Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
Earth and Space Sciences Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and space sciences.	A. Explain how evidence from stars and other celestial objects provide information about the processes that cause changes in the composition and scale of the physical universe. B. Explain that many processes occur in patterns within the Earth's systems. C. Explain the 4.5 billion-year-history of Earth and the 4 billion-year-history of life on Earth based on observable scientific evidence in the geologic record. D. Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources. E. Explain the processes that move and shape Earth's surface. F. Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.	1. Summarize the relationship between the climatic zone and the resultant biomes. (This includes explaining the nature of the rainfall and temperature of the mid-latitude climatic zone that supports the deciduous forest.) 2. Explain climate and weather patterns associated with certain geographic locations and features (e.g., tornado alley, tropical hurricanes and lake effect snow). 3. Explain how geologic time can be estimated by multiple methods (e.g., rock sequences, fossil correlation and radiometric dating). 4. Describe how organisms on Earth contributed to the dramatic change in oxygen content of Earth's early atmosphere. 5. Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		6. Describe ways that human activity can alter biogeochemical cycles (e.g., carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers). 7. Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geologic time scales, global warming, depletion of resources and exponential population growth).

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
Life Sciences Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.	A. 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. B. Explain the characteristics of life as indicated by cellular processes and describe the process of cell division and development. C. Explain the genetic mechanisms and molecular basis of inheritance. D. Explain the flow of energy and the cycling of matter through biological and ecological systems (cellular, organismal and ecological). E. Explain how evolutionary relationships contribute to an understanding of the unity and diversity of life. F. Explain the structure and function of ecosystems and relate how ecosystems change over time. G. Describe how human activities can impact the status of natural systems.	1. 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 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. 3. 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 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.

Standard	Benchmark	Indicators
	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.) I. Explain how natural selection and other evolutionary mechanisms account for the unity and diversity of past and present life forms. J. Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences.	structure and function of DNA to protein synthesis and the characteristics of an organism. 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). 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. 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.
By the end of the 9 – 10 program, Students will . . .		
H. Describe a foundation of biological	5. Illustrate the relationship of the	

Standard	Benchmark	Indicators
		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). 10. Describe how cells and organisms acquire and release energy (photosynthesis, chemosynthesis, cellular respiration and fermentation). 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). 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.
By the end of the 9 – 10 program, Students will . . .	9. Describe how matter cycles and	

Standard	Benchmark	Indicators
		organisms within a species increases the likelihood that at least some members of a species will survive under gradually changing environmental conditions. 14. Relate diversity and adaptation to structures and their functions in living organisms (e.g., adaptive radiation). 15. Explain how living things interact with biotic and abiotic components of the environment (e.g., predation, competition, natural disasters and weather). 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. 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.
By the end of the 9 – 10 program, Students will . . .		
	13. Explain that the variation of	

Standard	Benchmark	Indicators
		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. 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. nonsustainable agriculture). 20. Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution.
By the end of the 9 – 10 program, Students will . . .		
	18. Describe ways that human activities	

Standard	Benchmark	Indicators
		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. 22. Describe historical scientific developments that occurred in evolutionary thought (e.g., Lamarck and Darwin, Mendelian Genetics and modern synthesis). 23. 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.)
By the end of the 9 – 10 program, Students will . . .		
		21. Explain that natural selection

Standard	Benchmark	Indicators
		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. 25. 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. 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).
By the end of the 9 – 10 program, Students will . . .		
		24. Analyze how natural selection and

Standard	Benchmark	Indicators
		that have important long-lasting effects on science and society (e.g., biological evolution, germ theory, biotechnology and discovering germs). 28. Analyze and investigate emerging scientific issues (e.g., genetically modified food, stem cell research, genetic research and cloning).
By the end of the 9 – 10 program, Students will . . .		
	27. Describe advances in life sciences	

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
Physical Sciences Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with the physical sciences.	A. Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms. B. Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances. C. Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance. D. Explain the movement of objects by applying Newton's three laws of motion. E. Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored). F. Explain how energy may change form or be redistributed but the total quantity of energy is conserved. G. Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter.	

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
	H. Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences.	

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
Science and Technology Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.	A. Explain the ways in which the processes of technological design respond to the needs of society. B. Explain that science and technology are interdependent; each drives the other.	1. Cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the need to meet human needs and solve human problems. 2. Describe examples of scientific advances and emerging technologies and how they may impact society. 3. Explain that when evaluating a design for a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced and disposed of in addition to who will sell, operate and take care of it. Explain how the costs associated with these considerations may introduce additional constraints on the design.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
Scientific Inquiry Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.	A. Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.	1. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g. OSHA, MSDS, eyewash, goggles and ventilation). 2. Present scientific findings using clear language, accurate data, appropriate graphs, tables, maps and available technology. 3. Use mathematical models to predict and analyze natural phenomena. 4. Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations. 5. Explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
Scientific Ways of Knowing Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.	A. Explain that scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. B. Explain how scientific inquiry is guided by knowledge, observations, ideas and questions. C. Describe the ethical practices and guidelines in which science operates. D. Recognize that scientific literacy is part of being a knowledgeable citizen.	1. Discuss science as a dynamic body of knowledge that can lead to the development of entirely new disciplines. 2. Describe that scientists may disagree about explanations of phenomena, about interpretation of data or about the value of rival theories, but they do agree that questioning, response to criticism and open communication are integral to the process of science. 3. Recognize that science is a systematic method of continuing investigation, based on observation, hypothesis testing, measurement, experimentation, and theory building, which leads to more adequate explanations of natural phenomena. 4. Recognize that ethical considerations limit what scientists can do. 5. Recognize that research involving voluntary human subjects should be conducted only with the informed consent of the subjects and follow rigid guidelines and/or laws.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		6. Recognize that animal-based research must be conducted according to currently accepted professional standards and laws. 7. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue.