Standard	Benchmark	Indicators
	By the end of the 11 – 12 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 technology can be used to gather evidence and increase our understanding of the universe. B. Describe how Earth is made up of a series of interconnected systems and how a change in one system affects other systems. C. Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future. D. Summarize the historical development of scientific theories and ideas and describe emerging issues in the study of Earth and space sciences.	1. Explain how scientists obtain information about the universe by using technology to detect electromagnetic radiation that is emitted, reflected or absorbed by stars and other objects. 2. Explain how the large-scale motion of objects in the universe is governed by gravitational forces and detected by observing electromagnetic radiation. 3. Explain how information about the universe is inferred by understanding that stars and other objects in space emit, reflect or absorb electromagnetic radiation, which we then detect. 4. Explain how astronomers infer that the whole universe is expanding by understanding how light seen from distant galaxies has longer apparent wavelengths than comparable light sources close to Earth. 5. Investigate how thermal energy transfers in the world's oceans impact physical features (e.g., ice caps, oceanic and atmospheric currents) and weather patterns. 6. Describe how scientists estimate how much of a given resource is available on Earth.

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	By the end of the 11 – 12 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 how processes at the cellular level affect the functions and characteristics of an organism. B. Explain how humans are connected to and impact natural systems. C. Explain how the molecular basis of life and the principles of genetics determine inheritance. D. Relate how biotic and abiotic global changes have occurred in the past and will continue to do so in the future. E. Explain the interconnectedness of the components of a natural system. F. Explain how human choices today will affect the quality and quantity of life on earth. G. Summarize the historical development of scientific theories and ideas within the study of life sciences.	1. Recognize that information stored in DNA provides the instructions for assembling protein molecules used by the cells that determine the characteristics of the organism. 2. Explain why specialized cells/structures are useful to plants and animals (e.g., stoma, phloem, xylem, blood, nerve, muscle, egg and sperm). 3. 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. 4. 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. 5. Examine the inheritance of traits through one or more genes and how a single gene can influence more than one trait.

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	By the end of the 11 – 12 program, Students will . . .	
		6. Explain how developmental differentiation is regulated through the expression of different genes. 7. Relate diversity and adaptation to structures and functions of living organisms at various levels of organization. 8. 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.). 9. 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. 10. Explain additional components of the evolution theory, including genetic drift, immigration, emigration and mutation. 11. Trace the historical development of a biological theory or idea (e.g., genetics, cytology and germ theory). 12. Describe advances in life sciences that have important, long-lasting effects on science and society (e.g., biotechnology).

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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. Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena. B. Recognize that some atomic nuclei are unstable and will spontaneously break down. C. Describe how atoms and molecules can gain or lose energy only in discrete amounts. D. Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems. E. Summarize the historical development of scientific theories and ideas within the study of physical sciences.	1. Explain how atoms join with one another in various combinations in distinct molecules or in repeating crystal patterns. 2. Describe how a physical, chemical or ecological system in equilibrium may return to the same state of equilibrium if the disturbances it experiences are small. Large disturbances may cause it to escape that equilibrium and eventually settle into some other state of equilibrium. 3. Explain how all matter tends toward more disorganized states and describe real world examples (e.g., erosion of rocks and expansion of the universe). 4. Recognize that at low temperatures some materials become superconducting and offer little or no resistance to the flow of electrons. 5. Use and apply the laws of motion to analyze, describe and predict the effects of forces on the motions of objects mathematically. 6. Recognize that the nuclear forces that hold the nucleus of an atom together, at nuclear distances, are stronger than the electric forces that would make it fly apart.

Standard	Benchmark	Indicators
	By the end of the 11 – 12 program, Students will . . .	
		7. Recognize that nuclear forces are much stronger than electromagnetic forces, and electromagnetic forces are vastly stronger than gravitational forces. The strength of the nuclear forces explains why greater amounts of energy are released from nuclear reactions (e.g., from atomic and hydrogen bombs and in the sun and other stars). 8. Describe how the observed wavelength of a wave depends upon the relative motion of the source and the observer (Doppler effect). If either is moving towards the other, the observed wavelength is shorter; if either is moving away, the observed wavelength is longer (e.g., weather radar, bat echoes and police radar). 9. Describe how gravitational forces act between all masses and always create a force of attraction. Recognize that the strength of the force is proportional to the masses and weakens rapidly with increasing distance between them.

