

National Essential Skills Study (NESS)

Your final survey choices must be submitted electronically at www.LeaderEd.com/ness.html. Use this printout to examine the topics and make your preliminary selections.

Mathematics

Choose a minimum of **20** topic statements and a maximum of **30** topic statements as the ones you think are most important for high school graduates to know and be able to do.

Numbers and Operations

- Perform operations fluently with positive and negative numbers, including decimals, ratios, percents, and fractions, and show reasoning to justify results.
- Demonstrate understanding of, and accurately apply, place value to round off numbers.
 - Place value is a positional system of notation in which the position of a number with respect to a point determines its value. In the decimal (base ten) system, the value of the digits is based on the number ten.
 - When a number is rounded (or rounded off), it is approximated by eliminating the least significant digits. Whole numbers can be rounded to the tens place, hundreds place, thousands place, and so on.
- Use the properties of real (rational and irrational) numbers and demonstrate understanding of ordering and absolute value.
 - Real numbers are all rational and irrational numbers (but not the imaginary numbers). The real numbers represent all the points on the number line.
 - A rational number is a number that can be expressed in the form a/b .
 - An irrational number is a number that cannot be written as a fraction, for example, the square root of 2.
 - The absolute value of a number is the distance from the origin on a number line.
- Perform operations and solve equations containing complex numbers.
 - A complex number is a number that can be written in the form $a + bi$, where a and b are real numbers and i is an imaginary number, which can be represented as $i = \sqrt{-1}$.
- Apply techniques to obtain a rational approximation or estimate of a quantity or number (including irrational numbers such as radicals).
 - For example, $x^2 = 8$, therefore $x = \pm 2(\sqrt{2})$.
- Perform operations with radicals, such as addition, subtraction, and multiplication.
- Factor a composite number into its prime components and use least common denominators or least common multiples to solve equations.
 - A composite number has more than two factors, for example, 6 has four factors (1, 2, 3, 6); 5 is not a composite number because it has only 2 factors, 1 and 5.
- Understand and apply the basic properties and laws of exponents and scientific notation to solve problems, including those with fractional, negative, and zero exponents.

Algebra

- Understand and apply basic algebraic properties (commutative and associative laws of addition and multiplication, distributive law of multiplication over addition, and identities and inverses).
 - The commutative property states that for some operations, you can change the order of the terms and not change the outcome of the operation; it holds for addition and multiplication; it does not hold for subtraction or division. $a+b = b+a$
 - The associative property for an operation states that changing the grouping of the numbers does not change the result of the operation. $(a+b)+c = a+(b+c)$
 - The additive identity is the number zero because zero plus any number is equal to the original number. $a+0 = a$
 - The multiplicative identity is one, because $a \cdot 1 = 1 \cdot a = a$.
 - The inverse property of addition states that for every number a , $a + (-a) = 0$ (zero).
 - The inverse property of multiplication states that for every non-zero number a , $a \cdot (1/a) = 1$.
- Apply variables in expressions and equations to solve problems (i.e., write mathematical equations for given situation, create a mathematical model to understand the relationships between variables, or make connections between the structures of mathematically abstract concepts and the real world).
- Simplify and solve algebraic equations by identifying and using the correct order of operations and techniques necessary to carry out the solution.
- Find the solution of linear equations and inequalities where the variable appears on either or both sides and in which one or both sides must be simplified before solving the equation (e.g., solve $x + 2(x - 3) = -4x + 5$ for x).
- Simplify polynomials by performing operations (addition, subtraction, multiplication, and division) to simplify expressions (e.g., $(2a + 2) + (3a - 1) = 5a + 1$).
- Perform division of a polynomial by a monomial by dividing powers with like bases, using the rules for the division of powers with like bases to simplify fractions with monomial denominators and reducing fractions to lowest terms.
- Solve linear inequalities and graph the solution set on a number line.
 - A solution set is a number (or ordered pair of numbers, or set of numbers) that produces a true statement when substituted for the variable(s) in an equation or inequality.
- Solve quadratic equations by applying various tools or techniques.
 - A quadratic equation is a polynomial equation of the second degree. The general form is $ax^2 + by + c = 0$, where $a \neq 0$
- Use proportional reasoning to solve real-world problems.
- Know and apply the components and properties of the rectangular coordinate system: x - y axis, origin, quadrants, abscissa (x -coordinate) and ordinate (y -coordinate), and general representation of a point (x,y).
- Solve systems of linear equations algebraically or graphically.
- Find the graphic solution of systems of linear inequalities (i.e., graph the solution set or region of the coordinate plane common to both inequalities).
- Solve and graphically sketch problems involving two variables that exhibit direct and indirect variation.
- Know the equation of a line and interpret graphically using the slope-intercept form ($y = mx+b$) and the point-slope form ($y - b = m(x-a)$).
- Know the equation for the slope of a line and compute slope given the coordinates of two points.
- Know how to sketch basic conic sections (e.g., circles, parabolas) by using their equations and solve systems of non-linear equations graphically.
 - A parabola is the graph of a quadratic or second-degree equation.
- Understand the characteristics of maxima and minima and be able to determine maximum and minimum points mathematically on a graph or curve.
 - Maxima and minima, also known as extrema, are points in the domain of a function at which the function takes the largest (maximum) or smallest (minimum) value either within a given neighborhood (local extrema) or on the function domain in its entirety (global extrema).

