Alignment Document
State of New York and Aventa Learning Earth Science

Earth Science

2005-2007 Benchmark Blueprint

Discipline	Standards	Key Ideas	Benchmarks	Unit Name	Course Topic Description
E Earth Science	**E.1** Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.	**E.1.1** Abstraction and symbolic representation are used to communicate mathematically. For example:	**E.1.1.1** use eccentricity, rate, gradient, standard error of measurement, and density in context		
		E.1.2 Deductive and inductive reasoning are used to reach mathematical conclusions. For example:	**E.1.2.1** determine the relationships among: velocity, slope, sediment size, channel shape, and volume of a stream		
			E.1.2.2 understand the relationships among: the planets' distance from the Sun, gravitational force, period of revolution, and speed of revolution		
		E.1.3 Critical thinking skills are used in the solution of mathematical problems. For example:	**E.1.3.1** in a field, use isolines to determine a source of pollution		
		E.1.1 The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process. For example:	**E.1.1.1** show how our observation of celestial motions supports the idea of stars moving around a stationary Earth (the geocentric model), but further investigation has led scientists to understand that most of these changes are a result of Earth's motion around the Sun (the heliocentric model)	Astronomy	The Earth, Moon and Sun
		E.1.2 Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity. For example:	**E.1.2.1** test sediment properties and the rate of deposition		
		E.1.3 The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena. For example:	**E.1.3.1** determine the changing length of a shadow based on the motion of the Sun		
		E.1.1 Engineering design is an iterative	**E.1.1.1** after experimenting with conduction		

		process involving modeling and optimization (finding the best solution within given constraints); this process is used to develop technological solutions to problems within given constraints. For example:	of heat (using calorimeters and aluminum bars), make recommendations to create a more efficient system of heat transfer		
			E.1.1.2 determine patterns of topography and drainage around your school and design solutions to effectively deal with runoff		
	E.2 Students will access, generate, process, and transfer information, using appropriate technologies.	**E.2.1** Information technology is used to retrieve, process, and communicate information as a tool to enhance learning. For example:	**E.2.1.1** analyze weather maps to predict future weather events		
			E.2.1.2 use library or electronic references to obtain information to support a laboratory conclusion		
		E.2.2 Knowledge of the impacts and limitations of information systems is essential to its effective and ethical use. For example:	**E.2.2.1** obtain printed or electronic materials which exemplify miscommunication and/or misconceptions of current commonly accepted scientific knowledge		
		E.2.3 Information technology can have positive and negative impacts on society, depending upon how it is used. For example:	**E.2.3.1** discuss how early warning systems can protect society and the environment from natural disasters such as hurricanes, tornadoes, earthquakes, tsunamis, floods, and volcanoes	Plate Tectonics	Earthquake Activity
	E.4 Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.	**E.4.1** The Earth and celestial phenomena can be described by principles of relative motion and perspective.	**E.4.1.1** Explain complex phenomena, such as tides, variations in day length, solar insolation, apparent motion of the planets, and annual traverse of the constellations.	Astronomy	Multiple locations
			E.4.1.1.a Most objects in the solar system are in regular and predictable motion.		
			E.4.1.1.a.1 These motions explain such phenomena as the day, the year, seasons, phases of the moon, eclipses, and tides.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.a.2 Gravity influences the motions of celestial objects. The force of gravity between two objects in the universe depends on their masses and the distance between them.		
			E.4.1.1.b Nine planets move around the Sun in nearly circular orbits.	Astronomy	The Solar System
			E.4.1.1.b.1 The orbit of each planet is an ellipse with the Sun located at one of the foci.		
			E.4.1.1.b.2 Earth is orbited by one moon and many artificial satellites.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.c Earth's coordinate system of latitude and longitude, with the equator and prime meridian as reference lines, is based upon Earth's rotation and our observation of		

			the Sun and stars.		
			E.4.1.1.d Earth rotates on an imaginary axis at a rate of 15 degrees per hour. To people on Earth, this turning of the planet makes it seem as though the Sun, the moon, and the stars are moving around Earth once a day. Rotation provides a basis for our system of local time; meridians of longitude are the basis for time zones.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.e The Foucault pendulum and the Coriolis effect provide evidence of Earth's rotation.		
			E.4.1.1.f Earth's changing position with regard to the Sun and the moon has noticeable effects.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.f.1 Earth revolves around the Sun with its rotational axis tilted at 23.5 degrees to a line perpendicular to the plane of its orbit, with the North Pole aligned with Polaris.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.f.2 During Earth's one-year period of revolution, the tilt of its axis results in changes in the angle of incidence of the Sun's rays at a given latitude; these changes cause variation in the heating of the surface. This produces seasonal variation in weather.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.g Seasonal changes in the apparent positions of constellations provide evidence of Earth's revolution.	Astronomy	
			E.4.1.1.h The Sun's apparent path through the sky varies with latitude and season.	Astronomy	The Earth, Moon and Sun
			E.4.1.1.i Approximately 70 percent of Earth's surface is covered by a relatively thin layer of water, which responds to the gravitational attraction of the moon and the Sun with a daily cycle of high and low tides.	Astronomy	The Earth, Moon and Sun
			E.4.1.2 Describe current theories about the origin of the universe and solar system.	Astronomy	The Universe
			E.4.1.2.a The universe is vast and estimated to be over ten billion years old. The current theory is that the universe was created from an explosion called the Big Bang. Evidence for this theory includes:	Astronomy	The Universe
			E.4.1.2.a.1 cosmic background radiation	Astronomy	The Universe

			E.4.1.2.a.2 a red-shift (the Doppler effect) in the light from very distant galaxies.	Astronomy	The Universe
			E.4.1.2.b Stars form when gravity causes clouds of molecules to contract until nuclear fusion of light elements into heavier ones occurs. Fusion releases great amounts of energy over millions of years.	Astronomy	The birth of a star
			E.4.1.2.b.1 The stars differ from each other in size, temperature, and age.	Astronomy	The birth of a star
			E.4.1.2.b.2 Our Sun is a medium-sized star within a spiral galaxy of stars known as the Milky Way. Our galaxy contains billions of stars, and the universe contains billions of such galaxies.	Astronomy	The birth of a star
			E.4.1.2.c Our solar system formed about five billion years ago from a giant cloud of gas and debris. Gravity caused Earth and the other planets to become layered according to density differences in their materials.		
			E.4.1.2.c.1 The characteristics of the planets of the solar system are affected by each planet's location in relationship to the Sun.	Astronomy	The Solar System
			E.4.1.2.c.2 The terrestrial planets are small, rocky, and dense. The Jovian planets are large, gaseous, and of low density.	Astronomy	The Solar System
			E.4.1.2.d Asteroids, comets, and meteors are components of our solar system.		
			E.4.1.2.d.1 Impact events have been correlated with mass extinction and global climatic change.		
			E.4.1.2.d.2 Impact craters can be identified in Earth's crust.		
			E.4.1.2.e Earth's early atmosphere formed as a result of the outgassing of water vapor, carbon dioxide, nitrogen, and lesser amounts of other gases from its interior.	Atmosphere and Climate	Structure of Atmosphere
			E.4.1.2.f Earth's oceans formed as a result of precipitation over millions of years. The presence of an early ocean is indicated by sedimentary rocks of marine origin, dating back about four billion years.	Atmosphere and Climate	Structure of Atmosphere
			E.4.1.2.g Earth has continuously been recycling water since the outgassing of water early in its history. This constant recirculation of water at and near Earth's surface is		

			described by the hydrologic (water) cycle.		
			E.4.1.2.g.1 Water is returned from the atmosphere to Earth's surface by precipitation. Water returns to the atmosphere by evaporation or transpiration from plants. A portion of the precipitation becomes runoff over the land or infiltrates into the ground to become stored in the soil or groundwater below the water table. Soil capillarity influences these processes.		
			E.4.1.2.g.2 The amount of precipitation that seeps into the ground or runs off is influenced by climate, slope of the land, soil, rock type, vegetation, land use, and degree of saturation.		
			E.4.1.2.g.3 Porosity, permeability, and water retention affect runoff and infiltration.		
			E.4.1.2.h The evolution of life caused dramatic changes in the composition of Earth's atmosphere. Free oxygen did not form in the atmosphere until oxygen-producing organisms evolved.		
			E.4.1.2.i The pattern of evolution of life-forms on Earth is at least partially preserved in the rock record.	Geological time	Fossils and Rocks
			E.4.1.2.i.1 Fossil evidence indicates that a wide variety of life-forms has existed in the past and that most of these forms have become extinct.	Geological time	Fossils and Rocks
			E.4.1.2.i.2 Human existence has been very brief compared to the expanse of geologic time.	Geological time	Fossils and Rocks
			E.4.1.2.j Geologic history can be reconstructed by observing sequences of rock types and fossils to correlate bedrock at various locations.	Geological time	Relative time scale
			E.4.1.2.j.1 The characteristics of rocks indicate the processes by which they formed and the environments in which these processes took place.	Geological time	Relative time scale
			E.4.1.2.j.2 Fossils preserved in rocks provide information about past environmental conditions.		
			E.4.1.2.j.3 Geologists have divided Earth history into time units based upon the fossil	Geological time	Relative time scale

			record.		
			E.4.1.2.j.4 Age relationships among bodies of rocks can be determined using principles of original horizontality, superposition, inclusions, cross-cutting relationships, contact metamorphism, and unconformities. The presence of volcanic ash layers, index fossils, and meteoritic debris can provide additional information.	Geological time	Relative time scale
			E.4.1.2.j.5 The regular rate of nuclear decay (half-life time period) of radioactive isotopes allows geologists to determine the absolute age of materials found in some rocks.	Geological Time	Numeric Time scale
		E.4.2 Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.	**E.4.2.1** Use the concepts of density and heat energy to explain observations of weather patterns, seasonal changes, and the movements of Earth's plates.	The World of Weather	Wind
			E.4.2.1.a Earth systems have internal and external sources of energy, both of which create heat.	The World of Weather	Wind
			E.4.2.1.b The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's interior results in the formation of regions of different densities. These density differences result in motion.	The World of Weather	Wind
			E.4.2.1.c Weather patterns become evident when weather variables are observed, measured, and recorded. These variables include air temperature, air pressure, moisture (relative humidity and dewpoint), precipitation (rain, snow, hail, sleet, etc.), wind speed and direction, and cloud cover.	The World of Weather	Moisture
			E.4.2.1.d Weather variables are measured using instruments such as thermometers, barometers, psychrometers, precipitation gauges, anemometers, and wind vanes.	The World of Weather	Wind
			E.4.2.1.e Weather variables are interrelated. For example:	The World of Weather	Moisture
			E.4.2.1.e.1 temperature and humidity affect air pressure and probability of precipitation	The World of Weather	Moisture
			E.4.2.1.e.2 air pressure gradient controls wind velocity	The World of Weather	Moisture
			E.4.2.1.f Air temperature, dewpoint, cloud formation, and precipitation are affected by the expansion and contraction of air due to	The World of Weather	Moisture

			vertical atmospheric movement.		
			E.4.2.1.g Weather variables can be represented in a variety of formats including radar and satellite images, weather maps (including station models, isobars, and fronts), atmospheric cross-sections, and computer models.	The World of Weather	Weather and Forecasting
			E.4.2.1.h Atmospheric moisture, temperature and pressure distributions; jet streams, wind; air masses and frontal boundaries; and the movement of cyclonic systems and associated tornadoes, thunderstorms, and hurricanes occur in observable patterns. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.	The World of Weather	Weather and Forecasting
			E.4.2.1.i Seasonal changes can be explained using concepts of density and heat energy. These changes include the shifting of global temperature zones, the shifting of planetary wind and ocean current patterns, the occurrence of monsoons, hurricanes, flooding, and severe weather.		
			E.4.2.1.j Properties of Earth's internal structure (crust, mantle, inner core, and outer core) can be inferred from the analysis of the behavior of seismic waves (including velocity and refraction).	Plate Tectonics	Earthquake Activity
			E.4.2.1.j.1 Analysis of seismic waves allows the determination of the location of earthquake epicenters, and the measurement of earthquake magnitude; this analysis leads to the inference that Earth's interior is composed of layers that differ in composition and states of matter.	Plate Tectonics	Earthquake Activity
			E.4.2.1.k The outward transfer of Earth's internal heat drives convective circulation in the mantle that moves the lithospheric plates comprising Earth's surface.	Plate Tectonics	Continental Drift
			E.4.2.1.l The lithosphere consists of separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is	Plate Tectonics	Continental Drift

			a dynamic geologic system.		
			E.4.2.1.l.1 These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges.	Plate Tectonics	Earthquake Activity
			E.4.2.1.l.2 Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges.	Plate Tectonics	Earthquake Activity
			E.4.2.1.l.3 Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.	Plate Tectonics	Earthquake Activity
			E.4.2.1.m Many processes of the rock cycle are consequences of plate dynamics. These include the production of magma (and subsequent igneous rock formation and contact metamorphism) at both subduction and rifting regions, regional metamorphism within subduction zones, and the creation of major depositional basins through down-warping of the crust.	Plate Tectonics	What drives plates?
			E.4.2.1.n Many of Earth's surface features such as mid-ocean ridges/rifts, trenches/subduction zones/island arcs, mountain ranges (folded, faulted, and volcanic), hot spots, and the magnetic and age patterns in surface bedrock are a consequence of forces associated with plate motion and interaction.	Plate Tectonics	Continental Drift
			E.4.2.1.o Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution.		
			E.4.2.1.p Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition.	Weathering	Weathering and Erosion
			E.4.2.1.q Topographic maps represent landforms through the use of contour lines that are isolines connecting points of equal elevation. Gradients and profiles can be determined from changes in elevation over a given distance.		
			E.4.2.1.r Climate variations, structure, and characteristics of bedrock influence the	Plate Tectonics	Deformation

