

**New Hampshire Science Grades 9-12  
Curriculum Standards**

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<b>LIFE SCIENCE</b>	<b>Boardworks High School Biology Presentations</b>
<b>LS1 - All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, &amp; species).</b>	
<b>1. CLASSIFICATION</b>	
<b>Grades 9 - 11</b>	
S:LS1:11:1.1 Describe how organisms are classified into a hierarchy of groups and subgroups, which are based on similarities that reflect their evolutionary relationships.	Classification
S:LS1:11:1.2 Explain that organisms that possess similar DNA code are more closely related than those in which DNA varies greatly.	Classification
S:LS1:11:1.3 Identify plants and animals according to binomial nomenclature.	Classification
S:LS1:11:1.4 Differentiate between prokaryotic and eukaryotic cells according to general structure and degrees of complexity.	Eukaryotic Cells Prokaryotic Cells
<b>Grades 11-12 (Advanced)</b>	
S:LS1:12:1.1 Differentiate between prokaryotic and eukaryotic cells at the biochemical level, using cell wall composition, DNA structure, and other biochemical pathways.	Eukaryotic Cells Organelles Prokaryotic Cells
<b>2. LIVING THINGS AND ORGANISMS</b>	
<b>Grades 9 - 11</b>	
S:LS1:11:2.1 Identify the structures of different types of cell parts/organelles and explain the functions they perform.	Eukaryotic Cells Organelles Prokaryotic Cells
S:LS1:11:2.2 Recognize how cell functions are regulated through changes in the activity of the functions performed by proteins, and through the selective expression of individual genes; and explain how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division.	Controlling Protein Synthesis Protein Synthesis

S:LS1:11:2.3 Recognize how an organism's organization and complexity accommodate its need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain it.	Blood and Blood Vessels Digestion Photosynthesis 1 Photosynthesis 2 Specialized Plant Cells The Kidneys The Respiratory System
S:LS1:11:2.4 Explain how the processes of photosynthesis and cellular respiration are interrelated and contribute to biogeochemical cycles.	Aerobic Respiration Carbon Cycle Photosynthesis 2
S:LS1:11:2.5 Describe the structures of proteins and their role in cell function.	Enzymes Proteins
<i>S:LS1:11:2.6 Describe the chemical reactions involved in cell functions using examples from the nervous, immune and endocrine systems in multicellular animals.</i>	–
S:LS1:11:2.7 Recognize that because all matter tends toward more disorganized states, living systems need a continuous input of energy to maintain their chemical and physical organizations.	Homeostasis The Endocrine System
<i>S:LS1:11:2.8 Use data and observation to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival (e.g., protein synthesis, DNA transport, nerve cells).</i>	–
<b>Grades 11-12 (Advanced)</b>	
S:LS1:12:2.1 Compare the processes of mitosis and meiosis, including disruptions to the cycles, such as disease or cancer.	Genetic Mutations Meiosis Mitosis The Stages of Meiosis The Stages of Mitosis
S:LS1:12:2.2 Explain the process of cell differentiation, using stem cells as an example	Cell Differentiation
<b>3. REPRODUCTION</b>	
<b>Grades 9-11</b>	
S:LS1:11:3.1 Describe the chemical and structural properties of DNA and explain its role in identifying the characteristics of an organism.	DNA Genes and Alleles Nucleic Acids
S:LS1:11:3.2 Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells; and explain why other changes in an organism cannot be passed on.	Genetic Mutation
<i>S:LS1:11:3.3 Describe the alternation of generations, life cycles with haploid and diploid phases in living organisms, such as bacteria, plants and animals.</i>	–

