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.

Science

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.

Scientific Inquiry, Design, and Analysis

❒ Know and apply the principles of scientific inquiry for generating knowledge, including prediction, estimation, developing hypotheses, drawing conclusions, evaluation, and following ethical principles and professional procedures.

❒ Plan and apply real or hypothetical models and constructions to facilitate short- and long-term investigation, learning, and solutions to practical problems, including experimental design that incorporates variables and a method for collecting fair and adequate data.

❒ Use the Scientific Method to collect data and draw conclusions. Understand that all scientific conclusions and theories are subject to modification as new data are collected and reviewed publicly by peers and that all scientific ideas must satisfy common criteria including the ability to be tested.

- Scientific Method
  1. observation - information secured by viewing or noting a fact or occurrence
  2. research - diligent and systematic inquiry or investigation into a subject
  3. hypothesis - forming a preliminary possible explanation of the data
  4. testing - test the hypothesis by collecting more data
  5. results - interpreting the results of the test and deciding if the hypothesis should be rejected because the results contradict it
  6. conclusion - stating a conclusion that can be evaluated independently by others

❒ Understand that science and technology merge to meet the needs of society and that technology can often have unforeseen impacts on people and the environment that may be complicated to correct.

❒ Identify individual, cultural, and technological contributions to scientific knowledge that have had an impact on the history of human society and the quality of life worldwide.

❒ Make observations and accurate and precise measurements using senses, tools, and technology.

❒ Recognize and demonstrate safe laboratory procedures and behavior.

❒ Know the history and assess the benefits and drawbacks of modern technologies (e.g., nanotechnology, biotechnology, and information technology).

- Nanotechnology is the engineering of functional systems on a molecular scale.

❒ Explain, interpret, and classify observations and data in a logical way. Present information using scientific vocabulary, mathematical relationships, and technology.

❒ Understand the interdisciplinary nature of physical, life, Earth, and space sciences and make connections among the unifying concepts and processes of science.

Physical Science

❒ Understand the concepts of force and motion as they apply to simple machines (e.g., levers and pulleys).

- A simple machine is any device that requires the application of only a single force to work.

- ❒ Know and apply the relationship among mass, volume, and density for a substance and compare these properties between different substances.

- ❒ Measure or estimate physical properties using dimensional quantities (e.g., time, length, mass, pressure, volume, acceleration, temperature) and use significant figures correctly when estimating, measuring, and calculating these quantities.

- ❒ Investigate electric current (i.e., the flow of electric charge) and apply it to voltage, conductivity, amperage, resistance, and circuits in parallel and series.

- ❒ Examine the concepts of radioactivity and half-life and investigate nuclear energy and reactions, including conservation of mass-energy and nuclear fission and fusion.

  - Half-life is the time required for half of the atoms of a radioactive substance to become disintegrated.

- ❒ Compare and investigate various types of energy (e.g., heat, light, electromagnetic, nuclear, internal, wave, potential vs. kinetic) and energy transfer and know how to apply measurements of energy.

- ❒ Understand and apply the concepts of work and power and how they relate to energy.

  - Work happens when a force displaces an object; power is the time-rate of doing work.

- ❒ Understand and apply kinematics (i.e., the mathematical methods of describing motion, including velocity, acceleration, and displacement, without regard to the forces that produce it) to solve problems.

- ❒ Examine how images are formed from light rays and investigate the concepts and real-world applications of reflection (images formed in plane, concave, and convex mirrors) and refraction (images formed through converging and diverging lenses).

  - A beam of light passing through a converging lens is brought to a point or focus.
  - Parallel beams of light passing through a diverging lens are caused to spread out.

- ❒ Understand and apply statics (the relation between forces acting on an object at rest) and dynamics (the relation between the forces acting on an object and the resulting motion) to solve problems.

- ❒ Identify different types of waves (sound, light, ocean surface, seismic, etc.), apply the characteristics of waves (i.e., frequency, period, amplitude, phase, wavelength, speed, Doppler Effect, and wave fronts), and explain how waves interact with each other and their environment (e.g., superposition, diffraction, refraction).

- ❒ Analyze two-dimensional motion and trajectories by separating the motion of a projectile or object into x and y components of the vector quantities of displacement, velocity, and acceleration (including acceleration due to gravity). Analyze centripetal acceleration and force of an object in uniform circular motion.

- ❒ Compare and contrast the three most prominent models of the atom: the Rutherford, Bohr, and Cloud models. Examine how each theorizes the way in which electrons orbit about the nucleus.

- ❒ Apply the laws of thermodynamics to investigate thermal energy relationships in systems.

  - Zeroth Law: If two thermodynamic systems are in thermal equilibrium with a third, they are also in thermal equilibrium with each other.
  - First Law: In any process, the total energy of the universe remains constant. In other words, energy can neither be created nor destroyed; rather energy is conserved.
  - Second Law: In simple terms, over time differences in temperature, pressure, and density tend to even out in a physical system which is isolated from the outside world. The measure of how far along this evening-out process has progressed is called entropy.
  - Third Law: As temperature approaches absolute zero, the entropy of a system approaches a constant.

- ❒ Investigate and apply Newton's three laws of motion to determine the relationships between the forces acting on a body and the resulting motion of the body.

  - Newton's three laws of motion state:
    1. A body at rest remains at rest, and a body in motion continues to move in a straight line with a constant speed unless and until an external unbalanced force acts upon it.
    2. The rate of change of momentum of a body is directly proportional to the impressed force and takes place in the direction in which the force acts.
    3. To every action (force applied) there is an equal and opposite reaction.

- ❒ Investigate the inputs and outputs of physical systems and determine the conditions under which a system reaches equilibrium. Describe the tendency for systems to increase in disorder over time.

Earth Science

- ❒ Explain the processes involved in the water cycle (evaporation, condensation, precipitation, transpiration, surface runoff, percolation, etc.).
- ❒ Examine how natural events cause environmental change and impact populations.
- ❒ Examine how humans, through technology, cause environmental change by disrupting the equilibrium or balance of nature. Critique ways to improve environmental protection through education, research, laws, and conservation and judge the effectiveness of conservation practices and preservation techniques on environmental quality.
- ❒ Understand and compare energy transformations in living systems, geological systems, and artificial systems constructed by humans.
- ❒ Employ knowledge of ecology to study the interactions, relationships, and interdependence of organisms with their living and nonliving environments (e.g., ecosystems, communities, and populations).
- ❒ Explain the properties of and cycles within the atmosphere and investigate the effects of acid rain, smoke, volcanic dust, urban development, and greenhouse gases on climate change over time.
- ❒ Explain the concepts involving the Earth's water (ground and surface water) and identify possible or potential sources, types, concentration, and long-range effects of pollution.
- ❒ Identify and explain the properties and measurements of electromagnetic energy (energy radiated from all objects not at a temperature of absolute zero), solar energy (energy from the sun), and Earth energy (energy released from the decay of radioactive matter).
- ❒ Understand that weather and climate involve energy transfer in and out of the atmosphere by means of conduction, convection, and radiation.
- ❒ Understand the weathering process, identify factors that contribute to various rates of weathering, and explain how soil is formed as a result of weathering.
- ❒ Describe or measure positions on the Earth's surface using coordinate systems (e.g., lines of latitude and longitude) and topographic maps.
    - Topographic maps show intervals of elevation of a surface area.
- ❒ Explain how the tilt of the Earth's axis affects the climate and seasonal variability of regions as the planet revolves around the sun.
- ❒ Identify and comprehend factors that affect climate patterns such as latitude, elevation, large water bodies and ocean currents, mountain barriers, and wind belts.
- ❒ Identify and compare the components of soil and other factors that influence soil texture, fertility, and resistance to erosion (e.g., plant roots and debris, bacteria, fungi, worms, and rodents).
- ❒ Compare characteristic similarities and differences between rocks, sediments, and minerals.
- ❒ Observe, measure, and examine various landscape characteristics (e.g., hill slopes, stream patterns, and soil associations) and the relationship of characteristics between landscape regions.
- ❒ Know the history of the geocentric and heliocentric solar system models and how they are used to explain celestial and/or terrestrial objects or events.
    - Geocentric refers to Earth-centered.
    - Heliocentric refers to sun-centered.
- ❒ Learn the geometry of the Earth's orbit around the sun and the gravitational force and energy effects on the planet relative to its position in the orbit.
- ❒ Understand weather prediction as a probability of occurrence by examining atmospheric variables (e.g., temperature, pressure, moisture, wind, and storm tracks) and the factors that produce change in these variables.

