Curriculum Framework for Biology

School: The Delaware Met **Curricular Tool: Science and Global Issues - Biology** **Grade: 10**

Standards Alignment	Unit Concept Big Ideas	Essential Questions Student Learning Targets	Assessments
Unit One: Sustainability **Timeline : 6 weeks**			
Standard 1: Nature and Application of Science and Technology[1] **Standard 6: Life Processes** **Strand:** Regulation and Behavior **Substrand B:** Multi-cellular animals have nervous	One of the most critical global issues of our time is how to live in ways that will sustain our planet's systems and resources. Humans can alter the living and non-living factors within an ecosystem,	How do humans have an impact on the diversity and stability of ecosystems? How can aspects of sustainability be viewed from a personal,	Formative Assessments: Teacher observation Graphic organizers Journal Entries KWLs Pre-tests

[1] Standard one represents the process or method through which students will be taught. This course is arranged around five large units. This organization allows students the time to inquire, reason, and test their ideas. To save space and repetition, each unit lists standard one, but the actual standards will only appear here.
Standard 1: Nature and Application of Science and Technology.
Strand: Understandings and Abilities of Scientific Inquiry
Substrand A. Understand that: Scientists conduct investigations for a variety of reasons including to explore new phenomena, to replicate other's results, to test how well a theory predicts, to develop new products, and to compare theories.
Be able to: Identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation.
Substrand B. Understand that: Science is distinguished from other ways of knowing by the use of empirical observations, experimental evidence, logical arguments and healthy skepticism.
Be able to: Design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis.
Substrand C. Understand that: Theories in science are well-established explanations of natural phenomena that are supported by many confirmed observations and verified hypotheses. The application of theories allows people to make reasonable amended to become more complete with the introduction
of new evidence.
Be able to: Collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results.
Substrand D. Understand that: Investigating most real-world problems requires building upon previous scientific findings and cooperation among individuals with knowledge and expertise from a variety of scientific fields. The results of scientific studies are considered valid when subjected to critical review where contradictions are resolved and the explanation is confirmed.
Be able to: Construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence.
Substrand E. Understand that: In communicating and defending the results of scientific inquiry, arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge. (American Association for the Advancement of Science, 2001)
Be able to: Communicate and defend the results of scientific investigations using logical arguments and connections with the known body of scientific information.
Substrand F. Understand that: Knowledge and skill from sources other than science are essential to scientific inquiry. These include mathematics, reading, writing, and technology.
Be able to: Use mathematics, reading, writing and technology when conducting scientific inquiries.
Strand Science, Technology, and Society
Substrand A. The pursuit of science can generate the need for advanced technology. Advanced technology, in turn, can provide the opportunity to pursue new scientific knowledge.
Substrand B. The social, economic, and political forces of a society have a significant influence on what science and technology programs are pursued, funded, and implemented.

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systems that generate behavioral responses. These responses result from interactions between organisms of the same species, organisms of different species, and from environmental changes. **Standard 7: Diversity and Continuity of Living Things** **Strand:** Reproduction, Heredity, and Development **Substrand I** Embryological development in plants and animals involves a series of orderly changes in which cells divide and differentiate. Development is controlled by genes whose expression is influenced by internal factors and may also be influenced by environmental factors. Alteration in this balance may interfere with normal growth and development. **Strand:** Diversity and Evolution **Substrand C:** The process of natural selection occurs when some heritable variations that arise from random mutation and recombination give individuals within a species some survival advantages over others. These offspring with advantageous adaptations are more likely to survive and reproduce, this increasing the proportion of individuals within a population with advantageous characteristics. When populations become isolated, these changes may accumulate and eventually result in new species. **Substrand D:** Evolution does not proceed at the same rate in all populations; nor does it progress in a linear or set direction. Environmental changes have a strong influence on the evolutionary process. Other factors that influence evolution include: sexual selection, mutation, genetic drift, and genetic modification. **Substrand E:** Organisms are classified into a hierarchy of groups and subgroups based on similarities in structure, comparisons in DNA and protein and evolutionary relationships. **Substrand F:** Genetically diverse populations are more likely to survive changing environments.	thereby creating changes to the overall system. The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. How can the cell theory explain the historical development of cells and explain how life evolved over time and will continue to evolve beyond our lives? <u>Concepts</u> Sustainability Indicators Life cycle of products Correlation and causality	community, and global perspective? How is matter transferred and energy transferred/transformed in living systems? <u>Students will</u> • investigate what it means to live in a sustainable world., • investigate why sustainability often raises more questions than it can answer. • discover that most sustainability problems are a result of people's overuse and misuse of the earth's resources. • will identify sustainability challenges in towns, countries, and larger regions around the world. • learn about communities that have applied scientific knowledge and technology to address their local resource challenges. • estimate the impact of your own lifestyle on the ecological sustainability of the planet. • apply the fundamentals of scientific inquiry to investigate a city facing a sustainability dilemma. The evidence gathered will then be used to suggest a course of action for the community.	Conferences Observations Question and Answer Sessions First Drafts / Quizzes Journals Interviews Short responses Quickwrites Tickets in/out of the door Participation in lab work Notetaking <u>Summative Assessments:</u> Tests on specific areas Essays/written report Presentations Projects Presentations Model of key ideas Lab reports Portfolios Checklists/rubrics Debates