Logic and Reasoning

- Understand and apply a systematic methodology or procedure (e.g., direct or indirect measurement, direct or indirect proof, inductive or deductive reasoning) to model and solve problems.
 - In deductive reasoning, the conclusion is necessitated by, or reached from, previously known facts (the premises).
 - In inductive reasoning, the premises of an argument are believed to support the conclusion but do not ensure it.
- Analyze the truth value of compound sentences by creating truth tables.
 - A truth table is a mathematical table used in logic to tell whether a propositional expression is true for all legitimate input values.
- Apply pattern recognition in data sets and series to reason or solve problems involving arithmetic, geometry, exponents, etc.

Geometry

- Understand the properties of and apply parallel, perpendicular, and intersecting lines in problem-solving situations.
- Classify angles by measure (acute, right, obtuse, and straight) and understand angle relationships (supplementary, complementary, and vertical).
- Understand the properties and applications of the undefined terms of geometry (point, line, and plane) and their relationship with intuitive concepts (i.e., collinear points, coplanar points, opposite rays, and parallel lines).
- Compute the distance between two points on a coordinate plane (length of a line segment) and determine the midpoint of a line segment between two points.
- Understand the properties of circles (radius, arc, diameter, chord, secant, and tangent) and apply circle quantities (lengths of line segments, angle measure within a circle, circumference, and area) in problem-solving situations.
- Compute the perimeter and area of common two-dimensional figures.
- Understand the properties and classification of polygons (triangles, the family of quadrilaterals, pentagon, hexagon, etc.) and apply knowledge of angle and side relationships of geometric shapes in problem-solving situations
- Apply the Pythagorean Theorem to right triangles.
 - The Pythagorean Theorem states that for a right triangle, the sum of the squares of the two shorter sides (a and b) is equal to the square of the hypotenuse (h): $a^2 + b^2 = h^2$
- Know the classification and properties of three-dimensional figures (prisms, rectangular solids, pyramids, right circular cylinders, cones, and spheres) and be able to compute the volume and surface area of common solids.
- Use geometric methods, such as using an unmarked straightedge and compass, to complete basic geometric constructions.
- Apply transformations (reflection, rotation, translation, and dilation) of 2-dimensional figures graphically to interpret, analyze, and illustrate the concepts of congruency, similarity, and symmetry.
 - A transformation is the mapping, or movement, of all the points of a figure in a plane according to a common operation.
 - Congruent means having the same size, shape and measure.
- Apply transformation concepts to examine two-dimensional aspects or representations of three-dimensional figures (e.g., isometries and nets).
 - The net of a polyhedron is an arrangement of edge-joined polygons in the plane which can be folded to become the faces of the polyhedron.

Relations and Functions

- Define and apply the properties of relations and functions (domain, range, function composition, and inverses) and use algebraic and graphic methods to determine if a relation is a function.
 - A relation is a rule that gives an output number for every valid input number.
 - A function is a rule of matching elements of two sets of numbers in which an input value from the first set has only one output value in the second set.
 - Range is the y -coordinates of the set of points on a graph. The range is the output in a function or a relation.
- Express, graph, and interpret exponential and logarithmic functions.
 - Exponential functions are functions where $f(x) = a^x + B$ where a is any real constant and B is any expression. For example, $f(x) = e^x - 1$ is an exponential function.
 - Logarithmic functions are the inverse of exponential functions. For example, the inverse of $y = a^x$ is $y = \log_a x$, which is the same as $x = a^y$.

- Express a linear function ($f(x) = mx + b$) with the appropriate notation and determine the ordered pairs.
 - In a linear function, the variables appear only in the first degree, are multiplied by constants, and are combined only by addition and subtraction.
- Apply step and piecewise functions, including greatest integer and absolute value functions.
 - A piecewise function is defined on a sequence of intervals. A common example is the absolute value.
- Express, graph, and interpret polynomial functions (linear, quadratic, cubic, etc.).