S:LS1:11:3.4 Explain or justify with evidence how the alteration of the DNA sequence may produce new gene combinations that make little difference, enhance capabilities, or can be harmful to the organism (e.g., selective breeding, genetic engineering, mutations).	DNA Replication 2 Genetic Engineering Genetic Mutations GM Organisms Selective Breeding
<b>Grade 11-12 (Advanced)</b>	
<i>S:LS1:12:3.1 Compare and contrast the alternation of generations' life cycles; and understand the variations of the haploid and diploid phases that produce diplontic, haplontic, and isomorphic alternation of generations in living organisms.</i>	–
<b>LS2 - Energy flows and matter recycles through an ecosystem.</b>	
<b>1. ENVIRONMENT</b>	
Grades 9-11	
S:LS2:11:1.1 Explain how the amount of life an environment can sustain is restricted by the availability of matter and energy, and the ability of the ecosystem to recycle materials.	Recycling Nutrients
S:LS2:11:1.2 Describe how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years.	Describing Populations Predator-Prey Relationships
S:LS2:11:1.3 Identify the factors in an ecosystem that can affect its carrying capacity.	Describing Populations
S:LS2:11:1.4 Analyze and describe how environmental disturbances, such as climate changes, natural events, human activity and the introduction of invasive species, can affect the flow of energy or matter in an ecosystem.	Energy Loss in Food Chains Energy Transfer in Food Chains Extinction Food Chains Food Webs Loss of Diversity
<i>S:LS:11:1.5 Using data from a specific ecosystem, explain relationships or make predictions about how environmental disturbance (human impact or natural events) affects the flow of energy or cycling of matter in an ecosystem. [LS2(9-11)INQ+SAE-3]</i>	–
<i>S:LS2:11:1.6 Explain or evaluate potential bias in how evidence is interpreted in reports concerning a particular environmental factor that impacts the biology of humans.</i>	–
<b>2. FLOW OF ENERGY AND RECYCLING OF MATERIALS</b>	
Grades 9-11	
S:LS2:11:2.1 Use examples from local ecosystems to describe the relationships among organisms at the different trophic levels.	Food Webs Food Chains
<b>3. RECYCLING OF MATERIALS</b>	
Grades 9-11	

S:LS2:11:3.1 Explain that as matter and energy flow through different levels of organization in living systems and between living systems and the environment, elements, such as carbon and nitrogen, are recombined in different ways.	Carbon Cycle Nitrogen Cycle Water Cycle
S:LS2:11:3.2 Trace the cycling of matter (e.g., carbon cycle) and the flow of energy in a living system from its source through its transformation in cellular, biochemical processes (e.g., photosynthesis, cellular respiration, fermentation).	Aerobic Respiration Anaerobic Respiration Carbon Cycle Energy Transfer in Food Chains Photosynthesis 2 Nitrogen Cycle
<b>LS3 - Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).</b>	
<b>1. CHANGE</b>	
Grades 9-11	
S:LS3:11:1.1 Identify ways humans can impact and alter the stability of ecosystems, such as habitat destruction, pollution, and consumption of resources; and describe the potentially irreversible effects these changes can cause.	Air Pollution Extinction Human Impact on the Environment Loss of Diversity Water Pollution
S:LS3:11:1.2 Identify ways of detecting, and limiting or reversing environmental damage.	Sustainability
<i>S:LS3:11:1.3 Analyze the aspects of environmental protection, such as ecosystem protection, habitat management, species conservation and environmental agencies and regulations; and evaluate and justify the need for public policy in guiding the use and management of the environment.</i>	–
<b>2. EVIDENCE OF EVOLUTION</b>	
Grades 9-11	
S:LS3:11:2.1 Explain the currently accepted theory for the development of life on Earth, including the history of its origin and the evolutionary process.	Darwin Evolution The Process of Evolution
S:LS3:11:2.2 Recognize that the abilities and behaviors an organism has, and likelihood of its survival strongly depend on its heritable characteristics, which can be biochemical and anatomical.	Animal Adaptations Behavior Plant Adaptations The Process of Evolution
S:LS3:11:2.3 Explain the contributions of Darwin, Malthus, Wallace and Russell to the advancement of life science.	Darwin

S:LS3:11:2.4 Explain evolution in terms of how the Earth's present-day life forms evolved from earlier, distinctly different species as a consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection.	Genetic Mutation The Process of Evolution
<i>S:LS3:11:2.5 Explain how evidence from technological advances supports or refutes the genetic relationships among groups of organisms (e.g., DNA analysis, protein analysis). [LS3(9-11)NOS-6]</i>	-
S:LS3:11:2.6 Given information about living or extinct organisms, cite evidence to explain the frequency of inherited characteristics of organisms in a population; or explain the evolution of varied structures (with defined functions) that affected the organisms' survival in a specific environment (e.g., giraffe, wind pollination of flowers).	Animal Adaptations Plant Adaptations Population Genetics
<b>3. NATURAL SELECTION</b>	
Grades 9-11	
S:LS3:11:3.1 Explain the concept of natural selection.	Evolution The Process of Evolution
S:LS3:11:3.2 Explain the diversity and unity of past and present life forms on Earth using currently accepted theories.	Evolution The Process of Evolution
S:LS3:11:3.3 Recognize how a species' chance of survival increases with each variation of an organism within the species; and explain how, in the event of a major global change, the greater the diversity of species on Earth, the greater the chance for survival of life.	Evolution Population Genetics
S:LS3:11:3.4 Analyze present day data and research in areas, including antibiotic resistance in bacteria, changes in viral genomes, such as bird flu, and DNA sequencing; and relate it to the concepts of natural selection.	Antibiotics and Vaccinations Superbugs
S:LS3:11:3.5 Identify and describe ways genes may be changed and combined to create genetic variation within a species.	DNA Replication 2 Genetic Mutations Population Genetics
S:LS3:11:3.6 Explain that gene mutations and new combinations may have a variety of effects on the organism, including positive and negative ones, or none at all.	Genetic Mutations
S:LS3:11:3.7 Explain the concepts of Mendelian genetics.	Gregor Mendel
S:LS3:11:3.8 Use pedigree charts and Punnet Squares to determine patterns of inheritance.	Gregor Mendel Incomplete Dominance and Codominance
S:LS3:11:3.9 Given a scenario, provide evidence that demonstrates how sexual reproduction results in a great variety of possible gene combinations and contributes to natural selection (e.g., Darwin's finches, isolation of a species, Tay Sach's disease).	Meiosis Population Genetics
Grades 11-12 (Advanced)	

S:LS3:12:3.1 Understand the types of mutations that cause changes in DNA and cause the appearance of new alleles, such as frameshift and point mutations, and the chromosomal mutations of insertion, deletion, translocation, and duplication.	DNA Replication 2 Genetic Mutations
<b>LS4 - Humans are similar to other species in many ways, and yet are unique among Earth's life forms.</b>	
<b>1. BEHAVIOR</b>	
Grades 9-11	
S:LS4:11:1.1 Recognize that the immune system, endocrine system, and nervous system can affect the homeostasis of an organism.	Homeostasis Hormones Immune Responses Immune System Nerve Impulses The Endocrine System The Nervous System Thermoregulation
S:LS4:11:1.2 Describe how the functions of all the human body systems are interrelated at a chemical level and how they maintain homeostasis.	Homeostasis
<b>2. DISEASE</b>	
Grades 9-11	
S:LS4:11:2.1 Explain that disease in organisms can be caused by intrinsic failures of the system or infection by other organisms, and describe as well as provide examples of how some diseases are caused by: the breakdown in cellular function, congenital conditions, genetic disorders, malnutrition, and emotional health, including stress.	Genetic Mutations Glucoregulation HIV and AIDS Inherited Diseases Infectious Diseases Nutrition
S:LS4:11:2.2 Explain that vaccines were developed to reduce or eliminate diseases; and provide examples of how these medical advances have proven to be successful.	Antibodies and Vaccinations
S:LS4:11:2.3 Describe and provide examples of how new medical techniques, efficient health care delivery systems, improved sanitation, and a more complete understanding of the nature of disease provides today's humans a better chance of staying healthier than their forebears.	Antibodies and Vaccinations Genetic Engineering for Health Care Pasteurization
<i>S:LS4:11:2.4 Describe how some drugs mimic or block the molecules involved in transmitting nerve or hormone signals and explain how this disturbs the normal operations of the brain and body.</i>	-
S:LS4:11:2.5 Explain that gene mutation in a cell can result in uncontrolled division, which is called cancer; and describe how exposure of cells to certain chemicals and radiation increase mutation, and thus the chance for cancer.	Genetic Mutations

