ADW GRADE 6-8 EARTH AND SPACE SCIENCE STANDARDS & INSTRUCTION GUIDE

ESS.1 Earth's Place in the Universe	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and the moon, and seasons.	• Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. • Earth's rotation axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. • The seasons are a result of that tilt and are caused by the differential intensity (direct/indirect) of sunlight on different areas of Earth across the year. • The moon's orbit around the Earth once in about 28 days changes the portion of the lighted half of the moon that we can see from Earth both during day and night and results in us seeing the moon phases. • A solar eclipse occurs when the Moon's shadow appears on Earth's surface; a solar eclipse can only occur during the new moon phase. • A lunar eclipse occurs when the Moon moves into Earth's shadow. Lunar eclipses can only occur during the full moon phase. • Examples of models can be physical, graphical, or conceptual.	• Earth-sun-moon system • rotation • rotation axis • revolution • tilt • orbit • seasons • lunar phases • solar eclipse • lunar eclipse • satellite • **Galileo** • **Copernicus**	• https://www.jpl.nasa.gov/edu/teach/activity/modeling-the-earth-moon-system/

ESS.1 Earth's Place in the Universe	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.1-2	Construct explanations for how gravity affects the motion of objects in the solar system and tides on Earth.	• Gravity is the attractive force that exists between all objects in the universe, dependent upon how much mass the objects have and how far apart they are. • Gravity is the force that keeps the planets in orbit around the Sun and governs the rest of the motion in the solar system. • The solar system appears to have formed from a nebula, a disk of dust and gas, drawn together by gravity. • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. • Artificial and natural satellites are kept in orbit around a planet due to its gravitational pull on them. • Tides on Earth are caused by the gravitational pull of the moon and, to a lesser extent, the sun. • This gravitational pull results in a tidal bulge and a cycle of low and high tides as the Earth rotates.	• gravity • galaxy • solar system • orbit • planets • moons • high tide • low tide • neap tide • spring tide • nebula	• https://phet.colorado.edu/en/simulation/gravity-and-orbits

ESS.1 Earth's Place in the Universe	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.1-3	Obtain and communicate information to describe how data from technologies provide information about objects in the solar system and the universe.	• The Sun is the largest object in the solar system, but it is not the largest star in the solar system. It appears to be the largest star because it is closest to Earth. • The data comes from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. • Data from these technologies can be used to determine scale properties of objects in the solar system, including the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), period of rotation, period of revolution, distance from the Sun, and orbital radius.	• sun • stars • planets • moons • asteroids • comets • gravity • Earth-based instruments • space-based telescopes • spacecraft • astronomical unit	• https://www.nasa.gov/mission_pages/hubble/main/index.html

ESS.1 Earth's Place in the Universe	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8-ESS.1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history.	• The geologic time scale interpreted from rock strata provides a way to organize Earth's history. • Fossils provide important evidence of how life and environmental conditions have changed. • Thousands of layers of sedimentary rock confirm the long history of the changing surface of the Earth and the changing life forms whose remains are found in successive layers. • The youngest layers of rock are not always found on top because of folding, breaking, and uplifting of layers. • Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	• geological time scale • decade • century • epoch • era • eon • period • fossil • rock strata • relative dating	• https://serc.carleton.edu/NAGTWorkshops/paleo/activities/35715.html

ESS.2 Earth's Systems	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8-ESS.2-1	Obtain and communicate information about the relative position, density, and composition of Earth's layers and the cycling of matter and energy within and between them.	• All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. • The Earth's interior is composed of layers called the crust, mantle, and core. • Earth's hot interior is a main source of energy that drives the cycling and moving of materials. • The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials. • The rock cycle model describes the relationship between the processes and forces that create igneous, sedimentary, and metamorphic rocks. • The processes of melting, crystallization, weathering, deformation, and sedimentation act together to form minerals and rocks through the cycling of Earth's materials.	• energy • matter • core • mantle • crust • convection currents • density • gravity • physical change • chemical change • weathering • erosion • melting • crystallization • deformation • sedimentation • minerals • rocks • igneous rock • sedimentary rock • metamorphic rock • rock cycle	• https://www.learner.org/interactives/rockcycle/rockdiagram/

ESS.2 Earth's Systems	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.2-2	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.	• Plate tectonics is the unifying theory that explains the past and current crustal movements at the Earth's surface. • This theory provides a framework for understanding geologic history. • Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at deep ocean trenches. • Earth's plates are influenced by activity in the mantle and core that produce major geologic events (i.e., mountain building, earthquakes, volcanic eruptions, ocean basin formation, seafloor spreading, and subduction). • Matching coastlines and similarities in rock type and life forms suggest that today's continents are separated parts of what was long ago a single continent. • Different geologic features and events occur at different plate boundaries.	• lithospheric plates • Continental drift theory • seafloor spreading • mid-ocean ridges • Theory of plate tectonics • convergent boundary • divergent boundary • transform boundary • subduction • rift valleys • mountains • volcanoes • earthquakes • Pangaea • **Alfred Wegener** • **Harry Hess**	• https://www.learner.org/interactives/dynamicearth/otherboundaries/ • https://www.learner.org/interactives/dynamicearth/convergentboundaries/ • https://www.learner.org/interactives/dynamicearth/continentsovertime/

