Norton City Schools Standards-Based Science Course of Study 2003

HIGH SCHOOL ELECTIVE
ADVANCED PLACEMENT BIOLOGY (USED AS A YEAR-LONG OR BLOCK-SCHEDULED COURSE)
Life Sciences Standard (LS)

11-12 Benchmarks	Grade Level Indicators and Sub-Objectives	Teaching Strategies/Resources
By the end of the 11-12 program, the student will: **<u>Life Sciences</u>** ✶ **Explain how processes at the cellular level affect the functions and characteristics of an organism. (LS-A)** ✶ **Explain how humans are connected to and impact natural systems. (LS-B)** ✶ **Explain how the molecular basis of life and the principles of genetics determine inheritance. (LS-C)** ✶ **Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. (LS-D)** ✶ **Explain the interconnectedness of the components of a natural system. (LS-E)** ✶ **Explain how human choices today will affect the quality and quantity of life on earth. (LS-F)**	**By the end of Eleventh/Twelfth Grades, the student will:** **<u>Characteristics and Structure of Life</u>** ✶ **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. (LS-11-1)** ✶ **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. (LS-11-2)** ✶ **Relate how birth rates, fertility rates and death rates are affected by various environmental factors. (LS-11-3)** ✶ **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. (LS-11-4)** ✶ **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. (LS-11-5)** ✶ **Recognize that information stored in DNA provides the instructions for assembling protein molecules used by the cells that determine the characteristics of the organism. (LS-12-1)** ✶ **Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). (LS-12-2)**	

✶ **Summarize the historical development of scientific theories and ideas within the study of life sciences. (LS-G)** ✶ **Describe a foundation of biological evolution as the change in gene frequency of a population over time. Explain the historical and current scientific developments, mechanisms and processes of biological evolution. Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this benchmark does not mandate the teaching or testing of intelligent design.) (LS-H)** ✶ **Explain how natural selection and other evolutionary mechanisms account for the unity and diversity of past and present life forms. (LS-I)** ✶ **Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences. (LS-J)**	✶ **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. (LS-12-3)** ✶ **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. (LS-12-4)** **<u>Heredity</u>** ✶ **Examine the inheritance of traits through one or more genes and how a single gene can influence more than one trait. (LS-12-5)** ✶ **Explain how developmental differentiation is regulated through the expression of different genes. (LS-12-6)** **<u>Diversity and Interdependence of Life</u>** ✶ **Predict some possible impacts on an ecosystem with the introduction of a non-native species. (LS-11-6)** ✶ **Show how populations can increase through linear or exponential growth with corresponding effects on resource use and environmental pollution. (LS-11-7)** ✶ **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. (LS-11-8)** ✶ **Give examples of how human activity can accelerate rates of natural change and can have unforeseen consequences. (LS-11-9)** ✶ **Explain how environmental factors can influence heredity or development of organisms. (LS-11-10)** ✶ **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. (LS-11-11)** ✶ **Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. (LS-12-7)**	

	✶ **Based on the structure and stability of ecosystems and their nonliving components, predict the biotic and abiotic changes in such systems when disturbed (e.g., introduction of non-native species, climatic change, etc.). (LS-12-8)** ✶ **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. (LS-12-9)** **<u>Evolutionary Theory</u>** ✶ **Recognize that ecosystems change when significant climate changes occur or when one or more new species appear as a result of immigration or speciation. (LS-11-12)** ✶ **Describe how the process of evolution has changed the physical world over geologic time. (LS-11-13)** ✶ **Describe how geologic 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. (LS-11-14)** ✶ **Explain additional components of the evolution theory, including genetic drift, immigration, emigration and mutation. (LS-12-10)** **<u>Historical Perspectives and Scientific Revolutions</u>** ✶ **Trace the historical development of a biological theory or idea (e.g., genetics, cytology and germ theory). (LS-12-11)** ✶ **Describe advances in life sciences that have important, long-lasting effects on science and society (e.g., biotechnology). (LS-12-12)** **<u>Sub-Objectives to Meet Indicators:</u>** **Biochemistry** • Compare and contrast organic and inorganic substances. • Classify the four main groups of biologically important organic polymers (i.e., carbohydrates, lipids, proteins, and nucleic acids) and their monomer units. • Recognize relationships between monomers and polymers and the various organic substances.	

	• Distinguish among nonpolar covalent, polar covalent, and ionic bonds. • Compare and contrast buffers, acids, and bases. • Demonstrate the ability to perform a dehydration synthesis and a hydrolysis reaction. **Cytology** • Recognize the relationship between the cell theory and how technology has added to or taken away from various portions of that theory. • Describe the historical contribution to cell theory with regard to scientific inquiry. • Demonstrate competency in proper utilization and the implementation of microscopes in general biological research. • Associate the different cell organelles with their particular functions and their relevance to the continuation of life. • Show the interrelationships of the cell organelles in the production of cell products. • Compare and contrast eukaryotic and prokaryotic cells. • Explain the probable functions and ultra structure of the cytoskeleton. **Homeostasis and Plasma Membrane** • Recognize the importance of membrane surface area versus volume of a cell. • Construct an apparatus that demonstrates the processes of diffusion and osmosis. • Identify and differentiate between the processes of active and passive cellular transport and their importance to maintaining life through both endocytosis and exocytosis. • Discuss how membrane proteins determine in part what cells can transport. • Describe the fluid-mosaic model of membrane structure. • Distinguish among hypertonic, hypertonic, and isotonic solutions. • Explain how a concentration gradient works. • Discuss osmotic pressure. • Explain the sodium/potassium pump. • Explain dynamic equilibrium. **Energy and Enzymes** • Explain the First and Second Laws of Thermodynamics.	

	• Distinguish between catabolic and anabolic pathways. • Describe the function of ATP in the cell. • List the three components of ATP and identify the major class of macromolecules to which each belongs. • Describe the function of enzymes in a biological system. • Explain the induced fit model of enzyme function. • Differentiate between competitive and noncompetitive inhibition. • Explain how enzyme activity can be regulated or controlled. **Photosynthesis** • Trace the role of carbon dioxide in the Calvin cycle. • Utilize various extraction methods of chromatography to compare and contrast pigments of various plants and algae. • Identify various leaf structures and their relationships to photosynthesis. • Demonstrate how different wavelengths of light correspond to different plant pigments. • Compare and contrast photosynthesizers to chemosynthesizers. • Compare and contrast the light and light independent (Calvin Cycle) reactions of photosynthesis. • Describe the relationship between the action spectrum and absorption spectrum. • Describe the chemiosmotic mechanism of photophosphorylation. **Cellular Respiration** • Distinguish between aerobic and anaerobic respiration. • Recount the steps involved in glycolysis, the Krebs Cycle, and the electron transport chain. • Trace the flow of energy from glucose to ATP via cellular respiration. • Relate mitochondrial structure and function to cellular respiration. • Explain how membrane structure is related to membrane function in chemiosmosis. • Summarize the net ATP yield from glucose oxidation. • Explain why fermentation is necessary. • Differentiate between plant fermentation and animal fermentation. **Mitosis/Meiosis** • Differentiate between asexual and sexual reproduction in plants and animals.	

	• Trace the significant events that occur during mitosis and the two meiotic divisions (I, II). • Recognize the relationship between crossing over and independent assortment with genetic variability. • Determine the difference in the genetic outcomes of mitotic daughter cells. • Relate the role of the cell cycle to various cells and predict the outcomes that will result from manipulation of the cell cycle. • Illustrate how meiosis is responsible for the production of gametes in animals and spores in plants. • Illustrate karyotypes and how they may differ with different genetic abnormalities. **From Mendelian to Modern Genetic Theory** • Recount a brief history of Mendel's work in genetics. • Distinguish between a genotype and its corresponding phenotype and the role of alleles. • Associate Mendel's Law of Dominance and Law of Independent Assortment with the results of a cross and probability. • Employ the Punnet Square to determine results of monohybrid and dihybrid crosses. • Discuss non-Mendelian trait inheritance such as sex-linked, sex-influenced, codominance, and polygenic traits. • Construct a karyotype from model chromosomes to determine genetic disorders and sex of the individual. **DNA/RNA** • Identify the monomers involved in the structure of DNA and RNA. • Explain the central dogma of DNA. • Discuss 3' to 5' and 5' to 3'concept. • Compare and contrast the processes of translation and transcription • Create a model demonstrating replication, translation, and transcription of nucleic acids. • Investigate mutations and distinguish between various types and their implications to population. • Discuss present genetic technology and projects to future needs (PCR, gene splicing, gel electrophoresis, and DNA fingerprinting). • Discuss ethical issues in genetic research and its relation to testing, gene	

	therapies, and DNA ownership. • Examine the pros and cons of gene therapy and recombinant DNA. **Origins and History of Life** • Trace the chronology of the origin and history of life from Lamarck to Darwin to present day. • Recount and evaluate scientific evidence supporting modern evolutionary theory, including geographic separation, fossils, anatomical similarities and biochemical differences. • State the conditions for the Hardy-Weinberg Law to be in effect and what conditions can change the genetic outcomes. • Recognize relationships between mutations and change over time in plant and animal populations. • Recognize the relationship between selection and fitness of an organism. • Predict the impact of genetic drift on a population and its effects in the community. • Characterize reproductive barriers and their effects on a population. • Examine modern trends in evolutionary theory, such as adaptive radiation and convergent/divergent, evolution and identify examples of these trends in the world. **Plant Biology** • Compare and contrast hormone systems. • Describe plant anatomy and the various functions of plant parts. • Classify vascular plants according to their reproductive cycles. **Animal Biology** • Classify invertebrates and vertebrates according to given criteria. • Investigate human anatomy and physiology emphasizing the immune, excretory, nervous, and circulatory systems.	