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. Describe that stars produce energy from nuclear reactions and that processes in stars have led to the formation of all elements beyond hydrogen and helium. 2. Describe the current scientific evidence that supports the theory of the explosive expansion of the universe, the Big Bang, over 10 billion years ago. 3. Explain that gravitational forces govern the characteristics and movement patterns of the planets, comets and asteroids in the solar system. 4. Explain the relationships of the oceans to the lithosphere and atmosphere (e.g., transfer of energy, ocean currents and landforms). 5. Explain how the slow movement of material within Earth results from: a. thermal energy transfer (conduction and convection) from the deep interior; b. the action of gravitational forces on regions of different density. 6. Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding).

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		7. Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating). 8. Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., heliocentric theory and plate tectonics theory).

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.	

Standard	Benchmark	Indicators
	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.	
By the end of the 9 – 10 program, Students will . . .		
H. 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.		

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.	1. Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes. 2. Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. 3. Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation. 4. Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize that the periodic table was formed as a result of the repeating pattern of electron configurations. 5. Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.

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.	6. Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water). 7. Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations). 8. Demonstrate that the pH scale (0-14) is used to measure acidity and classify substances or solutions as acidic, basic, or neutral. 9. Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors). 10. Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		11. Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant. 12. Explain how an object's kinetic energy depends on its mass and its speed ($KE=\frac{1}{2}mv^2$). 13. Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight (mg where m is the object's mass and g is the acceleration due to gravity) and height (h) above a reference surface ($PE=mgh$). 14. Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at extremely high energies.) 15. Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		16. Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). 17. Demonstrate that thermal energy can be transferred by conduction, convection or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation). 18. Demonstrate that electromagnetic radiation is a form of energy. Recognize that light acts as a wave. Show that visible light is a part of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). 19. Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		20. Describe how waves can superimpose on one another when propagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed by materials they enter, and change direction and speed when entering a different material. 21. Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time. 22. Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it. 23. Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object. (F net =ma. Note that weight is the gravitational force on a mass.) 24. Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		25. Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight). 26. Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., atomic theory, quantum theory and Newtonian mechanics). 27. Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics, ceramics and communication technology).

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. Describe means of comparing the benefits with the risks of technology and how science can inform public policy. 2. Identify a problem or need, propose designs and choose among alternative solutions for the problem. 3. Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined.

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. Distinguish between observations and inferences given a scientific situation. 2. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles and ventilation). 3. Construct, interpret and apply physical and conceptual models that represent or explain systems, objects, events or concepts. 4. Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs. 5. Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. 6. Draw logical conclusions based on scientific knowledge and evidence from investigations.

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. Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose - to better understand a portion of our universe. 2. Illustrate that the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations. 3. Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions. 4. Explain how support of ethical practices in science (e.g., individual observations and confirmations, accurate reporting, peer review and publication) are required to reduce bias. 5. Justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. 6. Explain that inquiry fuels observation and experimentation that produce data that are the foundation of scientific disciplines. Theories are explanations of these data.

Standard	Benchmark	Indicators
	By the end of the 9 – 10 program, Students will . . .	
		7. Recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. 8. Illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work and their efforts to advance scientific knowledge in their area of study. 9. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue.