

SCIENCE – UNIFYING STANDARDS

THE NATURE OF SCIENCE

- 1.0 **Research and Investigation:** Students understand that science is a way of learning about the natural world. They use scientific inquiry and develop ideas based on data collected from investigations they design.
- 2.0 **Communication:** Students understand that the universe can be described by principles derived through scientific inquiry. They effectively communicate their understanding of ideas developed in scientific investigation through a variety of media.
- 3.0 **Connections and Implications:** Students review the consequences of the process and products of scientific inquiry. They understand the role that scientific advances have had throughout history.

EARTH SCIENCE

- 1.0 **Characteristics of the Universe:** Students understand Earth-based and space-based astronomy reveals the structure, scale, and dynamic nature of the solar system, stars, galaxies, and the universe.
- 2.0 **The Dynamic Earth:** Students understand that the Earth is constantly changing and being shaped due to a variety of natural events, processes, and human activity. The Earth is a collection of interacting cycles, structures, and processes that can be described in terms of space, time, energy, and matter.

LIFE SCIENCE

- 1.0 **Diversity and Interdependence:** Students understand that living things are diverse and interdependent. They recognize the relationship between cooperation and competition among organisms in ecosystems.
- 2.0 **Cellular Structures and Functions:** Students understand that cells are the basic structures of all living systems. They understand the complementary relationship between the structure and function of cells, organs, organ systems, whole organisms, and ecosystems.
- 3.0 **Change and Evolution:** Students understand that living things grow, develop, change, and evolve through time, depending on environmental influences. They know that traits of species can change through generations and that instruction of traits is contained in the genetic material of organisms.

PHYSICAL SCIENCE

- 1.0 **Forces and Motion:** Students understand the nature of forces and the relationship between forces and motion. They recognize that the relationship is described by one set of laws. They understand that all matter is in motion and that motion changes as a result of forces between matter. They realize that these forces affect everyday life, and that the effects can be identified, measured, and predicted.
- 2.0 **Energy, Momentum and Transformation:** Students understand that when matter interacts with matter, energy and momentum can be transferred or distributed, and that energy may be transformed. When matter interacts the total amount of matter, energy, and momentum remain the same.
- 3.0 **Structure and Properties of Matter:** Students understand that all matter is made up of particles. They understand the relationship between the structure and properties of matter. They know that a finite number of basic elements combine in various ways which determine all properties, characteristics, and behaviors of matter.

EARTH SCIENCE

Focus Goals Level 9 – 12

1.0 Characteristics of the Universe: Earth-based and space-based astronomy reveals the structure, scale, and dynamic nature of the solar system, stars, galaxies, and the universe.

- 1.1 Know and understand the scale, structure, development, and physical behavior of planetary systems.
- 1.2 Know and understand the scale, structure, development, and physical behavior of stars.
- 1.3 Know and describe the current scientific cosmologic models.

2.0 The Dynamic Earth: Students understand that the Earth is constantly changing and being shaped due to a variety of natural events, processes, and human activity. The Earth is a collection of interacting cycles, structures, and processes that can be described in terms of space, time, energy, and matter.

- 2.1 Understand and explain the historical development of the theory of plate tectonics and the physical evidence related to the theory.
- 2.2 Understand and explain that plate tectonics is a model used to describe the changing patterns of land, sea, and mountains on the Earth's surface.
- 2.3 Know and describe how the geology of California underlies the state's wealth of natural resources as well as its natural hazards.
- 2.4 Know and describe how each element on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of biogeochemical cycles.
- 2.5 Understand and describe how that life has changed Earth's atmosphere and changes in the atmosphere affect conditions for life.
- 2.6 Understand and explain that energy enters the Earth system primarily as solar radiation and eventually escapes as heat.
- 2.7 Know and understand that the heating of the Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.
- 2.8 Know and understand that climate is the long term average of a region's weather and depends on many factors.

EARTH SCIENCE
Level 9 – 12

1.0 Characteristics of the Universe: Students understand Earth-based and space-based astronomy reveals the structure, scale, and dynamic nature of the solar system, stars, galaxies, and the universe.

1.1 Know and understand the scale, structure, development, and physical behavior of planetary systems. (c1)

- Recognize that Earth rocks, moon rocks, and other extraterrestrial sources provide evidence that the solar system's format from a nebular cloud of dust and gas approximately 4.6 billion years ago. (c1b)
- Analyze a chart showing the order and relative distances of the planets. (s)
- Explain how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system. (c/ES1a)
- Identify evidence from geological studies of the Earth and other planets that the early Earth was very different from today. (c/ES1c)
- Evaluate evidence for the dramatic effects of asteroid impacts in shaping the surface of planets and their moons, and in mass extinctions of life on Earth. (c/ES1f)
- Identify evidence showing that the planets are much closer than the stars. (c/ES1d)
- Relate the shapes of planetary orbits to the forces causing those orbits. (s)
- *Recognize evidence for the existence of planets orbiting other stars. (c/ES1g)

1.2 Know and understand the scale, structure, development, and physical behavior of stars. (c/ES2)

- Explain how stars condense by gravity out of clouds of molecules of the lightest elements. (p)
- Recognize that the sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium. (c/ES1e)
- Describe evidence showing that all elements with an atomic number greater than that of Lithium have been formed by nuclear fusion in stars. (c/ES2c)
- Recognize that stars differ in their life cycles.
- Recognize that visual, radio, and X-ray telescopes collect data that reveal these differences. (c/ES2d)
- Interpret observations of stars such as color and brightness. (s)
- *Describe evidence that the color, brightness, and evolution of a star are determined by a balance between gravitational collapse and nuclear fusion. (c/ES2f)

1.3 Know and describe the current scientific cosmologic models. (c2)

- Recognize that the universe is composed of billions of galaxies, which are found in groups or clusters. (p)
- Recognize that the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years. (c/ES2a)
- Recognize that galaxies are made of billions of stars, form most of the visible mass of the universe and are classified according to shape. (c/ES2b)

- *Recognize that accelerators boost subatomic particles to energy levels that simulate conditions in the stars and in early history of the universe before stars formed. (c/ES2e)
- *Explain how the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years. (c/ES2g)

2.0 The Dynamic Earth: Students understand that the Earth is constantly changing and being shaped due to a variety of natural events, processes, and human activity. The Earth is a collection of interacting cycles, structures, and processes that can be described in terms of space, time, energy, and matter.

2.1 Understand and explain the historical development of the theory of plate tectonics and the physical evidence related to the theory. (c/ES3)

- Analyze a fossil chart. (s)
- Associate fossil formation with environmental conditions. (s)
- Interpret and draw conclusions from geologic models. (s)
- Identify fossil, stratigraphic, and glacial evidence, and the puzzle fit of the continents that led to the development of Wegener's Theory of Continental Drift. (p)
- Describe how features of the ocean floor (magnetic patterns, age, and sea floor topography) provide evidence for seafloor spreading. (cES3a)
- Relate seafloor spreading, the pattern of earthquake and volcanic activity, and convection currents in the mantle support the plate tectonics. (p)

2.2 Understand and explain that plate tectonics is a model used to describe the changing patterns of land, sea, and mountains on the Earth's surface. (c/ES3)

- Identify the principal structures that form at the three different kinds of plate boundaries. (c/ES3b)
- Interpret a minerals chart. (s)
- Use a rock cycle chart to identify the series of events that result in the three major rock classifications. (s)
- Explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes. (c/ES3c)
- Explain how and why earthquakes occur, and the scales used to measure their intensity and magnitude. (c/ES3d)
- Identify two kinds of volcanoes, one with violent eruptions producing steep slopes and the other with voluminous lava flows producing gentle slopes. (c/ES3e)
- Describe how the location and properties of hot spots, subduction zones, and spreading centers are used to classify volcanoes. (c/ES3f)

2.3 Know and describe how the geology of California underlies the state's wealth of natural resources and its natural hazards. (c/ES9)

- Use a topographic map to identify common features of California, such as mountain, valleys, and canyons. (s)
- Identify the resources of major economic importance in California and describe their relation to California's geology. (c/ES9a)

