

**OHIO SCIENCE STANDARDS  
Content Standards Mapping**

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<b>LIFE SCIENCE</b>	<b>Boardworks High School Biology Presentations</b>
<b>Grade 10</b>	
1. Explain that living cells:	
<i>a. Are composed of a small number of key chemical elements (carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur).</i>	-
b. Are the basic unit of structure and function of all living things.	Cells to Organisms Eukaryotic Cells Prokaryotic Cells
<i>c. Come from pre-existing cells after life originated.</i>	-
d. Are different from viruses.	HIV and AIDS
2. Compare the structure, function and interrelatedness of cell organelles in eukaryotic cells (e.g., nucleus, chromosome, mitochondria, cell membrane, cell wall, chloroplast, cilia, flagella) and prokaryotic cells.	Eukaryotic Cells Organelles Prokaryotic Cells
3. Explain the characteristics of life as indicated by cellular processes including:	
a. Homeostasis.	Homeostasis
b. Energy transfers and transformations.	Aerobic Respiration Eukaryotic Cells Photosynthesis 1 Photosynthesis 2
c. Transportation of molecules.	Eukaryotic Cells Organelles
d. Disposal of wastes.	Eukaryotic Cells
e. Synthesis of new molecules.	Nucleic Acids Protein Synthesis Transcription and Translation
4. Summarize the general processes of cell division and differentiation, and explain why specialized cells are useful to organisms and explain that complex multicellular organisms are formed as highly organized arrangements of differentiated cells.	Cells to Organisms Cell Differentiation Meiosis Mitosis Specialized Plant Cells The Stages of Meiosis The Stages of Mitosis

<p>5. Illustrate the relationship of the structure and function of DNA to protein synthesis and the characteristics of an organism.</p>	<p>Controlling Protein Synthesis DNA Genes and Alleles Protein Synthesis Proteins Transcription and Translation</p>
<p>6. Explain that a unit of hereditary information is called a gene, and genes may occur in different forms called alleles (e.g. gene for pea plant height has two alleles, tall and short).</p>	<p>Genes and Alleles Gregor Mendel</p>
<p>7. Describe that spontaneous changes in DNA are mutations, which are a source of genetic variation. When mutations occur in sex cells, they may be passed on to future generations; mutations that occur in body cells may affect the functioning of that cell or the organism in which that cell is found.</p>	<p>Cell Differentiation DNA Replication 1 DNA Replication 2 Genes and Alleles Genetic Mutations Genetic Variation Meiosis Patterns of Inheritance</p>
<p>8. Use the concepts of Mendelian and non-Mendelian genetics (e.g. segregation, independent assortment, dominant and recessive traits, sex-linked traits and jumping genes) to explain inheritance.</p>	<p>Genetic Variation Gregor Mendel Inherited Diseases Meiosis Patterns of Inheritance The Stages of Meiosis</p>
<p>9. Describe how matter cycles and energy flows through different levels of organization in living systems and between living systems and the physical environment. Explain how some energy is stored and much is dissipated into the environment as thermal energy (e.g. food webs and energy pyramids).</p>	<p>Energy Loss in Food Chains Energy Transfer in Food Chains Food Chains Food Webs</p>
<p>10. Describe how cells and organisms acquire and release energy (photosynthesis, chemosynthesis, cellular respiration and fermentation).</p>	<p>Aerobic Respiration Anaerobic Respiration Fermentation Photosynthesis 1 Photosynthesis 2</p>

<p>11. Explain that living organisms use matter and energy to synthesize a variety of organic molecules (e.g. proteins, carbohydrates, lipids and nucleic acids) and to drive life processes (e.g. growth, reacting to the environment, reproduction and movement).</p>	<p>Lipids Monosaccharides Nucleic Acids Polysaccharides Protein Synthesis Proteins</p>
<p>12. Describe that biological classification represents how organisms are related with species being the most fundamental unit of the classification system. Relate how biologists arrange organisms into a hierarchy of groups and subgroups based on similarities and differences that reflect their evolutionary relationships.</p>	<p>Classification</p>
<p>13. Explain that the variation of organisms within a species increases the likelihood that at least some members of a species will survive under gradually changing environmental conditions.</p>	<p>Evolution Extinction The Process of Evolution</p>
<p>14. Relate diversity and adaptation to structures and their functions in living organisms (e.g. adaptive radiation).</p>	<p>Animal Adaptation Introduction to Biodiversity Plant Adaptation Specialized Plant Cells</p>
<p>15. Explain how living things interact with biotic and abiotic components of the environment (e.g. predation, competition, natural disasters and weather).</p>	<p>Ecosystems Ecosystems and Succession Host-Parasite Relationship Predator-Prey Relationship</p>
<p>16. Relate how distribution and abundance of organisms and populations in ecosystems are limited by the ability of the ecosystem to recycle materials and the availability of matter, space and energy.</p>	<p>Describing Populations Ecosystems Recycling Nutrients</p>
<p>17. Conclude that ecosystems tend to have cyclic fluctuations around a state of approximate equilibrium that can change when climate changes, when one or more new species appear as a result of immigration or when one or more species disappear.</p>	<p>Describing Populations Ecosystems</p>
<p>18. Describe ways that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. Explain how changes in technology/biotechnology can cause significant changes, either positive or negative, in environmental quality and carrying capacity.</p>	<p>Describing Populations Ecosystems GM Organisms Human Impact on the Environment Loss of Diversity Over-fishing The Process of Evolution Water Pollution</p>

<p>19. Illustrate how uses of resources at local, state, regional, national, and global levels have affected the quality of life (e.g. energy production and sustainable vs. non-sustainable agriculture).</p>	<p>Air Pollution Climate Change Fossil Fuels Human Impact on the Environment Sustainability The Impact of Mining The Impact of Using CFCs Water Pollution</p>
<p>20. Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution.</p>	<p>Evolution Population Genetics The Process of Evolution</p>
<p>21. Explain that natural selection provides the following mechanism for evolution; undirected variation in inherited characteristics exist within every species. These characteristics may give individuals an advantage or disadvantage compared to others in surviving and reproducing. The advantaged offspring are more likely to survive and reproduce. Therefore, the proportion of individuals that have advantageous characteristics will increase. When an environment changes, the survival value of some inherited characteristics may change.</p>	<p>Darwin Evolution Extinction The Process of Evolution</p>
<p>22. Describe historical scientific developments that occurred in evolutionary thought (e.g. Lamarck and Darwin, Mendelian Genetics and modern synthesis).</p>	<p>Darwin Evolution Gregor Mendel</p>
<p>23. Deleted</p>	<p style="background-color: #cccccc;"> </p>
<p>24. Analyze how natural selection and other evolutionary mechanisms (e.g. genetic drift, immigration, emigration, mutation) and their consequences provide a scientific explanation for the diversity and unity of past life forms, as depicted in the fossil record, and present life forms.</p>	<p>Darwin Evolution Ecosystems Fossil Record The Process of Evolution</p>
<p>25. <i>Explain that life on Earth is thought to have begun as simple, one celled organisms approximately 4 billion years ago. During most of the history of Earth only single celled microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.</i></p>	<p style="text-align: center;">–</p>
<p>26. Use historical examples to explain how new ideas are limited by the context in which they are conceived. These ideas are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g. biological evolution, germ theory, biotechnology and discovering germs).</p>	<p>Darwin Evolution Gregor Mendel Pasteurization</p>