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Substrand G: Biological evolution is the foundation for modern biology and is used to make predictions for medical, environmental, agricultural and other societal purposes. **Standard 8: Ecology** **Strand:** Human Impact **Substrand A**. Exponential growth of the global human population and the resulting increase in consumption places severe stress on finite resources. **Substrand B.** Human decisions concerning the use of resources can affect the stability and biodiversity of the ecosystems and the natural recycling processes which maintain the quality of air, water, and land. **Substrand C.** Human activities have a major effect on other species. For example, increased land use reduces habitat available to other species, pollution changes the chemical composition of air, soil, and water, and introduction of non-native species disrupts the ecological balance. **Substrand D.** Advances in technology can help mitigate human impact on the environment and increase the carrying capacity of the ecosystem.			
Unit Two: Ecology – Living on Earth **Timeline: 7 weeks**			
Standard 1: Nature and Application of Science and Technology (all) **Standard 8:** Ecology **Strand:** Interactions within the Environment **Substrand A:** Earth's ecosystems are interconnected by biological, chemical, and physical processes. Changes in one ecosystem may have local and/or global consequences. **Substrand B:** Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate complex ecosystems that are stable over long periods of	Our world holds an amazing variety of organisms living in all sorts of environments. Organisms affect their environments, and in turn the environment affects them. Matter needed to sustain life is continually recycled among and between organisms and the environment. Energy from the Sun flows	How do we build sustainability from an ecosystems perspective? What does this mean for how humans impact various ecosystems? How do matter and energy link organisms to each other and their environments? How should fisheries be managed to build sustainability in the oceans?	<u>Formative Assessments:</u> Teacher observation Graphic organizers Journal Entries KWLs Pre-tests Conferences Observations Question and Answer Sessions First Drafts / Quizzes Journals Interviews

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time and tend to have cyclic fluctuations around an equilibrium. **Substrand C:** Ecosystems undergo major changes as a result of such factors as climate change, introduction of new species, and habitat destruction. These can be the result of natural processes and /or human impact. **Sustrand D:** Changes in the physical, chemical, or biological conditions of an ecosystem can alter the diversity of species in the system. Over time, ecosystems change and population of organisms adapt, move, or become extinct. **Substrand E:** The carrying capacity for a specific population in an ecosystem depends on the resources available. Given adequate biotic and abiotic resources and no disease or predators, populations increase at rapid rates. Resources, predation and climate, limit growth of populations in specific niches in an ecosystem. **Substrand F:** Populations can increase through exponential growth. Higher populations result in competition for limited resources and increases in envrironmental pollution. **Strand:** Energy Flow and Material Cycles in the Environment **Substrand A.** The Law of Conservation of Matter applies to ecosystems. Matter needed to sustain life in ecosystems is continually recycled (e.g., carbon cycle, water cycle, nitrogen cycle, mineral cycles) among organisms and between organisms and the environment. **Substrand B**. The Law of Conservation of Energy applies to ecosystems. All energy is conserved as it passes from the Sun through an ecosystem. During energy transformations, some energy is converted to unusable heat. A continual input of energy from the Sun keeps the process going. **Substrand C**. At each level of a food pyramid some energy is stored, but much is dissipated as heat. Consequently the number of trophic levels is finite, and the number of individuals in a population that feed at	irreversibly through ecosystems and is conserved as organisms use and transform it. <u>Concepts:</u> Biomes Stability and climate change in ecosystems Invasive species Population dynamics Energy flow through ecosystems Carbon and nitrogen cycles Photosynthesis and cellular respiration Symbiotic relationships Predator-prey relationships	<u>Students will:</u> • understand the complex web of relationships within ecosystems is essential to understanding their sustainability. • describe how humans interact with ecosystems in many ways. • recognize that we rely on ecosystems to supply us food, shelter, energy, and the oxygen we breathe. As we consume resources and discard our wastes, we change ecosystems and sometimes threaten their sustainability. • examine a variety of ecological issues including the impact of human activities on ecosystems. • examine what can happen when people cause pollution in an area vital to nonhuman and human organisms. • learn about invasive species and their impacts on established ecosystems. You will also investigate how different management strategies affect the sustainability of fisheries. • plan and advocate for actions humans can take to help sustain ecosystems for the future.	Short responses Quickwrites Tickets in/out of the door Participation in lab work Notetaking <u>Summative Assessments:</u> Tests on specific areas Essays/written report Presentations Projects Presentations Model of key ideas Lab reports Portfolios Checklists/rubrics Debates

