# GE 501 Earth and Space Science
# Correlation to Texas Essential Knowledge and Skills (TEKS) High School Earth and Space Science

| Learning Objectives | ESS Theme | TEKS Performance Expectations The student is expected to: |
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| 1. Evaluate the differing theories that explain the structure, scale, composition, origin, and history of the universe. | Earth in Space and Time | HS-ESS-C-4-A. Evaluate the evidence concerning the Big Bang model such as red shift and cosmic microwave background radiation and current theories of the evolution of the universe, including estimates for the age of the universe<br><br>HS-ESS-C-4-B. Explain how the Sun and other stars transform matter into energy through nuclear fusion |
| 2. Describe the solar nebular accretionary disk model. | Earth in Space and Time | HS-ESS-C-4-C. Investigate the process by which a supernova can lead to the formation of successive generation stars and planets<br><br>HS-ESS-C-5-A. Analyze how gravitational condensation of solar nebular gas and dust can lead to the accretion of planetesimals and protoplanets<br><br>HS-ESS-C-5-B. Investigate thermal energy sources, including kinetic heat of impact accretion, gravitational compression, and radioactive decay, which are thought to allow protoplanet differentiation into layers<br><br>HS-ESS-C-5-C. Contrast the characteristics of comets, asteroids, and meteoroids and their positions in the solar system, including the orbital regions of the terrestrial planets, the asteroid belt, gas giants, Kuiper Belt, and Oort Cloud<br><br>HS-ESS-C-5-D. Explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal<br><br>HS-ESS-C-5-E. Compare terrestrial planets to gas-giant planets in the solar system, including structure, composition, size, density, orbit, surface features, tectonic activity, temperature, and suitability for life<br><br>HS-ESS-C-5-F. Compare extra-solar planets with planets in our solar system and describe how such planets are detected |

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| 3. Cite evidence that shows how Earth's atmosphere, hydrosphere, and geosphere formed and changed through time. | Earth in Space and Time | HS-ESS-C-6-A. Analyze the changes of Earth's atmosphere that could have occurred through time from the original hydrogen-helium atmosphere, the carbon dioxide-water vapor-methane atmosphere, and the current nitrogen-oxygen atmosphere<br><br>HS-ESS-C-6-B. Evaluate the role of volcanic outgassing and impact of water-bearing comets in developing Earth's atmosphere and hydrosphere<br><br>HS-ESS-C-6-C. Investigate how the formation of atmospheric oxygen and the ozone layer impacted the formation of the geosphere and biosphere<br><br>HS-ESS-C-6-D. Evaluate the evidence that Earth's cooling led to tectonic activity, resulting in continents and ocean basins |
| 4. Explain how Earth's interior is differentiated chemically, physically, and thermally. | Solid Earth | HS-ESS-C-9-A. Evaluate heat transfer through Earth's subsystems by radiation, convection, and conduction and include its role in plate tectonics, volcanism, ocean circulation, weather, and climate<br><br>HS-ESS-C-9-B. examine the chemical, physical, and thermal structure of Earth's crust, mantle, and core, including the lithosphere and asthenosphere;<br><br>HS-ESS-C-9-C. Explain how scientists use geophysical methods such as seismic wave analysis, gravity, and magnetism to interpret Earth's structure |

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| 5. Identify plate tectonics as the global mechanism for major geologic processes, and describe how heat transfer as governed by the principles of thermodynamics serves as the driving force for those processes. | Solid Earth | HS-ESS-C-10-A. Investigate how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics<br><br>HS-ESS-C-10-B. Describe how heat and rock composition affect density within Earth's interior and how density influences the development and motion of Earth's tectonic plates<br><br>HS-ESS-C-10-C. Explain how plate tectonics accounts for geologic processes and features, including sea floor spreading, ocean ridges and rift valleys, subduction zones, earthquakes, volcanoes, mountain ranges, hot spots, and hydrothermal vents<br><br>HS-ESS-C-10-D. Calculate the motion history of tectonic plates using equations relating rate, time, and distance to predict future motions, locations, and resulting geologic features<br><br>HS-ESS-C-10-E. Distinguish the location, type, and relative motion of convergent, divergent, and transform plate boundaries using evidence from the distribution of earthquakes and volcanoes<br><br>HS-ESS-C-10-F. Evaluate the role of plate tectonics with respect to long-term global changes in Earth's subsystems such as continental buildup, glaciation, sea level fluctuations, mass extinctions, and climate change |
| 6. Describe how the geosphere continuously changes over a range of time scales and the impact of dynamic and complex interactions among Earth's subsystems on that process. | Solid Earth | HS-ESS-C-11-A. compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface<br><br>HS-ESS-C-11-B. Explain how plate tectonics accounts for geologic surface processes and features, including folds, faults, sedimentary basin formation, mountain building, and continental accretion<br><br>HS-ESS-C-11-C. Analyze changes in continental plate configurations such as Pangaea and their impact on the biosphere, atmosphere, and hydrosphere through time<br><br>HS-ESS-C-11-D. Interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps using appropriate technologies<br><br>HS-ESS-C-11-E. Evaluate the impact of changes in Earth's subsystems on humans such as earthquakes, tsunamis, volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of fresh water |

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| 7. Explain the process of scientific dating to determine the age of fossils and rock sequences, how that process is used to construct a chronology of Earth's history, and how fossils provide evidence for geological and biological evolution. | Earth in Space and Time | HS-ESS-C-7-A. Evaluate relative dating methods using original horizontality, rock superposition, lateral continuity, cross-cutting relationships, unconformities, index fossils, and biozones based on fossil succession to determine chronological order<br><br>HS-ESS-C-7-B. Calculate the ages of igneous rocks from Earth and the Moon and meteorites using radiometric dating methods<br><br>HS-ESS-C-7-C. Understand how multiple dating methods are used to construct the geologic time scale, which represents Earth's approximate 4.6-billion-year history<br><br>HS-ESS-C-8-A. Analyze and evaluate a variety of fossil types such as transitional fossils, proposed transitional fossils, fossil lineages, and significant fossil deposits with regard to their appearance, completeness, and alignment with scientific explanations in light of this fossil data<br><br>HS-ESS-C-8-B. Explain how sedimentation, fossilization, and speciation affect the degree of completeness of the fossil record<br><br>HS-ESS-C-8-C. Evaluate the significance of the terminal Permian and Cretaceous mass extinction events, including adaptive radiations of organisms after the events |

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| 8. Identify the hydrosphere, cryosphere, and atmosphere subsystems of fluid Earth, and describe how the subsystems interact on various time scales with the biosphere and geosphere. | Fluid Earth | HS-ESS-C-13-A. Quantify the components and fluxes within the hydrosphere such as changes in polar ice caps and glaciers, salt water incursions, and groundwater levels in response to precipitation events or excessive pumping<br><br>HS-ESS-C-13-B. Analyze how global ocean circulation is the result of wind, tides, the Coriolis effect, water density differences, and the shape of the ocean basins<br><br>HS-ESS-C-13-C. Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature trends over the past 150 years<br><br>HS-ESS-C-13-D. Discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate<br><br>HS-ESS-C-13-E. Investigate the causes and history of eustatic sea-level changes that result in transgressive and regressive sedimentary sequences<br><br>HS-ESS-C-13-A. Discuss scientific hypotheses for the origin of life by abiotic chemical processes in an aqueous environment through complex geochemical cycles given the complexity of living systems |
| 9. Describe the process by which Earth’s global ocean stores solar energy and serves as a driving force for weather and climate through complex atmospheric interactions. | Fluid Earth | HS-ESS-C-14-A. Analyze the uneven distribution of solar energy on Earth's surface, including differences in atmospheric transparency, surface albedo, Earth's tilt, duration of insolation, and differences in atmospheric and surface absorption of energy<br><br>HS-ESS-C-14-B. Investigate how the atmosphere is heated from Earth's surface due to absorption of solar energy, which is re-radiated as thermal energy and trapped by selective absorbers<br><br>HS-ESS-C-14-C. Explain how thermal energy transfer between the ocean and atmosphere drives surface currents, thermohaline currents, and evaporation that influence climate<br><br>HS-ESS-C-14-D. Describe the formation and structure of Earth's magnetic field, including its interaction with charged solar particles to form the Van Allen belts and auroras |

