals to the hundredths place.

4.2.3 By the end of fourth grade, students will estimate, add, and subtract fractions with like denominators without calculators and solve word problems.

Example Indicator:

- Solve problems involving fractions of halves, fourths, and eighths using the operations of addition and subtraction.

4.3 MEASUREMENT

4.3.1 By the end of fourth grade, students will estimate, measure, and solve word problems using metric units for linear measure, area, mass/weight, capacity and temperature.

Example Indicators:

- Use the appropriate units of measurement.
- Estimate and accurately measure length to the nearest meter or centimeter and calculate area.
- Estimate and accurately measure mass/weight to the nearest gram.
- Estimate and accurately measure capacity to the nearest milliliter.
- Measure and read temperature accurately to the nearest degree using Celsius thermometer.

4.3.2 By the end of fourth grade, students will estimate, measure, and solve word problems using standard units for linear measure, area, mass/weight, capacity, and temperature.

Example Indicators:

- Use the appropriate units of measurement.
- Estimate and accurately measure length to the nearest yard, foot, inch, and quarter inch and calculate area.
- Estimate and accurately measure mass/weight to the nearest ounce and pound.
- Estimate and accurately measure capacity to the nearest fluid ounce.
- Measure and read temperature accurately to the nearest degree using Fahrenheit thermometer.

4.3.3 By the end of fourth grade, students will tell and write correct time to the minute using an analog clock.

Example Indicators:

- Set an analog clock to a given time.
- State time in different ways (8:35, 35 minutes after 8:00, or 25 minutes until 9:00).
- Identify time of day (am, pm, noon, and midnight).

4.3.4 By the end of fourth grade, students will measure and determine the perimeter of a many-sided figure without a formula using standard and metric units of measure.

4.4 GEOMETRY/SPATIAL CONCEPTS

4.4.1 By the end of fourth grade, students will identify, describe, and create two- and three-dimensional geometric shapes.

4.4.2 By the end of fourth grade, students will identify and draw points, lines, line segments, rays, and angles.

4.4.3 By the end of fourth grade, students will identify, analyze, and compare two-dimensional geometric figures using congruence, symmetry, similarity, and simple transformations.

4.5 DATA ANALYSIS, PROBABILITY, AND STATISTICAL CONCEPTS

4.5.1 By the end of fourth grade, students will collect, organize, record, and interpret data and describe the findings.

Example Indicators:

- Collect, organize, and interpret data in line plots, tables, charts, and graphs **(**pie graphs, bar graphs, and pictographs**)**.
- Draw valid conclusions from displayed data.
- Investigate and record patterns in a simple probability situation in an organized way.

4.6 ALGEBRAIC CONCEPTS

4.6.1 By the end of fourth grade, students will use and interpret variables and mathematical symbols to write and solve one-step equations.

Example Indicators:

- Use letters, boxes, or other symbols to stand for any number, measured quantity, or object in simple situations to demonstrate the beginning concept of a variable and writing formulas.
- Identify and use various indicators of multiplication (parentheses, x, *) and division, (/, ÷).

4.6.2 By the end of fourth grade, students will identify, describe, and extend arithmetic patterns, using concrete materials and tables.

Example Indicator:

- Use Input/Output or function box to identify and extend patterns.

GRADE 8

8.1 NUMERATION/NUMBER SENSE

8.1.1 By the end of eighth grade, students will recognize natural numbers, whole numbers, integers, and rational numbers.

8.1.2 By the end of eighth grade, students will determine equivalences among fractions, decimals, and percents.

Example Indicators:

- Find the equivalencies among fractions, decimals, and percents.
- Solve problems with appropriate equivalencies.

8.1.3 By the end of eighth grade, students will write and use numbers in expanded exponential form and scientific notation.

Example Indicators:

- Write numbers in expanded form using exponential notation.
- Express small and large numbers using scientific notation.

8.1.4 By the end of eighth grade, students will identify and display numbers including prime and composite, factors and multiples, divisibility, powers, and properties.

Example Indicator:

- Properties of numbers may include but not be limited to order of operations, commutative, associative, distributive, identity, and inverse.

8.2 COMPUTATION/ESTIMATION

8.2.1 By the end of eighth grade, students will add, subtract, multiply, and divide decimals and proper, improper, and mixed fractions with uncommon and common denominators with and without the use of technology.

8.2.2 By the end of eighth grade, students will identify the appropriate operation and do the correct calculations when solving word problems.

8.2.3 By the end of eighth grade, students will solve problems involving whole numbers, integers, and rational numbers (fractions, decimals, ratios, proportions, and percents) with and without the use of technology.

Example Indicators:

- Use proportions to solve scale-model problems with fractions and decimals.
- Problems should be of increasing level of difficulty and involve real-life situations.

8.2.4 By the end of eighth grade, students will apply the order of operations to solve problems with and without the use of technology.

Example Indicator:

- Evaluate all types of numerical expressions, including grouping symbols and exponents.