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higher levels is limited. **Substrand D.** Biomagnification is an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. Biomagnification increases as trophic levels increase. **Strand:** Human Impact **Substrand E**. The complexity and interaction of these ecosystems requires individual and collaborative efforts on a local, regional, national, and international scale.			
Unit Three: Cell Biology **Timeline: 8 weeks**			
Standard 1: Nature and Application of Science and Technology (all) **Standard 6: Life Processes** **Strand:** Structure/Function Relationship **Substrand A:** In order to establish and maintain their complex organization and structure, organisms must obtain, transform, and transport matter and energy, eliminate waste products, and coordinate their internal activities. **Substrand B.** Cells take highly varied forms in different plants, animals, and microorganisms. Structural variations among cells determine the function each cell performs. **Substrand C:** Cells have distinct and separate structures (organelles), which perform and monitor processes essential for survival of the cell (e.g., energy use, waste disposal, synthesis of new molecules, and storage of genetic material). The highly specific function of each organelle is directly related to its structure. **Substrand D.** The cell membrane is dynamic and interacts with internal membranous structures as materials are transported into and out of the cell.	Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function. The effects of diseases vary from mild to devastating and affect sustainability at the environmental, economic, and social level. Diseases are caused by infectious microbes, such as bacteria and viruses, genetic factors, and other events that cause breakdowns in the structure or function of cells. Understanding the mechanisms of a disease is essential to people's ability to prevent, eradicate, and cure it and to maintain the sustainability of populations and communities. <u>Concepts:</u>	How does structure relate to function in living systems from the organismal to the cellular level? How can the disparities between developing and developed countries in terms of diseases impacting human life? How do we make decisions about priorities for disease interventions to prevent or treat diseases that limit the social, economic, and environmental progress of a culture? How can the cell theory explain the historical development of cells and explain how life evolved over time?	<u>Formative Assessments:</u> Teacher observation Graphic organizers Journal Entries KWLs Pre-tests Conferences Observations Question and Answer Sessions First Drafts / Quizzes Journals Interviews Short responses Quickwrites Tickets in/out of the door Participation in lab work Notetaking <u>Summative Assessments:</u> Tests on specific areas Essays/written report

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Substrand E. The transport of materials across the membrane can be passive (does not require the expenditure of cellular energy), or active (requires the expenditure of cellular energy) depending upon membrane structure and concentration gradients. **Substrand F:** Cells store and use information to guide their functions. DNA molecules in each cell carry coded instructions for synthesizing protein molecules. The protein molecules have important structural and regulatory functions. **Substrand H:** In multi-cellular organisms, cells perform specialized functions as parts of sub-systems, which work together to maintain optimum conditions for the benefit of the whole organism. **Strand 2:** Matter and Energy Transformations **Substrand A:** Cells carry out a variety of chemical transformations (i.e., cellular respiration, photosynthesis, and digestion) which allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones. Most of these transformations are made possible by protein catalysts called enzymes. **Substrand B:** Plant cells contain chloroplasts, which convert light energy into chemical energy through the process of photosynthesis. This chemical energy is used by the plants to convert carbon dioxide and water into glucose molecules, that may be used for energy or to form plant structures. Photosynthesis adds oxygen to the atmosphere and removes carbon dioxide. **Substrand C:** All organisms, including plants, use the process of cellular respiration to transform stored energy in food molecules into usable energy. The energy produced is stored in the form of ATP and is used by organisms to conduct their life processes. Cellular respiration may require oxygen and adds carbon dioxide to the atmosphere. **Substrand D:** Photosynthesis and cellular respiration are complementary processes resulting in the flow of	Cellular nature of life Cell structure and function Cell specialization and differentiation Cell division and the cell cycle Microbes and infectious diseases Breakdown of cellular function in diseases, such as diabetwes and cancer Respiration, photosynthesis, and cellular macromolecules	<u>Students will:</u> • examine several diseases and their social, environmental, and economic consequences. • learn about the mechanism of these diseases at the cellular level. • investigate the structures and functions of normal cells and some of the processes that occur inside these cells. • research and recommend how to best allocate limited funding to address world health problems.	Presentations Projects Presentations Model of key ideas Lab reports Portfolios Checklists/rubrics Debates

