Norton City Schools Standards-Based Science Course of Study 2003

NINTH/TENTH GRADE
BIOLOGY (USED AS A YEAR-LONG OR BLOCK-SCHEDULED COURSE)
Life Sciences Standard (LS)

9-10 Benchmarks	Grade Level Indicators and Sub-Objectives	Teaching Strategies/Resources
By the end of the 9-10 program, the student will: **<u>Life Sciences</u>** **✶ Explain that cells are the basic unit of structure and function of living organisms that once life originated all cells come from pre-existing cells, and that there are a variety of cell types. (LS-A)** **✶ Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. (LS-B)** **✶ Explain the genetic mechanisms and molecular basis of inheritance. (LS-C)** **✶ Explain the flow of energy and the cycling of matter through biological and ecological systems (cellular, organismal and ecological). (LS-D)** **✶ Explain how evolutionary relationships contribute to an understanding of the unity and diversity of life.**	**By the end of Ninth/Tenth Grade, the student will:** **<u>Characteristics and Structure of Life</u>** **✶ Explain that living cells** **a. are composed of a small number of key chemical elements (carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur)** **b. are the basic unit of structure and function of all living things** **c. come from pre-existing cells after life originated, and** **d. are different from viruses. (LS-10-1)** **✶ 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. (LS-10-2)** **✶ Explain the characteristics of life as indicated by cellular processes including** **a. homeostasis** **b. energy transfers and transformation** **c. transportation of molecules** **d. disposal of wastes** **e. synthesis of new molecules (LS-10-3)** **✶ 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. (LS-10-4)** **<u>Heredity</u>** **✶ Illustrate the relationship of the structure and function of DNA to protein synthesis and the characteristics of an organism. (LS-10-5)** **✶ Explain that a unit of hereditary information is called a gene, and**	

(LS-E) **✶ Explain the structure and function of ecosystems and relate how ecosystems change over time. (LS-F)** **✶ Describe how human activities can impact the status of natural systems. (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)**	**genes may occur in different forms called alleles (e.g., gene for pea plant height has two alleles, tall and short). (LS-10-6)** **✶ 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. (LS-10-7)** **✶ 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. (LS-10-8)** **<u>Diversity and Interdependence of Life</u>** **✶ 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). (LS-10-9)** **✶ Describe how cells and organisms acquire and release energy (photosynthesis, chemosynthesis, cellular respiration and fermentation). (LS-10-10)** **✶ 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). (LS-10-11)** **✶ 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. (LS-10-12)** **✶ 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. (LS-10-13)** **✶ Relate diversity and adaptation to structures and their functions in living organisms (e.g., adaptive radiation). (LS-10-14)** **✶ Explain how living things interact with biotic and abiotic components of the environment (e.g., predation, competition, natural disasters and weather). (LS-10-15)** **✶ 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. (LS-10-16) **✶ 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. (LS-10-17)** **✶ 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. (LS-10-18)** **✶ Illustrate how uses of resources at local, state, regional, national, and global levels have affected the quality of life (e.g., energy production, sustainable vs. nonsustainable agriculture). (LS-10-19)** **<u>Evolutionary Theory</u>** **✶ Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution. (LS-10-20)** **✶ 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. (LS-10-21)** **✶ Describe historical scientific developments that occurred in evolutionary thought (e.g., Lamarck and Darwin, Mendelian Genetics and modern synthesis). (LS-10-22)** **✶ Describe how scientists continue to investigate and critically analyze aspects of evolutionary theory. (The intent of this indicator does not mandate the teaching or testing of intelligent design.) (LS-10-23)** **✶ 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. (LS-10-24)** **✶ 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. (LS-10-25)

Historical Perspectives and Scientific Revolutions

- ✶ **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). (LS-10-26)**
- ✶ **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). (LS-10-27)**
- ✶ **Analyze and investigate emerging scientific issues (e.g., genetically modified food, stem cell research, genetic research and cloning). (LS-10-28)**

Sub-Objectives to Meet Indicators:

Introduction to Biology

- Identify the characteristics of a living organism.
- Differentiate between living and nonliving matter.
- Describe the dependence of living organisms on nonliving matter.
- Investigate various phenomena in implementing the steps of the scientific method.
- Describe the organization of life from atoms to the biosphere.

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.
- Explain how enzymatic function is related to pH and temperature.

Cytology

- Recognize the relationship between cell theory and how scientists have used technology to develop the cell theory with regard to scientific

	inquiry. • Demonstrate competency in proper utilization and implementation of microscopes in general biological research. • Associate the different cell organelles with their particular functions and their relevance to the continuation of life. • Compare and contrast eukaryotic and prokaryotic cells. **Homeostasis and Plasma Membrane** • Recognize the importance of membrane surface area versus volume of a cell. • Discuss how membrane proteins determine in part what cells can transport. • 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. **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 photosynthesizes and chemosynthesizers. • Compare and contrast the light and light independent (dark) reactions (Calvin Cycle) of photosynthesis. **Cellular Respiration** • Analyze the process of fermentation and its practical commercial uses. • 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. **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 outcome 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. **DNA/RNA** • Compare and contrast the structures of RNA and DNA. • 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. **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. • Discuss present genetic technology and project to future needs (e.g., PCR, gene splicing, gel electrophoresis, DNA fingerprinting, etc.). • Discuss ethical issues in genetic research and its relation to testing, gene therapies, and DNA ownership. **Origins and History of Life** • Trace the chronology of origins 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. • Model the vastness of geologic time by creating time-scaled models. • Label time-scaled models with the major fossil record trends, including mass extinction. • Recognize relationships between mutation and change over time in plant and animal populations. • Predict the impact of genetic drift on a population and its effect 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. • Recognize the relationship between selection and fitness of an organism. **Classification and Taxonomy** • Compare and contrast the characteristics of the six kingdoms of organisms. • Evaluate the history, methods, and purpose of taxonomy. • Demonstrate the use of concepts in classification and the purpose of phylogenetic classification. • Identify examples from each of the six kingdoms. • Compare and contrast anatomical structures of representative organisms. • Discuss the future trends or needs in classification. **Ecology** • Compare and contrast types of symbiotic relationships. • Explain the matter and energy relationships within ecological pyramids. • Distinguish between abiotic and biotic factors in the environment. • Explain interrelationship in changing food/energy webs. • Trace the stages/steps involved in cycling nutrients.	