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| 10. Explain how interactions among Earth's five subsystems influence climate and resource availability, which affect Earth's habitability. | Fluid Earth | HS-ESS-C-15-A. describe how changing surface-ocean conditions, including El Niño-Southern Oscillation, affect global weather and climate patterns<br><br>HS-ESS-C-15-B. Investigate evidence such as ice cores, glacial striations, and fossils for climate variability and its use in developing computer models to explain present and predict future climates<br><br>HS-ESS-C-15-C. Quantify the dynamics of surface and groundwater movement such as recharge, discharge, evapotranspiration, storage, residence time, and sustainability<br><br>HS-ESS-C-15-D. Explain the global carbon cycle, including how carbon exists in different forms within the five subsystems and how these forms affect life<br><br>HS-ESS-C-15-E. Analyze recent global ocean temperature data to predict the consequences of changing ocean temperature on evaporation, sea level, algal growth, coral bleaching, hurricane intensity, and biodiversity. |

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| 11. Describe how the use of energy, water, mineral, and rock resources impacts Earth's subsystems. | Solid Earth | HS-ESS-C-13-A. Evaluate how the use of energy, water, mineral, and rock resources affects Earth's subsystems;<br><br>HS-ESS-C-13-B. Describe the formation of fossil fuels, including petroleum and coal;<br><br>HS-ESS-C-13-C. Discriminate between renewable and nonrenewable resources based upon rate of formation and use;<br><br>HS-ESS-C-13-D. Analyze the economics of resources from discovery to disposal, including technological advances, resource type, concentration and location, waste disposal and recycling, and environmental costs; and<br><br>HS-ESS-C-13-E. Explore careers that involve the exploration, extraction, production, use, and disposal of Earth's resources. |

## Correlation of Performance Objectives to HS ESS TEKS Performance Expectations

| Performance Objectives | ESS Theme | TEKS Performance Expectations The student is expected to: |
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| 1. Recognize the value of aerial photographs and topographic maps as research tools. | Solid Earth | HS-ESS-C-11-D. Interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps. using appropriate technologies |
| 2. Examine the physical properties and motions of the planets and the various degrees of order and patterns exhibited in the solar system. | Earth in Space and Time | HS-ESS-C-11- C. Contrast the characteristics of comets, asteroids, and meteoroids and their positions in the solar system, including the orbital regions of the terrestrial planets, the asteroid belt, gas giants, Kuiper Belt, and Oort Cloud<br><br>HS-ESS-C-11- D. Explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal<br><br>HS-ESS-C-11- E. Compare terrestrial planets to gas-giant planets in the solar system, including structure, composition, size, density, orbit, surface features, tectonic activity, temperature, and suitability for life |

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| 3. Explore the natural processes that shape Earth and other terrestrial planets. | Solid Earth | HS-ESS-C-11- A. Compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface |
| 4. Use observation skills to examine the results of geologic processes at work on Earth and its moon. | Solid Earth | HS-ESS-C-11- A. Compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface |
| 5. Use data to draw conclusions about patterns that exist in our solar system. | Earth in Space and Time | HS-ESS-C-5-E. Compare terrestrial planets to gas-giant planets in the solar system, including structure, composition, size, density, orbit, surface features, tectonic activity, temperature, and suitability for life |
| 6. Examine evidence that has been used to verify the theory of plate tectonics. | Solid Earth | HS-ESS-C-10-A. Investigate how new conceptual interpretations of data and innovative geophysical technologies led to the current theory of plate tectonics |
| 7. Identify techniques that are used by seismologists to determine the location of earthquakes and to investigate the structure of Earth’s interior. | Solid Earth | HS-ESS-C-9-C. Explain how scientists use geophysical methods such as seismic wave analysis, gravity, and magnetism to interpret Earth's structure |