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energy and the cycling of matter in ecosystems.			
Unit Four: Genetics – Feeding the World **Timeline: 7 weeks**			
Standard 6: Life Processes **Strand:** Structure/Function Relationship **Substrand F:** Cells store and use information to guide their functions. DNA molecules in each cell carry coded instructions for synthesizing protein molecules. The protein molecules have important structural and regulatory functions. **Strand: Regulation and Behavior** **Substrand** **Substrand B**. The scientific investigation of cellular chemistry enables the biotechnology industry to produce medicines, foods, and other products for the benefit of society. **Standard 7:** Diversity and Continuity of Living Things **Strand:** Reproduction, Heredity, and Development **Substrand A:** Hereditary/genetic information in chromosomes is contained in molecules of DNA. Genes are sections of DNA that direct syntheses of specific proteins associated with traits in organisms. These consist of various combinations of four different nucleotides that encode this information through their sequences. **Substrand B:** Known patterns of inheritance can be used to make predictions about genetic variation. **Substrand C:** Mutations in DNA of organisms normally occur spontaneously at low rates, but can occur at higher rates. Most mutations have no effect on the organism, but some may be beneficial or harmful depending on the environment. **Substrand D:** Only random mutations in gametes can create the variation that inherited by an organism's offspring. Somatic mutations are not inherited, but may lead to cell death, uncontrolled cell growth, or cancer. **Substrand E:** During the cell cycle, DNA of the parent	Organisms reproduce, develop, have predictable life cycles, and pass on heritable traits to their offspring. Modern scientists study genetics to learn more about how genes work and to solve such practical problems as enhancing crop productivity, curing diseases, and producing new fuels. One dynamic, and sometimes controversial, technology that has emerged from genetics is genetic modification. The development of technology has allowed us to apply our knowledge of genetics, reproduction, development and evolution to meet human needs and wants. Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function. <u>Concepts</u> Sexual and asexual reproduction Mitosis and Meiosis Genotype and phenotype Mendel's research Genetic crosses, Punnett squares, and	Why do offspring resemble their parents and why are some sexes more likely than others to inherit specific traits? How does natural selection encourage inter and intra-specific diversity over time? How can our understanding of Mendelian genetics be used to predict patterns of inheritance? How do mutations influence the survival of an organism/species and how can a change of a nucleotide in a gene affect the structure and function of the protein for which it codes? How does recombinant DNA technology, as it is applied to genetic engineering, meet human needs and wants? What issues surround selective breeding and genetic modification? How can we collect data to make an informed decision about these evolving issues? How are genetically modified	<u>Formative Assessments:</u> Teacher observation Graphic organizers Journal Entries KWLs Pre-tests Conferences Observations Question and Answer Sessions First Drafts / Quizzes Journals Interviews Short responses Quickwrites Tickets in/out of the door Participation in lab work Notetaking <u>Summative Assessments:</u> Tests on specific areas Essays/written report Presentations Projects Presentations Model of key ideas Lab reports Portfolios Checklists/rubrics Debates