Trigonometry

- Know and apply the six basic trigonometric functions and ratios and solve right triangles using basic trigonometric ratios (sine, cosine, tangent).
- Understand the characteristics and uses of vectors (representations of velocity and force) and perform basic operations on vectors (e.g., vector addition and scalar multiplication).
 - A vector is characterized or defined by both magnitude (measure of numerical size) and direction. A vector can be represented by an arrow whose length represents the magnitude and the orientation represents the direction. For example, velocity is a vector since it can be used to describe how fast something is traveling and the direction it is going in.
- Perform the general solution of triangles by using the Law of Sines and Law of Cosines to obtain the angle and side length measurements of any triangle.
 - The Law of Sines is the relationship between sides and angles in any triangle.
 - The Law of Cosines is for calculating one side of a triangle when the angle opposite and the other two sides are known.
- Understand the trigonometric properties of the unit circle and sketch the graphs of basic circular functions ($y = \sin x$, $y = \cos x$, and $y = \tan x$, where the measure of the angle x is expressed in radians).

Discrete Mathematics

- Understand the concepts and apply the uses of matrices in modeling (i.e., finite graphs or structures that can be represented geometrically and interpreted algebraically in the form of a matrix).
 - A matrix is represented as a rectangular table of numbers organized in columns and rows.
- Create or evaluate algorithms (e.g., computer program codes, flowcharts) designed to accomplish a specific task.
- Understand the concepts of recurrence relations and apply them to solve consumer mathematics problems involving such things as percentage rates, personal loans, simple interest, compound interest, installment buying, mortgage rates, etc.
- Evaluate and use finite sequence and series as systematic and useful means of quantifying things.
 - A sequence is a pattern involving an ordered arrangement of numbers, geometric figures, letters, or other objects.
 - A series is a summation of the terms in a sequence.

Calculus

- Use anti-derivatives and the process of integration to determine areas, volumes, and distances.
 - The process of finding integrals is called integration. The process is usually used to find a measure of totality such as area, volume, mass, displacement, etc., when its distribution or rate of change with respect to some other quantity (position, time, etc.) is specified.
- Use derivatives and the process of differentiation to determine slopes of tangent lines, maxima and minima, velocity, and acceleration.
 - Derivatives can be used to characterize many properties of a function, including whether and at what rate the function is increasing or decreasing through a value of the function and where the function has maximum or minimum values.
 - In physics, the derivative of the position of a moving body is its velocity and the second derivative of the body's position is its acceleration. In turn, the velocity of the body in a given direction is its speed in that direction, another derivative.
- Understand the concepts and apply the uses of functions and limits (i.e., conduct limiting processes using functions to investigate infinite series and sequences).

Probability and Statistics

- Examine problem-solving situations involving simple probability and use probabilistic reasoning to compare and communicate the theoretical or empirical likelihood of events.
 - Theoretical probability is the ratio of the number of ways the event can occur to the total number of possibilities in the sample space.
 - Empirical probability of an event is the ratio of the number of times the event occurs to the total number of trials.
- Determine the probability of single and compound events and use the Counting Principle to determine the probability of independent events occurring jointly.
- Determine combinations (the various groupings a set may be arranged in without regard to order) and permutations (arrangements of a set where order matters).
- Evaluate and employ accurate and appropriate procedures for statistical data collection, organization, analysis, and display including making estimates and predictions, critiquing data, and drawing inferences (e.g., using the normal curve and z-scores, line of best fit).
- Understand and apply measures of central tendency (mean, median, and mode, and representative sampling of a population).
 - Central tendency is the degree of clustering of the values of a statistical distribution that is usually measured by the mean, mode, or median.
- Understand and apply measures of dispersion (range, mean deviation, variance, and standard deviation).
- Understand and apply the concepts and applications of quartiles (distributing groups into four equal sizes), percentiles (distributing individuals into 100 groups of equal size), and random distribution to understand and interpret data.
- Understand and apply the binomial theorem (e.g., explore the relationship of the binomial theorem with Pascal's triangle and the Fibonacci sequence).
 - The binomial theorem is an important formula giving the expansion of powers of sums.
- Apply summation notation to take the sum of an expression using limits (e.g., take the sum of $3i + 1$ from $i = 1$ to 5).
- Understand the importance of random sampling and sample size in generating representative data.
- Interpret data to determine correlation and distinguish between correlation and cause and effect.

Measurement

- Solve problems using units of metric measure and convert between metric and English/customary units.
- Use the technique of dimensional analysis to convert units of measure (e.g., kilometers/hour to meters/minute) and apply ratios in real-world situations (e.g., scale drawings).
- Understand accuracy and precision of measurement, round off numbers according to the correct number of significant figures, and determine percent error.

When you enter your survey responses online, you will be asked to check one of the boxes below. If you will be giving your completed survey to someone else to enter your choices, please indicate your position below.

Your Position:

(Select only one)

- English Language Arts Educator
- Mathematics Educator
- Science Educator
- Social Studies Educator
- Elementary (K-5) Educator

- Foreign Language Educator
- Art/Music Educator
- Physical/Health Education Educator
- Special Education Educator
- Career/Technical Education Educator
- School Administrator
- Guidance Counselor

- Other Educator
- Parent
- Community Member
- Business/Industry
- Student
- Other Non Educator