			development of landscape features including mountains, plateaus, plains, valleys, ridges, escarpments, and stream drainage patterns.		
			E.4.2.1.s Weathering is the physical and chemical breakdown of rocks at or near Earth's surface. Soils are the result of weathering and biological activity over long periods of time.	Weathering	Weathering and Erosion
			E.4.2.1.t Natural agents of erosion, generally driven by gravity, remove, transport, and deposit weathered rock particles. Each agent of erosion produces distinctive changes in the material that it transports and creates characteristic surface features and landscapes. In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.	Weathering	Physical Weathering
			E.4.2.1.u The natural agents of erosion include:	Weathering	Physical Weathering
			E.4.2.1.u.1 Streams (running water): Gradient, discharge, and channel shape influence a stream's velocity and the erosion and deposition of sediments. Sediments transported by streams tend to become rounded as a result of abrasion. Stream features include V-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries.	Weathering	Physical Weathering
			E.4.2.1.u.2 Glaciers (moving ice): Glacial erosional processes include the formation of U-shaped valleys, parallel scratches, and grooves in bedrock. Glacial features include moraines, drumlins, kettle lakes, finger lakes, and outwash plains.	Weathering	Glaciers: Formation and Growth
			E.4.2.1.u.3 Wave Action: Erosion and deposition cause changes in shoreline features, including beaches, sandbars, and barrier islands. Wave action rounds sediments as a result of abrasion. Waves approaching a shoreline move sand parallel to the shore within the zone of breaking waves.		
			E.4.2.1.u.4 Wind: Erosion of sediments by	Weathering	Winds

			wind is most common in arid climates and along shorelines. Wind-generated features include dunes and sand-blasted bedrock.		
			E.4.2.1.u.5 Mass Movement: Earth materials move downslope under the influence of gravity.		
			E.4.2.1.v Patterns of deposition result from a loss of energy within the transporting system and are influenced by the size, shape, and density of the transported particles. Sediment deposits may be sorted or unsorted.	Weathering	Glaciers: Formation and Growth
			E.4.2.1.w Sediments of inorganic and organic origin often accumulate in depositional environments. Sedimentary rocks form when sediments are compacted and/or cemented after burial or as the result of chemical precipitation from seawater.	Weathering	Physical Weathering
			E.4.2.2 Explain how incoming solar radiation, ocean currents, and land masses affect weather and climate.	Atmosphere and Climate	Heating the atmosphere
			E.4.2.2.a Insolation (solar radiation) heats Earth's surface and atmosphere unequally due to variations in:	Atmosphere and Climate	Heating the atmosphere
			E.4.2.2.a.1 the intensity caused by differences in atmospheric transparency and angle of incidence which vary with time of day, latitude, and season		
			E.4.2.2.a.2 characteristics of the materials absorbing the energy such as color, texture, transparency, state of matter, and specific heat	Atmosphere and Climate	Heat and Energy
			E.4.2.2.a.3 duration, which varies with seasons and latitude.		
			E.4.2.2.b The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's surface occurs as the result of radiation, convection, and conduction.	Atmosphere and Climate	Heating the atmosphere
			E.4.2.2.b.1 Heating of Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents.	Atmosphere and Climate	Heating the atmosphere
			E.4.2.2.c A location's climate is influenced by latitude, proximity to large bodies of water, ocean currents, prevailing winds, vegetative cover, elevation, and mountain ranges.	Atmosphere and Climate	Heat and Energy

			E.4.2.2.d Temperature and precipitation patterns are altered by:	Atmosphere and Climate	Heating the atmosphere
			E.4.2.2.d.1 natural events such as El Nino and volcanic eruptions		
			E.4.2.2.d.2 human influences including deforestation, urbanization, and the production of greenhouse gases such as carbon dioxide and methane.	Atmosphere and Climate	Heating the atmosphere
		E.4.3 Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.	**E.4.3.1** Explain the properties of materials in terms of the arrangement and properties of the atoms that compose them.	Rocks and Minerals	Atomic Structure of Minerals
			E.4.3.1.a Minerals have physical properties determined by their chemical composition and crystal structure.	Rocks and Minerals	Atomic Structure of Minerals
			E.4.3.1.a.1 Minerals can be identified by well-defined physical and chemical properties, such as cleavage, fracture, color, density, hardness, streak, luster, crystal shape, and reaction with acid.	Rocks and Minerals	Identifying Minerals
			E.4.3.1.a.2 Chemical composition and physical properties determine how minerals are used by humans.	Rocks and Minerals	Atomic Structure of Minerals
			E.4.3.1.b Minerals are formed inorganically by the process of crystallization as a result of specific environmental conditions. These include:	Rocks and Minerals	Minerals, Rocks and the Rock Cycle
			E.4.3.1.b.1 cooling and solidification of magma	Rocks and Minerals	Minerals, Rocks and the Rock Cycle
			E.4.3.1.b.2 precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes	Rocks and Minerals	Minerals, Rocks and the Rock Cycle
			E.4.3.1.b.3 rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure.	Rocks and Minerals	Minerals, Rocks and the Rock Cycle
			E.4.3.1.c Rocks are usually composed of one or more minerals.	Rocks and Minerals	Earth's Rock forming Minerals
			E.4.3.1.c.1 Rocks are classified by their origin, mineral content, and texture.	Rocks and Minerals	Earth's Rock forming Minerals
			E.4.3.1.c.2 Conditions that existed when a rock formed can be inferred from the rock's mineral content and texture.	Rocks and Minerals	Earth's Rock forming Minerals
			E.4.3.1.c.3 The properties of rocks determine how they are used and also influence land usage by humans.	Rocks and Minerals	Earth's Rock forming Minerals

	E.6 Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.	**E.6.1** Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions. For example:	**E.6.1.1** analyze a depositional-erosional system of a stream		
		E.6.2 Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design. For example:	**E.6.2.1** draw a simple contour map of a model landform		
			E.6.2.2 design a 3-D landscape model from a contour map		
			E.6.2.3 construct and interpret a profile based on an isoline map		
			E.6.2.4 use flowcharts to identify rocks and minerals		
		E.6.3 The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems. For example:	**E.6.3.1** develop a scale model to represent planet size and/or distance		
			E.6.3.2 develop a scale model of units of geologic time		
			E.6.3.3 use topographical maps to determine distances and elevations		
		E.6.4 Equilibrium is a state of stability due either to a lack of change (static equilibrium) or a balance between opposing forces (dynamic equilibrium). For example:	**E.6.4.1** analyze the interrelationship between gravity and inertia and its effects on the orbit of planets or satellites		
		E.6.5 Identifying patterns of change is necessary for making predictions about future behavior and conditions. For example:	**E.6.5.1** graph and interpret the nature of cyclic change such as sunspots, tides, and atmospheric carbon dioxide		
			E.6.5.2 based on present data of plate movement, determine past and future positions of land masses		
			E.6.5.3 using given weather data, identify the interface between air masses, such as cold fronts, warm fronts, and stationary fronts	The World of Weather	Weather and Forecasting
		E.6.6 In order to arrive at the best solution that meets criteria within constraints, it is often necessary to make trade-offs. For example:	**E.6.6.1** debate the effect of human activities as they relate to quality of life on Earth systems (global warming, land use, preservation of natural resources, pollution)		
	E.7 Students will apply the knowledge and thinking skills of mathematics, science, and	**E.7.1** The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer	**E.7.1.1** analyze the issues related to local energy needs and develop a viable energy generation plan for the community		
			E.7.1.2 investigate two similar fossils to determine if they represent a developmental change over time		

	technology to address real-life problems and make informed decisions.	decision making, design, and inquiry into phenomena. For example:	**E.7.1.3** investigate the political, economic, and environmental impact of global distribution and use of mineral resources and fossil fuels		
			E.7.1.4 consider environmental and social implications of various solutions to an environmental Earth resources problem		
		E.7.2 Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results. For example:	**E.7.2.1** collect, collate, and process data concerning potential natural disasters (tornadoes, thunderstorms, blizzards, earthquakes, tsunamis, floods, volcanic eruptions, asteroid impacts, etc.) in an area and develop an emergency action plan		
			E.7.2.2 using a topographic map, determine the safest and most efficient route for rescue purposes		