Norton City Schools Standards-Based Science Course of Study 2003

NINTH/TENTH GRADE
EARTH, SPACE AND PHYSICAL SCIENCE (USED AS A YEAR-LONG OR BLOCK-SCHEDULED COURSE)
Earth and Space Sciences Standard (ES)
Physical Sciences Standard (PS)

9-10 Benchmarks	Grade Level Indicators and Sub-Objectives	Teaching Strategies/Resources
By the end of the 9-10 program, the student will: **<u>Earth and Space Sciences</u>** **✶ 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. (ES-A)** **✶ Explain that many processes occur in patterns within the Earth's systems. (ES-B)** **✶ 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. (ES-C)** **✶ Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources. (ES-D)** **✶ Explain the processes that move and shape Earth's**	**By the end of Ninth/Tenth Grade, the student will:** **<u>The Universe</u>** **✶ 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. (ES-9-1)** **✶ Describe the current scientific evidence that supports the theory of the explosive expansion of the universe, the Big Bang, over 10 billion years ago. (ES-9-2)** **✶ Explain that gravitational forces govern the characteristics and movement patterns of the planets, comets and asteroids in the solar system. (ES-9-3)** **<u>Earth Systems</u>** **✶ Explain the relationships of the oceans to the lithosphere and atmosphere (e.g., transfer of energy, ocean currents and landforms). (ES-9-4)** **✶ 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.) (ES-10-1)** **✶ Explain climate and weather patterns associated with certain geographic locations and features (e.g., tornado alley, tropical hurricanes and lake effect snow). (ES-10-2)** **✶ Explain how geologic time can be estimated by multiple methods (e.g., rock sequences, fossil correlation and radiometric dating). (ES-**	

surface. (ES-E) **✶ Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences. (ES-F)** **<u>Physical Sciences</u>** **✶ 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. (PS-A)** **✶ 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. (PS-B)** **✶ 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. (PS-C)** **✶ Explain the movement of objects by applying Newton's three laws of motion. (PS-D)** **✶ Demonstrate that energy can**	**10-3)** **✶ Describe how organisms on Earth contributed to the dramatic change in oxygen content of Earth's early atmosphere. (ES-10-4)** **✶ Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life. (ES-10-5)** **✶ 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). (ES-10-6)** **<u>Processes that Shape Earth</u>** **✶ 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. (ES-9-5)** **✶ Explain the results of plate tectonic activity (e.g., magma generation, igneous intrusion, metamorphism, volcanic action, earthquakes, faulting and folding). (ES-9-6)** **✶ Explain sea-floor spreading and continental drift using scientific evidence (e.g., fossil distributions, magnetic reversals and radiometric dating). (ES-9-7)** **<u>Historical Perspectives and Scientific Revolutions</u>** **✶ 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). (ES-9-8)** **✶ 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). (ES-10-7)**	

be considered to be either kinetic (motion) or potential (stored). (PS-E) **✶ Explain how energy may change form or be redistributed but the total quantity of energy is conserved. (PS-F)** **✶ Demonstrate that waves (e.g., sound, seismic, water and light) have energy and waves can transfer energy when they interact with matter. (PS-G)** **✶ Trace the historical development of scientific theories and ideas, and describe emerging issues in the study of physical sciences. (PS-H)**	**<u>Nature of Matter</u>** **✶ 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. (PS-9-1)** **✶ Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral. (PS-9-2)** **✶ Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation. (PS-9-3)** **✶ 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. (PS-9-4)** **✶ 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. (PS-9-5)** **✶ 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). (PS-9-6)** **✶ Show how atoms may be bonded together by losing, graining 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). (PS-9-7)** **✶ Demonstrate that the pH scale (0-14) is used to measure acidity and classify solutions as acidic, basic, or neutral substances. (PS-9-8)** **✶ Investigate the properties of pure substances and mixtures (e.g. density, conductivity, hardness, properties of alloys, superconductors and semiconductors). (PS-9-9)** **✶ Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity. (PS-9-10)** **<u>Nature of Energy</u>** **✶ 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. (PS-9-11) **✶ Explain how an object's kinetic energy depends on its mass and its speed (KE = 1/2mv^2). (PS-9-12)** **✶ 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*). (PS-9-13)** **✶ 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.) (PS-9-14)** **✶ 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. (PS-9-15)** **✶ Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels). (PS-9-16)** **✶ 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). (PS-9-17)** **✶ 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). (PS-9-18)** **✶ 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. (PS-9-19)** **✶ 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. (PS-9-20)**	

	Forces and Motion ✶ **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. (PS-9-21)** ✶ **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. (PS-9-22)** ✶ **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.) (PS-9-23)** ✶ **Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object. (PS-9-24)** ✶ **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). (PS-9-25)** **Historical Perspectives and Scientific Revolutions** ✶ **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). (PS-9-26)** ✶ **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 and ceramics and communication technology). (PS-9-27)**	