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| 8. Examine agents and processes that modify Earth’s surface and the consequences of human interactions with these natural systems. | Solid Earth | HS-ESS-C-11- A. Compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface<br><br>HS-ESS-C-11- B. Explain how plate tectonics accounts for geologic surface processes and features, including folds, faults, sedimentary basin formation, mountain building, and continental accretion<br><br>HS-ESS-C-11- E. Evaluate the impact of changes in Earth's subsystems on humans such as earthquakes, tsunamis, volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of fresh water<br><br>HS-ESS-C-12- A. Evaluate how the use of energy, water, mineral, and rock resources affects Earth's subsystems |
| 9. Describe the landforms and processes that shaped Earth’s arid and glacial landscapes. | Solid Earth | HS-ESS-C-11- A. Compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface |
| 10. Describe the physical properties of minerals, and apply techniques to identify minerals as preparation for the study of rocks. | Solid Earth | HS-ESS-C-9- B. Examine the chemical, physical, and thermal structure of Earth's crust, mantle, and core, including the lithosphere and asthenosphere |
| 11. Classify the origins of rock as igneous, sedimentary, or metamorphic. | Earth in Space and Time | HS-ESS-C-11- A. Compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface |

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| 12. Investigate techniques and procedures used by scientists to interpret the geologic history of Earth. | Earth in Space and Time | HS-ESS-C-7-A. Evaluate relative dating methods using original horizontality, rock superposition, lateral continuity, cross-cutting relationships, unconformities, index fossils, and biozones based on fossil succession to determine chronological order<br><br>HS-ESS-C-7-B. Calculate the ages of igneous rocks from Earth and the Moon and meteorites using radiometric dating methods<br><br>HS-ESS-C-7-C. Understand how multiple dating methods are used to construct the geologic time scale, which represents Earth's approximate 4.6-billion-year history |
| 13. Explain the relationships that exists between the density of seawater and salinity and temperature. | Fluid Earth | HS-ESS-C-14-C. Explain how thermal energy transfer between the ocean and atmosphere drives surface currents, thermohaline currents, and evaporation that influence climate |
| 14. Investigate the causes, mechanics, and results of ocean-water movements. | Fluid Earth | HS-ESS-C-13-B. Analyze how global ocean circulation is the result of wind, tides, the Coriolis effect, water density differences, and the shape of the ocean basins<br><br>HS-ESS-C-14-C. Explain how thermal energy transfer between the ocean and atmosphere drives surface currents, thermohaline currents, and evaporation that influence climate. |
| 15. Identify the reasons that the amount of solar radiation intercepted by Earth varies for different latitudes and changes throughout the year at particular locations. | Fluid Earth | HS-ESS-C-14-A. Analyze the uneven distribution of solar energy on Earth's surface, including differences in atmospheric transparency, surface albedo, Earth's tilt, duration of insolation, and differences in atmospheric and surface absorption of energy |

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| 16. Describe the journey of solar radiation and how it is influenced and modified by air, land, and water. | Fluid Earth | HS-ESS-C-14-A. Analyze the uneven distribution of solar energy on Earth's surface, including differences in atmospheric transparency, surface albedo, Earth's tilt, duration of insolation, and differences in atmospheric and surface absorption of energy<br><br>HS-ESS-C-14-A. Investigate how the atmosphere is heated from Earth's surface due to absorption of solar energy, which is re-radiated as thermal energy and trapped by selective absorbers |
| 17. Examine the impact of changes in atmospheric moisture, pressure, and wind on Earth's weather. | Fluid Earth | HS-ESS-C-15-A. Describe how changing surface-ocean conditions, including El Niño - Southern Oscillation, affect global weather and climate patterns |
| 18. Investigate world climates using a system of climate classification. | Fluid Earth | |