- ❒ Identify and comprehend celestial observations (motions of objects in the sky), such as star paths and planetary, satellite, and sun motions. Use astronomical data to reveal the structure, scale, and changes in the solar system, stars, galaxies, and universe over time.

- ❒ Understand how and why the Earth's rotation and revolution around the sun affect the length of night and day, the changing of seasons, and weather patterns.

- ❒ Know the properties of the Earth's crust and interior (e.g., solid and liquid zones, compositions, density, temperature, and pressure) and examine evidence of crustal movement from deformed rock strata, displaced fossils, geosynclines, vertical movements, sea floor spreading, and continental drift.

- ❒ Understand how to sequence and correlate geologic events in Earth's history by analyzing the layers of rock, faults, joints, and folds, fossil evidence, volcanic time markers, etc.

- ❒ Know the processes involved in the rock cycle and examine the environmental factors necessary for rock formation, recognizing that sedimentary, igneous, and metamorphic rocks contain evidence of the minerals, temperatures, and forces that created them.

- ❒ Determine geologic history and age by examining the rock record and/or fossil sequencing and understand the technique of measuring geologic ages by absolute dating of rocks/fossils using known decay rates of radioactive isotopes.

- ❒ Know characteristics of the erosional-depositional system by differentiating between an erosional process and a depositional process.

- ❒ Differentiate between renewable and non-renewable resources (e.g., water, land, soil, minerals, and air) and understand the value of resource management, such as the reintroduction of wildlife, ocean fisheries management, and fire ecology. Determine energy sources and uses, including distribution, energy conversion, and energy costs and depletion.

- ❒ Research and evaluate scientific theories about the origins of the universe, the solar system, and life on Earth based upon available evidence.

- ❒ Follow the flow of energy through an ecosystem from photosynthetic organisms to herbivores to carnivores to decomposers and examine the recycling of matter through nature via the carbon and nitrogen cycles.

Chemistry

- ❒ Use various methods to indicate and measure the concentration (e.g., molarity) of a solution.

- ❒ Classify matter as an element, compound, or mixture.

- ❒ Analyze and evaluate the concepts and theories of acids and bases, including pH and alkalinity.

  - Alkalinity is a measure of the ability of a solution to neutralize acids to the equivalence points of carbonate or bicarbonate.
  - pH is a measure of the acidity of a solution in terms of activity of hydrogen ions.

- ❒ Know the symbols that represent one atom or one mole of atoms of an element. Name and write molecular and empirical formulas of chemical compounds.

  - The mole is a base unit that measures an amount of a particular substance.

- ❒ Understand the historical development of the Periodic Table. Apply the principles inherent in its development, including the properties and atomic structure of elements and resultant chemical compounds and the forces acting between and among atoms.

- ❒ Understand the fundamental properties and parts of the atom (electron, proton, and neutron). Derive the atomic number (the number of protons in the nucleus) and mass number (the total number of protons and neutrons) of a given element or isotope of an element.

  - Isotopes are any of the several different forms of an element, each having different atomic mass.