ESS.2 Earth's Systems	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.2-3	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	• The energy of the sun and the force of gravity drive the cycling of water through the hydrosphere and atmosphere. • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, crystallization, and precipitation, as well as downhill flows on land. • The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns.	• water/hydrologic cycle • atmosphere • hydrosphere • geosphere • evaporation • transpiration • condensation • run-off • groundwater • weather • climate • ozone layer	•

ESS.2 Earth's Systems	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.2-4	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	• The changes and movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. • Clouds, formed by condensation of water vapor, affect weather and climate. • Global patterns of atmospheric movement affect local weather. • Air masses flow from regions of high pressure to low pressure, causing weather at a fixed location to change over time. • Sudden changes in weather can results when different air masses collide. • Weather can be predicted within probabilistic ranges. • Instruments used in measuring weather-related phenomena include rain gauges, weather balloons, anemometer, barometer, wind vane, hygrometer, weather balloon, satellites, psychrometer, etc.)	• meteorology • weather • climate • temperature • pressure • humidity • relative humidity • dew point • clouds • fog • precipitation • wind • weather map • atmosphere • air mass • high pressure • low pressure • fronts • weather map • computer models	•

ESS.2 Earth's Systems	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.2-5	Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	• Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. • Climate is affected by ocean currents, Earth's surface features, latitude, and the atmosphere. • Climates have sometimes changed abruptly as a result in changes to Earth's crust, such as volcanic eruptions or impact of huge rocks from space. • Atmospheric circulation is based on the sun-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds. • Ocean circulation is based on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis Effect and the outlines of continents.	• temperature • salinity • oceans • latitude • longitude • global winds • geographic land distribution • ocean waves • ocean currents • Coriolis Effect • ocean zones	•

ESS.2 Earth's Systems	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.2-6	Construct an explanation based on evidence for how natural processes can change Earth's surface at varying time and spatial scales.	• The surface of Earth is constantly changing through natural processes. • Processes can be large, such as slow plate motions or the uplift of large mountain ranges. • Processes can be small, such as rapid landslides or microscopic geoscience processes (earthquakes, volcanoes, meteor impacts). • Processes can be slow (i.e., uplift, erosion, weathering, action of glaciers). • Processes can be rapid (i.e., landslides, tornadoes, hurricanes, volcanic eruptions, earthquakes, flooding, tsunamis). • Earth's surface is shaped in part by the motion of water, including ice, and wind over very long times. • This motion causes weathering, erosion, and deposition.	• weathering • erosion • deposition • earthquakes • volcanoes • uplift • glaciers • subduction • rift valleys	•

ESS.3 Earth and Human Activity	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources

SC.6-8.ESS.3-1	Construct a scientific explanation based on evidence for how the uneven distributions of Earth's minerals, energy, and groundwater resources are the result of past and current geological processes.	• Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. • These resources are distributed unevenly around the planet as a result of past geologic processes. • These resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. • The uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).	• mineral resources • ore • energy • groundwater • geoscience processes • renewable resource • solar energy • wind energy • water energy • geothermal energy • biomass energy • management solutions • nonrenewable resource • fossil fuels • coal • oil and natural gas • nuclear energy • fusion • fission • reclamation • land resources • deforestation • pollution • habitat	•

			destruction • air resources • water resources	

ESS.3 Earth and Human Activity	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8-ESS.3-2	Construct an argument supported by evidence for how increases in consumption of natural resources impact Earth's systems.	• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. • The different ways of obtaining, transforming, and distributing energy have different environmental consequences. • The benefits of Earth's resources, such as fresh water, air, soil, and trees are finite. These benefits can be preserved by not using them wastefully and not deliberately or accidentally destroying them.	• per-capita	•

ESS.3 Earth and Human Activity	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8.ESS.3-3	Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.	• Human activities have altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. • Human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land). • The design process can include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact • Human activities, such as the release of greenhouse gases from burning fossil fuels, have had an impact on the Earth's mean surface temperature. • Understanding climate science, engineering capabilities and other kinds of knowledge such as human behavior is a key factor in reducing human vulnerability to any changes to the Earth's mean surface temperature. • Some effects of human activities, such as the creation of pollution, have affected weather and the atmosphere.	• biosphere • natural habitat • extinction • ozone • greenhouse gases	•

ESS.3 Earth and Human Activity	Standard	Core Concepts	Scientific Terms and Scientists	EdTech Resources
SC.6-8-ESS.3-4	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	• The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values, by the findings of scientific research, and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. • Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and without notice, and thus are not yet predictable. • Natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). • Data can include the locations, magnitudes, and frequencies of the natural hazards. • Technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).	• natural hazards • technology	•