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cell replicates and the cell divides into two cells that are identical to the parent. This process is used for growth and repair of body tissues and for asexual reproduction. **Substrand F:** Meiosis is the production of sex cells (gametes). The production and release of these gametes is controlled by hormones. In meiosis, the number of chromosomes is reduced by one-half and chromosomes may randomly exchange homologous parts to create new chromosomes with combinations not necessarily found in the parent cell. This may increase variation within the species. **Substrand G**. Upon fertilization, the fusion of the gametes restores the original chromosome number, and new gene combinations lead to increased genetic variation, which, in turn, increases the likelihood of survival of the species. **Substrand H:** The sex chromosomes contain different genes, and therefore, certain traits will show patterns of inheritance based on gender.	pedigrees Patterns of inheritance Genes, alleles, chromosomes, and DNA Flow of genetic information Selective breeding Genetically modified organisms Biotechnology	organisms, particularly in the production of agricultural crops, being used? Who benefits from their use? Students will • learn about the historical desire to breed animals to create more desirable offspring. • consider how learning to manipulate the genes of various species can help or hinder animals and people. • debate if being about to modify genes will lead to unintended consequences for the environment and/or human health. • investigate how genes and patterns of inheritance function in organisms and generations of organisms. • describe the procedures and results of genetic modification • debate some of the benefits and trade-offs of producing specific genetically modified organisms.	
Unit Five: Evolution – Maintaining Diversity **Timeline: 7 weeks**			
Standard 1: Nature and Application of Science and Technology **Standard 6:** Life Processes **Strand 1:** Structure/Function Relationship **Substrand F:** Cells store and use information to guide	Each ecosystem differs from others in its varieties of species, genetic makeup of its species, and the evolutionary relationships of species. All of these levels of variation	How do we conserve genetic, species, and ecosystem diversity? How does natural selection encourage inter and intra-specific diversity over time?	Formative Assessments: Teacher observation Graphic organizers Journal Entries KWLs Pre-tests

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their functions. DNA molecules in each cell carry coded instructions for synthesizing protein molecules. The protein molecules have important structural and regulatory functions. **Standard 7:** Diversity and Continuity of Living Things **Strand 2:** Diversity and Evolution **Substrand A:** Evolution is a change in allelic frequencies of a population over time. The theory of evolution is supported by extensive biochemical, structural, embryological, and fossil evidence. **Substrand B:** The great diversity of organisms is the result of more than C.5 billion years of evolution that has filled every available niche with life forms. The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent with modification from common ancestors. **Substrand C:** the process of natural selection occurs when some heritable variations that arise from random mutation and recombination give individuals within a species some survival advantages over others. These offspring with advantageous adaptations are more likely to survive and reproduce, thus increasing the proportion of individuals within a population with advantageous characteristics. When populations become isolated, these changes may accumulate and eventually result in a new species. **Substrand D**. Evolution does not proceed at the same rate in all populations; nor does it progress in a linear or set direction. Environmental changes have a strong influence on the evolutionary process. Other factors that influence evolution include: sexual selection, mutation, genetic drift, and genetic modification. **Substrand E:** Organisms are classified into a hierarchy of groups and subgroups based on similarities in structure, comparisons in DNA and protein and evolutionary relationships. **Substrand F:** Genetically diverse populations are more likely to survive changing environments.	comprise the earth's biodiversity. The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring. <u>Concepts</u> Biodiversity Ecosystem services and humans' impact on species Natural selection and adaptation Darwin's research Geologic time Interpreting the fossil record Phylogeny Microevolution and macroevolution Biological species concept and specialization The genetic basis of evolution	What are the benefits to developing ecosystems services and intrinsic value models for conservation? Why is sexual reproduction important to the survival of most species? Why is diversity important to a species' ability to survive? <u>Students will</u> • study the evolutionary processes that produce biodiversity, what caused the subtle and dramatic shifts that occurred in the past, and how biodiversity might change in the future. • be challenged to complete a project as a conservationist, focusing on understanding the biodiversity of an area in order to establish priorities for conservation of species. • debate how human activities affect biodiversity. • investigate the levels of biodiversity and the evolutionary processes that increase, decrease, or maintain biodiversity. • examine humans' social, environmental, and economic influences on biodiversity, and make recommendations	Conferences Observations Question and Answer Sessions First Drafts / Quizzes Journals Interviews Short responses Quickwrites Tickets in/out of the door Participation in lab work Notetaking <u>Summative Assessments:</u> Tests on specific areas Essays/written report Presentations Projects Presentations Model of key ideas Lab reports Portfolios Checklists/rubrics Debates

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Substrand G. Biological evolution is the foundation for modern biology and is used to make predictions for medical, environmental, agricultural and other societal purposes.		for which forest area on a fictitious island should receive funds for conservation.	