S:LS4:11:2.6 Use evidence to make and support conclusions about the ways that humans or other organisms are affected by environmental factors or heredity (e.g., pathogens, diseases, medical advances, pollution, mutations).	Genetic Mutations Glucoregulation HIV and AIDS Infectious Diseases Inherited Diseases
<b>3. HUMAN IDENTITY</b>	
Grades 9-11	
S:LS4:11:3.1 Describe how the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, and environmental conditions and personal health behaviors.	Human Populations
S:LS4:11:3.2 Explain how the immune system functions to prevent and fight disease.	Immune System Immune Responses
S:LS4:11:3.3 Explain how the immune system, endocrine system, or nervous system works and draw conclusions about how systems interact to maintain homeostasis in the human body.	Homeostasis Hormones Immune System The Endocrine System The Nervous System
<b>LS5 - The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.</b>	
<b>1. DESIGN TECHNOLOGY</b>	
Grades 9-11	
S:LS5:11:1.1 Describe ways in which technology has increased our understanding of the life sciences.	Cell Theory Microscopy Pasteurization Understanding Genomes
S:LS5:11:1.2 Understand that technology is designed with a particular function in mind, and principles of life science are useful in creating technology for the life sciences.	Cell Theory Microscopy
Grades 11-12 (Advanced)	
S:LS5:12:1.1 Recognize the importance of technology as it relates to science, for purposes such as: access to information about living systems, medical diagnosis, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.	Microscopy Understanding Genomes
<b>2. TOOLS</b>	
Grades 9-11	

S:LS5:11:2.1 Describe the use and benefits of equipment such as light microscopes, transmission electron microscopes, scanning electron microscopes, spectrophotometers, probes, and robotics to the study of the life sciences.	Microscopy
<b>3. SOCIAL ISSUES (LOCAL AND GLOBAL)/MEDICAL TECHNOLOGY/BIOTECHNOLOGY</b>	
Grades 9-11	
<i>S:LS5:11:3.1 Describe ways technology can support and improve our understanding of environmental issues.</i>	–
S:LS5:11:3.2 Describe aspects of the medical system available to help people in New Hampshire, including: prevention programs, vaccines and pharmaceuticals, hospitals and rehabilitation facilities.	Antibodies and Vaccinations
S:LS5:11:3.3 Recognize that biotechnology is used in many areas, such as agriculture, pharmaceuticals, the environment, and genetic engineering; and understand that it requires extensive knowledge of the systems being changed.	Genetic Engineering for Health Care GM Organisms
S:LS5:11:3.4 Explain how advances in agriculture made using biotechnology have directly affected the food production over the past 100 years; and that this change has profoundly affected societies all over the globe, making larger populations and urban centers a possibility.	GM Organisms
Grades 11-12 (Advanced)	
S:LS5:12:3.1 Explain how genetic engineering is used to modify the DNA structure of an organism; and describe how this process is used to research and develop medically useful products, such as insulin.	Genetic Engineering for Health Care Genetic Engineering
S:LS5:12:3.2 Summarize arguments on both sides of a medical research controversy, such as stem cell research, cloning, or zootransplantation.	GM Organisms
<i>S:LS5:12:3.3 Analyze and evaluate a biotechnology system in New Hampshire that focuses on a specific goal, such as pharmaceutical development; and describe all elements of the system, identifying the costs and the benefits.</i>	–
<b>4 CAREER TECHNICAL EDUCATION CONNECTIONS</b>	
Grades 9-11	
<i>S:LS5:11:4.1 Explain the kinds of applications of knowledge and skills necessary for jobs/careers specific to the life sciences.</i>	–
Grades 11-12 (Advanced)	
<i>S:LS5:12:4.1 Understand the various scientific fields that use scientific content and skills; and distinguish between professional and skilled science jobs/careers in the life sciences.</i>	–