8.2.5 By the end of eighth grade, students will apply strategies of estimation when solving problems with and without the use of technology.

Example Indicators:

- Properly round to an appropriate place value if context permits.
- Perform estimation prior to calculation.
- Without a calculator, estimate square roots of whole numbers up to one hundred to the nearest whole number.
- Use compatible numbers to perform mental math.
- Use estimation to check reasonableness of an answer.

8.3 MEASUREMENT

8.3.1 By the end of eighth grade, students will select measurement tools and measure quantities for temperature, time, money, distance, angles, area, perimeter, volume, capacity, and weight/mass in standard and metric units at the designated level of precision.

8.3.2 By the end of eighth grade, students will convert units within measurement systems using standard and metric, given conversion factors.

Example Indicators:

- Convert between various units of area and various units of volume (square foot to square yards and cubic decimeters to liters, etc.).
- Check solutions to problems using unit analysis (feet/second to miles/hour).

8.4 GEOMETRY/SPATIAL CONCEPTS

8.4.1 By the end of eighth grade, students will identify, describe, compare, and classify two- and three-dimensional geometric figures (plane figures like polygons) and (circles and solid figures like prisms, pyramids, cones, spheres, and cylinders) and lines, line segments, rays, angles, parallel and perpendicular lines.

8.4.2 **By the end of eighth grade, students will use geometric properties, the Pythagorean theorem, and the relationships of congruence, similarity, and symmetry.**

8.4.3 **By the end of eighth grade, students will use formulas to solve problems involving perimeter and area of a square, rectangle, parallelogram, trapezoid and triangle and area and circumference of circles.**

8.4.4 **By the end of eighth grade, students will solve problems given formulas for volume and surface area of rectangular prisms, cylinders, and cones.**

8.4.5 **By the end of eighth grade, students will apply transformations to two- and three-dimensional geometric figures.**

Example Indicator:

- Draw geometric figures using translations or slides, rotations or turns, reflections or flips, and scale.

8.4.6 **By the end of eighth grade, students will use geometric terms and representations to describe the physical world.**

8.5 DATA ANALYSIS, PROBABILITY, AND STATISTICAL CONCEPTS

8.5.1 **By the end of eighth grade, students will collect, construct, and interpret data displays and compute mean, median, and mode.**

Example Indicator:

- Select appropriate representations of data when constructing data displays (graphs, tables, or charts).

8.5.2 **By the end of eighth grade, students will read and interpret tables, charts, and graphs to make comparisons and predictions.**

8.5.3 **By the end of eighth grade, students will conduct experiments or simulations to demonstrate theoretical probability and relative frequency.**

Example Indicator:

- Compare the results of a simulation (relative frequency) to the theoretical probability (a three color spinner or a coin).

8.5.4 **By the end of eighth grade, students will identify statistical methods and probability for making decisions.**

Example Indicators:

- Identify the use of appropriate sampling techniques.
- Identify the use of appropriate charts and graphs.
- Identify the use of measures of central tendency (mean, median, and mode) appropriately.

8.6 ALGEBRAIC CONCEPTS

8.6.1 By the end of eighth grade, students will demonstrate knowledge and use of the one- and two-dimensional coordinate systems.

Example Indicators:

- Order numbers on a number line.
- Graph ordered pairs on a coordinate plane.
- Generate a table of ordered pairs to graph an equation in two variables.

8.6.2 By the end of eighth grade, students will apply algebraic concepts and operations to solve linear equations and word problems.

Example Indicators:

- Solve multi-step equations with one variable.
- Use order of operations to evaluate algebraic expressions for given replacement values of the variables.
- Recognize and apply commutative, associative, distributive, inverse, and identity properties, and the properties of zero.

8.6.3 By the end of eighth grade, students will describe and represent relations, using tables, graphs, and rules.

Example Indicator:

- Use variables to recognize and describe patterns.

GRADE 12

12.1 NUMERATION/NUMBER SENSE

12.1.1 By the end of twelfth grade, students will describe and compare the relationships between subsets of real numbers.

Example Indicators:

- Draw Venn diagrams including but not limited to natural, whole, integers, rational, irrational, and real numbers.
- Find intersection and union of two sets of numbers.
- Given a number, identify which subsets it belongs.
- Justify why a number does not belong to a specific set.

12.1.2 By the end of twelfth grade, students will express the equivalent forms of numbers using exponents, radicals, scientific notation, absolute values, fractions, decimals, and percents.

12.2 COMPUTATION/ESTIMATION

12.2.1 By the end of twelfth grade, students will solve theoretical and applied problems using numbers in equivalent forms, radicals, exponents, scientific notation, absolute values, fractions, decimals, and percents, ratios and proportions, order of operations, and properties of real numbers.

12.2.2 By the end of twelfth grade, students will justify solutions to mathematical problems.

Example Indicator:

- Write an explanation based on the context of the problem stating why the solution is reasonable.