27. Describe advances in life sciences that have important long-lasting effects on science and society (e.g. biological evolution, germ theory, biotechnology and discovering germs).	Darwin Evolution Gregor Mendel Pasteurization
28. Analyze and investigate emerging scientific issues (e.g. genetically modified food, stem cell research, genetic research and cloning).	Genetic Engineering Genetic Engineering for Health Care GM Organisms
<b>Grade 11</b>	
1. Describe how the maintenance of a relatively stable internal environment is required for the continuation of life, and explain how stability is challenged by changing physical, chemical and environmental conditions as well as the presence of pathogens.	Homeostasis Immune System
2. Recognize that chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Some of this energy is released as thermal energy.	Digestion Lipids Monosaccharides Polysaccharides
<i>3. Relate how birth rates, fertility rates and death rates are affected by various environmental factors.</i>	Describing Populations
4. Examine the contributing factors of human population growth that impact natural systems such as levels of education, children in the labor force, education and employment of women, infant mortality rates, costs of raising children, birth control methods, and cultural norms.	Human Impact on the Environment
5. Investigate the impact on the structure and stability of ecosystems due to changes in their biotic and abiotic components as a result of human activity.	Ecosystems Extinction Human Impact on the Environment Loss of Diversity Over-fishing
<i>6. Predict some possible impacts on an ecosystem with the introduction of a non-native species.</i>	–
7. Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution.	Describing Populations Human Impact on the Environment
8. Recognize that populations can reach or temporarily exceed the carrying capacity of a given environment. Show that the limitation is not just the availability of space but the number of organisms in relation to resources and the capacity of earth systems to support life.	Describing Populations Ecosystems
9. Give examples of how human activity can accelerate rates of natural change and can have unforeseen consequences.	Extinction Human Impact on the Environment Loss of Diversity
10. Explain how environmental factors can influence heredity or development of organisms.	Environmental Variation

11. Investigate issues of environmental quality at local, regional, national and global levels such as population growth, resource use, population distribution, over-consumption, the capacity of technology to solve problems, poverty, the role of economics, politics and different ways humans view the earth.	Human Impact on the Environment
12. Recognize that ecosystems change when significant climate changes occur or when one or more new species appear as a result of immigration or speciation.	Climate Change Ecosystems Human Impact on the Environment Loss of Diversity Over-fishing Population Genetics
13. Describe how the process of evolution has changed the physical world over geologic time.	Evolution Fossil Record
14. Describe how geological time can be estimated by observing rock sequences and using fossils to correlate the sequences at various locations. Recognize that current methods include using the known decay rates of radioactive isotopes present in rocks to measure the time since the rock was formed.	Fossil Records Radioactive Dating
<b>Grade 12</b>	
1. Recognize that information stored in DNA provides the instructions for assembling protein molecules used by the cells that determine the characteristics of the organism.	Controlling Protein Synthesis DNA Protein Synthesis Transcription and Translation
2. Explain why specialized cells/structures are useful to plants and animals (e.g. stoma, phloem, xylem, blood, nerve, muscle, egg and sperm).	Blood and Blood Vessels Cell Differentiation Nerve Impulses Specialized Plant Cells
3. Explain that the sun is essentially the primary source of energy for life. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules.	Food Chains Photosynthesis 1 Photosynthesis 2
4. Explain that carbon-containing molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats). In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes.	Digestion Lipids Monosaccharides Nucleic Acids Polysaccharides Proteins
5. Examine the inheritance of traits through one or more genes and how a single gene can influence more than one trait.	Genes and Alleles Genetic Variation Inherited Disease Patterns of Inheritance

6. Explain how developmental differentiation is regulated through the expression of different genes.	Cell Differentiation
7. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization.	Animal Adaptations Cells to Organisms Eukaryotic Cells Organelles Plant Adaptations Prokaryotic Cells Specialized Plant Cells
8. Based on the structure and stability of ecosystems and their non-living components, predict the biotic and abiotic changes in such systems when disturbed (e.g. introduction of non-native species, climatic change, etc.).	Ecosystems
9. Explain why and how living systems require a continuous input of energy to maintain their chemical and physical organization. Explain that with death and the cessation of energy input, living systems rapidly disintegrate toward more disorganized states.	–
10. Explain additional components of the evolution theory, including genetic drift, immigration, emigration and mutation.	Evolution Genetic Variation Genetic Mutations Population Genetics The Process of Evolution
11. Trace the historical development of a biological theory or idea (e.g. genetics, cytology and germ theory).	Evolution Cell Theory Darwin Gregor Mendel Nucleic Acids Pasteurization Transcription and Translation
12. Describe advances in life sciences that have important, long-lasting effects on science and society (e.g. biotechnology).	Cell Theory Darwin Evolution Genetic Engineering Genetic Engineering for Health Care Gregor Mendel Pasteurization