

Science

National Rankings of Essential Skills (as of July 31, 2007)

National Essential Skills Study (NESS) Science Topic Statements	National Rank	NESS Priority	Subgroup Rankings			
			Business/ Industry	Other Non- Educators	Science Educators	Other Educators
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.	1	High	1	1	1	1
Identify and understand the structure and parts that compose the human body systems (e.g., cardiovascular, nervous, reproductive, lymphatic, muscular regions).	2	High	2	3	3	2
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.	3	High	4	4	2	3
Make observations and accurate and precise measurements using senses, tools, and technology.	4	High	9	6	4	6
Examine how natural events cause environmental change and impact populations.	5	High	7 *	7	10	5
Understand the concepts of force and motion as they apply to simple machines (e.g., levers and pulleys).	6	High	3	2	29	4
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	7	High	5	10	9	8
Explain the processes involved in the water cycle (evaporation, condensation, precipitation, transpiration, surface runoff, percolation, etc.).	8	High	7	5	20	7
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.	9	High	10	17	5	9
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.	10	High	6	16	13	10
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/imbances in normal functioning.	11	High	15	18	30	11
Explain, interpret, and classify observations and data in a logical way. Present information using scientific vocabulary, mathematical relationships, and technology.	12	High	20	24	7	15
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.	13	High	11	11	17	12

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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).	14	High	15	13	6	17
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.	15	High	17	26	13	16
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).	16	High	20	21	17	13
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.	17	High	11	22	8	19
Recognize and demonstrate safe laboratory procedures and behavior.	18	High	27	15	21	18
Know and apply the relationship among mass, volume, and density for a substance and compare these properties between different substances.	19	High	11	8	34	14
Classify matter as an element, compound, or mixture.	20	High	30	9	32	20
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.	21 A	High	11	12	11	23
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).	21 B	High	25	14	23	21
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.	23	High	27	22	25	24
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.	24	High	19	26	33	22
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.	25	High	22	20	27	25
Understand the interdisciplinary nature of physical, life, Earth, and space sciences and make connections among the unifying concepts and processes of science	26	High	31	25	16	26
Analyze physical change (e.g., change of phase between gases, liquids, and solids) and chemical change (e.g., conservation of mass-energy).	27	High	37	29	17	27
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.	28	High	26	38	30	28
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.	29	High	23	19	15	29

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Recognize the cell as a common unit between living systems and examine cell structure and function.	30	High	43	33	22	31
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.	31	High	32	32	12	32
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.	32	High	35	33	25	30
Explain how the tilt of the Earth's axis affects the climate and seasonal variability of regions as the planet revolves around the sun.	33	Medium	24	36	35	36
Know the survival requirements of animals and plants and the history, dynamics, and implications of population growth.	34	Medium	36	39	41	33
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.	35	Medium	43	43	43	34
Analyze and evaluate the concepts and theories of acids and bases, including pH and alkalinity.	36	Medium	37	29	37	37
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.	37	Medium	48	45	27	43
Identify and describe the levels of organization in living systems (i.e., cells, tissues, organs, organ systems, and organisms).	38	Medium	46	37	39	38
Understand and apply the concepts of work and power and how they relate to energy.	39 A	Medium	27	40	53	35
Identify and comprehend factors that affect climate patterns such as latitude, elevation, large water bodies and ocean currents, mountain barriers, and wind belts.	39 B	Medium	34	44	44	38
Investigate electric current (i.e., the flow of electric charge) and apply it to voltage, conductivity, amperage, resistance, and circuits in parallel and series.	41	Medium	18	28	45	42
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.	42	Medium	33	33	48	41
Trace the chronology of embryological development from conception to birth during pregnancy and the development from birth through adulthood.	43	Medium	40	46	55	40
Describe or measure positions on the Earth's surface using coordinate systems (e.g., lines of latitude and longitude) and topographic maps.	44	Medium	39	40	59	44
Explain the relationships between temperature, pressure, and volume of a gas.	45	Medium	51	49	38	45

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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).	46	Medium	53	31	40	46
Know the history and assess the benefits and drawbacks of modern technologies (e.g., nanotechnology, biotechnology, and information technology).	47	Medium	42	52	47	47
Understand that weather and climate involve energy transfer in and out of the atmosphere by means of conduction, convection, and radiation.	48 A	Medium	40	42	51	47
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.	48 B	Medium	57	47	24	50
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).	50	Medium	46	50	42	49
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.	51	Low	71	59	36	56
Understand and compare energy transformations in living systems, geological systems, and artificial systems constructed by humans.	52	Low	48	54	56	51
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.	53	Low	43	47	52	53
Understand the weathering process, identify factors that contribute to various rates of weathering, and explain how soil is formed as a result of weathering.	54	Low	65	55	66	52
Research and evaluate scientific theories about the origins of the universe, the solar system, and life on Earth based upon available evidence.	55	Low	59	56	59	54
Use various methods to indicate and measure the concentration (e.g., molarity) of a solution.	56	Low	59	53	61	57
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.	57	Low	48	51	46	60
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).	58	Low	55	61	78	54
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).	59	Low	51	57	63	59
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.	60	Low	55	62	72	58
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.	61	Low	61	62	54	64

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Examine the definitions and characteristics of organic compounds and functional groups. Understand and apply organic reactions involving substitution, addition, fermentation, oxidation, polymerization, etc.	62	Low	65	60	70	61
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.	63	Low	54	75	65	62
Know how to neutralize acids and bases and form a conjugate acid-base pair in acid-base reactions.	64	Low	71	66	62	66
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.	65	Low	63	69	56	69
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).	66	Low	81	69	63	67
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.	67	Low	68	62	58	70
Examine the concepts of radioactivity and half-life and investigate nuclear energy and reactions, including conservation of mass-energy and nuclear fission and fusion.	68	Low	63	57	66	68
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.	69	Low	58	66	80	63
Apply the laws of thermodynamics to investigate thermal energy relationships in systems.	70	Low	61	65	66	71
Observe, measure, and examine various landscape characteristics (e.g., hill slopes, stream patterns, and soil associations) and the relationship of characteristics between landscape regions.	71	Low	71	73	83	65
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.	72	Low	68	71	78	72
Explain chemical bonding in terms of the transfer or sharing of valence electrons.	73	Low	77	66	49	76
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).	74	Low	74	76	49	79
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.	75	Low	78	71	75	74
Compare characteristic similarities and differences between rocks, sediments, and minerals.	76	Low	74	73	81	73
Examine the chemical reactions involved in cell functions and the role of enzymes in facilitating the breakdown and synthesis of molecules.	77	Low	74	79	69	77

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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).	78	Low	65	77	81	75
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.	79	Low	78	81	77	78
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.	80	Low	82	82	73	80
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.	81	Low	83	80	74	80
Understand the concept and interpretation of the mole and the gram atomic mass, gram molecular mass, and molar volume of a gas.	82	Low	84	77	71	83
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.	83	Low	68	83	75	82
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.	84	Low	78	84	85	84
Know characteristics of the erosional-depositional system by differentiating between an erosional process and a depositional process.	85	Low	85	84	83	85

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