12.2.3 By the end of twelfth grade, students will perform estimations and computations of real numbers mentally, with paper and pencil, and with technology.

12.3 MEASUREMENT

12.3.1 By the end of twelfth grade, students will select and use measuring units, tools, and/or technology and explain the degree of accuracy and precision of measurements.

Example Indicators:

- Explain the accuracy of the measurement.
- Explain the precision of the measurement tool.

12.3.2 By the end of twelfth grade, students will convert between metric and standard units of measurement, given conversion factors.

Example Indicators:

- Change yards to meters.
- Change miles/hour to meters/second.

12.4 GEOMETRY/SPATIAL CONCEPT

12.4.1 By the end of twelfth grade, students will calculate perimeter and area of two-dimensional shapes and surface area and volume of three-dimensional shapes.

12.4.2 By the end of twelfth grade, students will create geometric models to describe the physical world.

Example Indicators:

- Create perspective drawing.
- Create scale models.

12.4.3 By the end of twelfth grade, students will evaluate characteristics and properties of two- and three-dimensional geometric shapes.

Example Indicators:

- Classify and compare attributes of two- and three- dimensional shapes.
- Classify shapes in terms of congruence and similarity and apply these relationships.
- Determine the effects of changing dimensions on perimeter, area, and volume.
- Investigate and deduce geometric properties using transformations such as translations, rotations, and reflections.

12.4.4 By the end of twelfth grade, students will apply coordinate geometry to locate and describe objects algebraically.

Example Indicators:

- Graph a geometric shape and determine the slope of the sides.
- Identify the missing vertices of a polygon.

12.4.5 By the end of twelfth grade, students will apply right triangle trigonometry to find length and angle measures.

12.4.6 By the end of twelfth grade, students will apply geometric properties to solve problems.

Example Indicator:

- Find missing angles and lengths of geometric shapes using geometric properties. (Properties may include but are not limited to similarity, parallel and line-transversal).

12.4.7 By the end of twelfth grade, students will apply deductive reasoning to arrive at a conclusion.

Example Indicators:

- Justify steps when solving an algebraic equation using properties of real numbers.
- Use logic statements, paragraph proof, two-column proof, or algebraic proof to arrive at a conclusion.

12.5 DATA ANALYSIS, PROBABILITY, AND STATISTICAL CONCEPTS

12.5.1 By the end of twelfth grade, students will select a sampling technique to gather data, analyze the resulting data and make inferences.

Example Indicators:

- Justify the chosen sampling techniques.
- Use technology to analyze data.

12.5.2 By the end of twelfth grade, students will write equations and make predictions from sets of data.

Example Indicators:

- Display data in a scatter plot, describe its shape, and estimate how close the data comes to fitting an equation.
- Relate the slope of a regression line to the rate of change for the data set.
- Determine what the y-intercept or beginning value indicates about the data.
- Determine the validity of predictions made from regression equations.

12.5.3 By the end of twelfth grade, students will apply theoretical probability to represent problems and make decisions.

Example Indicator:

- Explain the likelihood of the next event based on theoretical probabilities.

12.5.4 By the end of twelfth grade, students will evaluate how transformations on data affect the measures of central tendency and variability.

Example Indicators:

- Describe how adding the same amount to each score changes the mean, median, mode, range, outliers, interquartile points, maximum, and minimum.
- Describe how dropping an outlier changes the other measures.

12.5.5 By the end of twelfth grade, students will interpret data represented by the normal distribution and formulate conclusions.

Example Indicators:

- Sketch a normal or bell curve, label one and two standard deviations from the mean and fill in approximate percents associated with the deviations.
- Determine factors that will produce a curve that is not normal.
- Describe how sample size is related to a normal curve.
- Determine position or rank relative to others in a normally distributed group given the standard deviation and mean.

12.5.6 By the end of twelfth grade, students will calculate probabilities of independent events.

Example Indicator:

- Calculate probabilities using the fundamental counting principle and permutations.

12.6 ALGEBRAIC CONCEPTS

12.6.1 By the end of twelfth grade, students will graph and interpret algebraic relations and inequalities.

Example Indicators:

- Describe a graph by identifying intercepts, slope, maximum, minimum, increasing, decreasing, parallel, and perpendicular.
- Use families of curves to describe the effect of changing coefficients of an equation.

12.6.2 By the end of twelfth grade, students will solve problems involving equations and inequalities.

Example Indicator:

- Use appropriate methods to solve linear and quadratic equations.

12.6.3 By the end of twelfth grade, students will solve problems involving systems of two equations, and systems of two or more inequalities.

Example Indicator:

- Solve systems by graphing, substitution, elimination or matrices.

12.6.4 By the end of twelfth grade, students will solve problems using patterns and functions.

Example Indicators:

- Apply direct and indirect variations.
- Recognize the properties of families of functions.
- Recognize patterns of exponential growth and decay and their significance to real-life situations.
- Represent a problem in multiple formats **(**words, tables, graphs, and symbols**)**.