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	By the end of the 11 – 12 program, Students will . . .	
		10. Explain the characteristics of isotopes. The nuclei of radioactive isotopes are unstable and spontaneously decay emitting particles and/or wavelike radiation. It cannot be predicted exactly when, if ever, an unstable nucleus will decay, but a large group of identical nuclei decay at a predictable rate. 11. Use the predictability of decay rates and the concept of half-life to explain how radioactive substances can be used in estimating the age of materials. 12. Describe how different atomic energy levels are associated with the electron configurations of atoms and electron configurations (and/or conformations) of molecules.

Standard	Benchmark	Indicators
	By the end of the 11 – 12 program, Students will . . .	
		13. Explain how atoms and molecules can gain or lose energy in particular discrete amounts (quanta or packets); therefore they can only absorb or emit light at the wavelengths corresponding to these amounts. 14. 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., nuclear energy, quantum theory and theory of relativity). 15. Describe concepts/ideas in physical sciences that have important, long-lasting effects on science and society (e.g., quantum theory, theory of relativity, age of the universe).

Standard	Benchmark	Indicators
	By the end of the 11 – 12 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. Predict how human choices today will determine the quality and quantity of life on Earth.	1. Explain how science often advances with the introduction of new technologies and how solving technological problems often results in new scientific knowledge. 2. Describe how new technologies often extend the current levels of scientific understanding and introduce new areas of research. 3. Research how scientific inquiry is driven by the desire to understand the natural world and how technological design is driven by the need to meet human needs and solve human problems. 4. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges. 5. Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation.

Standard	Benchmark	Indicators
	By the end of the 11 – 12 program, Students will . . .	
		6. Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). 7. Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles and ventilation). 8. Create and clarify the method, procedures, controls and variables in complex scientific investigations. 9. Use appropriate summary statistics to analyze and describe data.

Standard	Benchmark	Indicators
	By the end of the 11 – 12 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. Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.	1. Formulate testable hypotheses. Develop and explain the appropriate procedures, controls and variables (dependent and independent) in scientific experimentation. 2. Derive simple mathematical relationships that have predictive power from experimental data (e.g., derive an equation from a graph and vice versa, determine whether a linear or exponential relationship exists among the data in a table). 3. Research and apply appropriate safety precautions when designing and/or conducting scientific investigations (e.g., OSHA, MSDS, eyewash, goggles and ventilation). 4. Create and clarify the method, procedures, controls and variables in complex scientific investigations. 5. Use appropriate summary statistics to analyze and describe data.

Standard	Benchmark	Indicators
	By the end of the 11 – 12 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 how scientific evidence is used to develop and revise scientific predictions, ideas or theories. B. Explain how ethical considerations shape scientific endeavors. C. Explain how societal issues and considerations affect the progress of science and technology.	1. Give examples that show how science is a social endeavor in which scientists share their knowledge with the expectation that it will be challenged continuously by the scientific community and others. 2. Evaluate scientific investigations by reviewing current scientific knowledge and the experimental procedures used, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence and suggesting alternative explanations for the same observations. 3. Select a scientific model, concept or theory and explain how it has been revised over time based on new knowledge, perceptions or technology. 4. Analyze a set of data to derive a principle and then apply that principle to a similar phenomenon (e.g., predator-prey relationships and properties of semiconductors). 5. Describe how individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies, hundreds of people may work together on major scientific questions or technical problem).

Standard	Benchmark	Indicators
	By the end of the 11 – 12 program, Students will . . .	
		6. Explain that scientists may develop and apply ethical tests to evaluate the consequences of their research when appropriate. 7. Describe the current and historical contributions of diverse peoples and cultures to science and technology and the scarcity and inaccessibility of information on some of these contributions. 8. Recognize that individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. 9. Recognize the appropriateness and value of basic questions "What can happen?" "What are the odds?" and "How do scientists and engineers know what will happen?" 10. Recognize that social issues and challenges can affect progress in science and technology. (e.g., Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.)

Standard	Benchmark	Indicators
	By the end of the 11 – 12 program, Students will . . .	
		11. Research how advances in scientific knowledge have impacted society on a local, national or global level.