- Relate the principal natural hazards in different California regions, to the tectonic basis of those hazards. (c/ES9b)
- Make predictions, such as the location of a mineral resource or an active earthquake fault, based on observation of geologic formations. (s)
- Explain the importance of water to society, the origins of California's fresh water, and the relationship between supply and need. (c/ES9c)
- *Analyze published geologic hazard maps of California and use the map information to identify evidence of geological events of the past and predict geological changes in the future. (c/ES9d)
- Relate the prominent natural features of San Diego County to geologic processes. (p)

2.4 Know and describe how each element on Earth moves among reservoirs in the solid Earth, oceans, atmosphere, and organisms as part of biogeochemical cycles. (cES7)

- Interpret a model of an Earth cycle such as the water cycle. (s)
- Explain the carbon cycle of photosynthesis and respiration, and the nitrogen cycle. (cES7a)
- Explain the global carbon cycle in terms of the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, and fossil fuels, and the movement of carbon among these reservoirs. (c/ES7b)
- Describe the movement of matter among reservoirs is driven by the Earth's internal and external sources of energy. (c/ES7c)
- *Recognize the relative residence times and flows of carbon in and out of its different reservoirs. (c/ES7d)

2.5 Understand and describe how life has changed Earth's atmosphere and changes in the atmosphere affect conditions for life. (c/ES8)

- Describe the thermal structure, physical nature, and chemical composition of the atmosphere. (c/ES8a)
- Explain how the atmosphere of the Earth has evolved over geologic time. (c/ES8b)
- Relate outgassing, the origin of atmospheric oxygen, and variations in carbon dioxide concentration to the composition of the atmosphere. (c/ES8b)
- Identify the location of the ozone layer in the upper atmosphere and describe its role in absorbing ultraviolet radiation. (cES8c)
- Describe how the ozone layer varies both naturally and in response to human activities. (c/ES8c)
- Evaluate how current evidence suggests that the Earth is experiencing global warming in part due to the activities of humans. (p)

2.6 Understand and explain that energy enters the Earth system primarily as solar radiation and eventually escapes as heat. (c/ES4)

- Compare the relative amount of incoming solar energy, the internal energy of the Earth, and the energy used by society. (c/ES4a)
- Analyze incoming solar radiation in terms of reflection, absorption, and photosynthesis. (c/ES4b)
- Identify the different atmospheric gases that absorb the thermal radiation of the Earth, and relate this to the greenhouse effect. (c/ES4c)
- *Compare the greenhouse conditions on Earth, Mars, and Venus, and their origins and climatic consequences. (c/ES4d)

2.7 Know and understand that the heating of the Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. (c5)

- Explain how differential heating of the Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat. (c/ES5a)
- Relate the rotation of the Earth and the circular motion of ocean currents and air in pressure centers. (c/ES5b)
- Describe the origin and effects of temperature inversions. (c/ES5c)
- Relate the properties of ocean water such as temperature and salinity to the layered structure of the oceans, generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms. (c/ES5d)
- Recognize that rain forests and deserts on Earth are distributed in bands at specific latitudes. (c/ES5e)
- *Relate the interaction of wind patterns, ocean currents, and mountain ranges to the global pattern of latitudinal bands of rain forests and deserts. (c/ES5f)
- *Describe the ENSO cycle (El Niño/La Niña) in terms of sea-surface and air temperature variations across the Pacific, and some climatic results of this cycle. (c/ES5g)

2.8 Know and understand that climate is the long term average of a region's weather and depends on many factors. (c/ES6)

- Read and evaluate graphs of atmospheric conditions and weather data. (s)
- Read and interpret a weather map. (s)
- Use observations to make inferences about weather conditions. (s)
- Recognize that weather (in the short run) and climate (in the long run) involve the transfer of energy in and out of the atmosphere. (c/ES6a)
- Relate latitude, elevation, topography, proximity to large bodies of water, and cold or warm ocean currents to climate. (c/ES6b)
- Relate changes in the climate of the Earth to changes in atmospheric composition, solar radiation, and plate movement. (c/ES6c)
- *Recognize that computer models are used to predict the effects of increasing greenhouse gases on climate for the planet as a whole and for specific regions. (c/ES6d)