- ❒ Examine the definitions and characteristics of organic compounds and functional groups. Understand and apply organic reactions involving substitution, addition, fermentation, oxidation, polymerization, etc.

- ❒ Know how to neutralize acids and bases and form a conjugate acid-base pair in acid-base reactions.
- ❒ Understand the concept and interpretation of the mole and the gram atomic mass, gram molecular mass, and molar volume of a gas.
  - Gram atomic mass is the mass, in grams, of one mole of atoms in a monatomic element.
  - Gram molecular mass is the mass, in grams, of one mole of a molecular substance.
  - The molar volume of a gas is the volume occupied by one mole of a substance in the form of a solid, liquid, or gas.
- ❒ Use stoichiometry (the math behind the chemistry) to compute quantitative relationships implied by chemical formulas and chemical equations (i.e., solve mass-mass, mass-volume, and volume-volume problems).
  - Stoichiometry is the calculation of quantitative (measurable) relationships of the reactants and products in chemical reactions (chemical equations).
- ❒ Analyze physical change (e.g., change of phase between gases, liquids, and solids) and chemical change (e.g., conservation of mass-energy).
- ❒ Explain chemical bonding in terms of the transfer or sharing of valence electrons.
- ❒ Recognize that chemical reactions take place all around us, both in living and nonliving systems, and that they always result in the formation of new substances. Identify the factors that affect reaction rate.
- ❒ Explain the relationships between temperature, pressure, and volume of a gas.

Life Science

- ❒ Examine the processes related to metabolic activity in cells which help plants and animals maintain life (e.g., transport of materials throughout the organism, gas exchange, excretion, chemical regulation, and reaction to stimuli).
- ❒ Identify and understand the structure and parts that compose the human body systems (e.g., cardiovascular, nervous, reproductive, lymphatic, muscular regions).
- ❒ Explain an organism's need for food and a nutritious diet and describe the processes of ingestion, digestion, and egestion and how disease represents changes/imbalances in normal functioning.
- ❒ Recognize the cell as a common unit between living systems and examine cell structure and function.
- ❒ Examine the foundations of genetics involving heredity and inherited traits passed on through generations, understand the gene-chromosome concept, and apply classical genetic studies (Mendelian genetics).
- ❒ Understand that sexual reproduction involves the union of sex cells that are usually produced by two separate parents with half of the genetic information coming from each parent, which allows for a high degree of genetic diversity.
- ❒ Identify and describe the levels of organization in living systems (i.e., cells, tissues, organs, organ systems, and organisms).
- ❒ Examine the characteristics and roles of simple organisms (bacteria, fungi, algae, and protozoa) and their possible interactions with complex living organisms (i.e., plants and animals).
- ❒ Trace the chronology of embryological development from conception to birth during pregnancy and the development from birth through adulthood.
- ❒ Know the survival requirements of animals and plants and the history, dynamics, and implications of population growth.
- ❒ Examine the chemical reactions involved in cell functions and the role of enzymes in facilitating the breakdown and synthesis of molecules.
- ❒ Examine evolution as it relates to the origin of life. Understand the evidence for evolution as explained and supported by the fossil record and the genetic code.
- ❒ Know the features of genetic patterns such as sex inheritance and sex linkage and how dominant and recessive traits explain variations that are hidden in one generation can be expressed in the next.

- ❒ Know that every cell nucleus contains DNA molecules that specify how proteins are assembled to regulate cells. Know the chemical and structural properties of DNA and its role in specifying the genetic characteristics of an organism. Understand the process of polypeptide synthesis.

- ❒ Know the Linnean classification system into which organisms are separated and grouped based on common characteristics. From largest to smallest, the classification groups include kingdom, phylum, class, order, family genus, and species.

- ❒ Understand that asexual reproduction involves the production of offspring from a single parent organism with all the genetic information coming from that parent (asexual reproduction occurs with unicellular organisms and some plants).

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