New York Science

Physical Setting/Earth Science

The Earth and celestial phenomena can be described by principles of relative motion and perspective. KI.1

PI.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. KI.1.PI.1

1.1a Most objects in the solar system are in regular and predictable motion. • These motions explain such phenomena as the day, the year, seasons, phases of the moon, eclipses, and tides. • 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. KI.1.PI.1.1A

1.1b Nine planets move around the Sun in nearly circular orbits. • The orbit of each planet is an ellipse with the Sun located at one of the foci. • Earth is orbited by one moon and many artificial satellites. KI.1.PI.1.1B

1.1c 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. KI.1.PI.1.1C

1.1d 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. KI.1.PI.1.1D

1.1e The Foucault pendulum and the Coriolis effect provide evidence of Earth's rotation. KI.1.PI.1.1E

1.1f Earth's changing position with regard to the Sun and the moon has noticeable effects. • 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. • 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 varia- tion in the heating of the surface. This produces seasonal variation in weather. KI.1.PI.1.1F

1.1g Seasonal changes in the apparent positions of constellations provide evidence of Earth's revolution. KI.1.PI.1.1G

1.1h The Sun's apparent path through the sky varies with latitude and season. KI.1.PI.1.1H

1.1i 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. KI.1.PI.1.1I

.1.2 Describe current theories about the origin of the universe and solar system. PI.1.2

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1.2a The universe is vast and estimated to be over ten billion years old. The current the- ory is that the universe was created from an explosion called the Big Bang. Evidence for this theory includes: • cosmic background radiation • a red-shift (the Doppler effect) in the light from very distant galaxies. KI.1.PI.1.2A

1.2b 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. • The stars differ from each other in size, temperature, and age. • 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. KI.1.PI.1.2B

1.2c 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. • The characteristics of the planets of the solar system are affected by each planet's location in relationship to the Sun. • The terrestrial planets are small, rocky, and dense. The Jovian planets are large, gaseous, and of low density. KI.1.PI.1.2C

1.2d Asteroids, comets, and meteors are components of our solar system. • Impact events have been correlated with mass extinction and global climatic change. • Impact craters can be identified in Earth's crust. KI.1.PI.1.2D

1.2e 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. KI.1.PI.1.2E

1.2f Earth's oceans formed as a result of precipitation over millions of years. The pres- ence of an early ocean is indicated by sedimentary rocks of marine origin, dating back about four billion years. KI.1.PI.1.2F

1.2g 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. • 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. • 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. • Porosity, permeability, and water retention affect runoff and infiltration. KI.1.PI.1.2G

1.2h 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. KI.1.PI.1.2H

1.2i The pattern of evolution of life-forms on Earth is at least partially preserved in the rock record. • Fossil evidence indicates that a wide variety of life-forms has existed in the past and that most of these forms have become extinct. • Human existence has been very brief compared to the expanse of geologic time. KI.1.PI.1.2I

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1.2j Geologic history can be reconstructed by observing sequences of rock types and fossils to correlate bedrock at various locations. • The characteristics of rocks indicate the processes by which they formed and the envi- ronments in which these processes took place. • Fossils preserved in rocks provide information about past environmental conditions. • Geologists have divided Earth history into time units based upon the fossil record. •Age relationships among bodies of rocks can be determined using principles of origi- nal horizontality, superposition, inclusions, cross-cutting relationships, contact meta- morphism, and unconformities. •The presence of volcanic ash layers, index fossils, and meteoritic debris can provide additional information. 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. KI.1.PI.1.2J

Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

PI.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. KI.2.PI.2.1

2.1a Earth systems have internal and external sources of energy, both of which create heat. KI.2.PI.2.1A

2.1b 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. KI.2.PI.2.1B

2.1c 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. KI.2.PI.2.1C

2.1d Weather variables are measured using instruments such as thermometers, barometers, psychrometers, precipitation gauges, anemometers, and wind vanes. KI.2.PI.2.1D

2.1e Weather variables are interrelated. For example: • temperature and humidity affect air pressure and probability of precipitation • air pressure gradient controls wind velocity KI.2.PI.2.1E

2.1f Air temperature, dewpoint, cloud formation, and precipitation are affected by the expansion and contraction of air due to vertical atmospheric movement. KI.2.PI.2.1F

2.1g Weather variables can be represented in a variety of formats including radar and satellite images, weather maps (including station models, isobars, and fronts), atmos- pheric cross-sections, and computer models. KI.2.PI.2.1G

2.1h Atmospheric moisture, temperature and pressure distributions; jet streams, winc air masses and frontal boundaries; and the movement of cyclonic systems and associ- ated tornadoes, thunderstorms, and hurricanes occur in observable patterns. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness. KI.2.PI.2.1H

2.1i 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. KI.2.PI.2.1I

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2.1j 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). • Analysisofseismicwavesallowsthedeterminationofthelocationofearthquakeepicenters, and the measurement of earthquake magnitude; this analysis leads to the inference that Earth's interior is composed of layers that differ in composition anc states of matter. KI.2.PI.2.1J

2.1k The outward transfer of Earth's internal heat drives convective circulation in the mantle that moves the lithospheric plates comprising Earth's surface. KI.2.PI.2.1K

2.1l 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 trans- form plate boundaries. These motions indicate Earth is a dynamic geologic system. • These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges. • Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges. • Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness. KI.2.PI.2.1L

2.1m Many processes of the rock cycle are consequences of plate dynamics. These include the production of magma (and subsequent igneous rock formation and contact metamor- phism) at both subduction and rifting regions, regional metamorphism within subduction zones, and the creation of major depositional basins through down-warping of the crust. KI.2.PI.2.1M

2.1n 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. KI.2.PI.2.1N

2.1o Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution. KI.2.PI.2.1O

2.1p Landforms are the result of the interaction of tectonic forces and the processes o weathering, erosion, and deposition. KI.2.PI.2.1P

2.1q 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. KI.2.PI.2.1Q

2.1r Climate variations, structure, and characteristics of bedrock influence the develop- ment of landscape features including mountains, plateaus, plains, valleys, ridges, escarpments, and stream drainage patterns. KI.2.PI.2.1R

2.1s Weathering is the physical and chemical breakdown of rocks at or near Earth's sur- face. Soils are the result of weathering and biological activity over long periods of time. KI.2.PI.2.1S

2.1t 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 land- scapes. In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness. KI.2.PI.2.1T

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2.1u The natural agents of erosion include: • Streams (running water): Gradient, discharge, and channel shape influence a stream's velocity and the erosion and deposition of sediments. Sediments trans- ported by streams tend to become rounded as a result of abrasion. Stream fea- tures include V-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries. • Glaciers (moving ice): Glacial erosional processes include the formation of U-shaped valleys, parallel scratches, and grooves in bedrock. Glacia features include moraines, drumlins, kettle lakes, finger lakes, and outwash plains. • Wave Action: Erosion and deposition cause changes in shoreline features includ- ing beaches, sandbars, and barrier islands. Wave action rounds sediment as a result of abrasion. Waves approaching a shoreline move sand parallel to the shore within the zone of breaking waves. • Wind: Erosion of sediments by wind is most common in arid climates and along shorelines. Wind-generated features include dunes and sand-blasted bedrock. • Mass Movement: Earth materials mov downslope under the influence of gravity. KI.2.PI.2.1U

2.1v 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. KI.2.PI.2.1V

2.1w Sediments of inorganic and organic origin often accumulate in depositional envi ronments. Sedimentary rocks form when sediments are compacted and/or cemented after burial or as the result of chemical precipitation from seawater. KI.2.PI.2.1W

PI.2.2 Explain how incoming solar radiation, ocean currents, and land masses affect weather and climate. KI.2.PI.2.2

2.2a Insolation (solar radiation) heats Earth's surface and atmosphere unequally due to variations in: • the intensity caused by differences in atmospheric transparency and angle of inci- dence which vary with time of day, latitude, and season • characteristics of the materials absorbing the energy such as color, texture, trans- parency, state of matter, and specific heat • duration, which varies with seasons and latitude. KI.2.PI.2.2A

2.2b The transfer of heat energy within the atmosphere, the hydrosphere, and Earth's surface occurs as the result of radiation, convection, and conduction. • Heating of Earth's surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents. KI.2.PI.2.2B

2.2c A location's climate is influenced by latitude, proximity to large bodies of water, ocean currents, prevailing winds, vegetative cover, elevation, and mountain ranges. KI.2.PI.2.2C

2.2d Temperature and precipitation patterns are altered by: • natural events such as El Niño and volcanic eruptions • human influences including deforestation, urbanization, and the production of green- house gases such as carbon dioxide and methane. KI.2.PI.2.2D

Matter is made up of particles whose properties determine the ob ch and its reactivity. KI.3

PI.3.1 Explain the properties of materials in terms of the arrangement and properties of the atoms that compose them. KI.3.PI.3.1

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3.1a Minerals have physical properties determined by their chemical composition and crystal structure.• 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. •Chemical composition and physical properties determine how minerals are used by humans. KI.3.PI.3.1A

3.1b Minerals are formed inorganically by the process of crystallization as a result of specific environmental conditions. These include: • cooling and solidification of magma • precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes • rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure. KI.3.PI.3.1B

3.1c Rocks are usually composed of one or more minerals. • Rocks are classified by their origin, mineral content, and texture. • Conditions that existed when a rock formed can be inferred from the rock's mineral content and texture. • The properties of rocks determine how they are used and also influence land usage by humans. KI.3.PI.3.1C