

**National Science Education Content Standards
Grades 9-12**

LSCell: The Cell

LSCell 1: Cells have particular structures that underlie their functions.

LSCell 2: Most cell functions involve chemical reactions.

LSCell 3: Cells store and use information to guide their functions.

LSCell 4: Cell functions are regulated.

LSCell 5: Plant cells contain chloroplasts, the site of photosynthesis.

LSCell 6: Cells can differentiate and form complete multicellular organisms.

LSGene: The Molecular Basis of Heredity

LSGene1: In all organisms, the instructions for specifying the characteristics of the organisms are carried in DNA.

LSGene2: Most of the cells in a human contain two copies of each of 22 different chromosomes. In addition there is a pair of chromosomes that determine sex.

LSGene3: Changes in DNA (mutations) occur spontaneously at low rates.

LSEvol: Biological Evolution

LSEvol1: Species evolve over time.

LSEvol2: The great diversity of organisms is the result of more than 3.5 billion years of evolution.

LSEvol3: Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms as well as for the striking molecular similarities observed among the diverse species of living organisms.

LSEvol4: The millions of different species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors.

LSEvol5A: Biological classifications are based on how organisms are related.

LSInter: The Interdependence of Organisms

LSInter1: The atoms and molecules on Earth cycle among the living and nonliving components of the biosphere.

LSInter2: Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.

LSInter3: Organisms both cooperate and compete in ecosystems.

LSInter4: Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite.

LSInter5: Human beings live within the world's ecosystems.

LSMat: Matter, Energy, and Organization in Living Systems

LSMat1: All matter tends toward more disorganized states.

LSMat2: The energy for life primarily derives from the sun.

LSMat3: The chemical bonds of food molecules contain energy.

LSMat4: The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism.

LSMat5: The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.

LSMat6: As matter and energy flows through different levels of organization of living systems (cells, organs, communities) and between living systems and the physical environment, chemical elements are recombined in different ways.



LSBeh: The Behavior of Organisms

LSBeh1: Multicellular animals have nervous systems that generate behavior.

LSBeh2: Organisms have behavioral responses to internal changes and to external stimuli.

LSBeh3: Like other aspects of an organism's biology, behaviors have evolved through natural selection.

LSBeh4: Behavioral biology has implications for humans, as it provides links to psychology, sociology, and anthropology.

UCP: Unifying Concepts and Processes

UCP1: Systems, order, and organization.

UCP2: Evidence, models, and explanation.

UCP3: Change, constancy, and measurement.

UCP4: Form and function.

SI: Science as Inquiry

SI1: Abilities necessary to do scientific inquiry.

SI2: Understandings about scientific inquiry.

PS: Physical Science

PS1: Structure of atoms.

PS2: Structure and properties of matter.

PS3: Chemical reactions.

PS4: Motions and Forces.

PS5: Conservation of energy and increase in disorder.

PS6: Interactions of energy and matter.

ESS: Earth and Space Science

ESS1: Energy in the earth system.

ESS2: Geochemical cycles.

ESS3: Origin and evolution of the earth system.

ESS4: Origin and evolution of the universe.

ST: Science and Technology

ST1: Abilities of technological design.

ST2: Understandings about science and technology.

SPSP: Science in Personal and Social Perspectives

SPSP1: Personal and community health.

SPSP2: Population growth.

SPSP3: Natural resources.

SPSP4: Environmental quality.

SPSP5: Natural and human-induced hazards.

SPSP6: Science and technology in local, national, and global challenges.

HNS: History and Nature of Science

HSN1: Science as a human endeavor.

HSN2: Nature of scientific knowledge.

HSN3: Historical perspectives.

