Curriculum Map and Pacing
Earth Science – 9th grade

Month	Content Expecations	Instruction *What instructional methods will be used to develop the skills and knowledge?*	Key Vocabulary *Listed as the term is introduced*	Assessmant	Resources (materials used)	Notes
September	• E2.1A Explain why the Earth is essentially a closed system in terms of matter. • E2.1B Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth. • E2.1C Explain, using specific examples, how a change in one system affects other Earth systems. • E2.2B Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy. • E2.2C Describe natural processes in which heat transfer in the Earth occurs by conduction, convection, and radiation. • E2.2e Explain how energy changes form through Earth systems. • *E2.2f Explain how elements exist in different compounds and states as they move from one reservoir to another.* • E2.3A Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans.	• Online learning • Reading/Interpreting • Diagrams of carbon cycle, nitrogen cycle, and water cycle • Global Warming Essay	• atmosphere • biogeochemical cycles • biosphere • carbon • carbon cycle • carbon dioxide • Earth Systems Science • Geosphere • greenhouse gases • hydrosphere • nitrogen cycle	• Online Tests	• Internet	• Online lesson

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	• E2.3b Explain why small amounts of some chemical forms may be beneficial for life but are poisonous in large quantities (e.g., dead zone in the Gulf of Mexico, Lake Nyos in Africa, fluoride in drinking water). • E2.3c Explain how the nitrogen cycle is part of the Earth system. • E2.4A Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits. • E2.4B Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems. • E2.4c Explain ozone depletion in the stratosphere and methods to slow human activities to reduce ozone depletion. • E2.4d Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution. • E5.4A Explain the natural mechanism of the greenhouse effect including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone). • E5.4C Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels and the average global temperature over the past 150 years. • E5.r4j Predict the global temperature increase by 2100, given data on the annual trends of CO2 concentration increase					

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October	• E3.4A Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries. • E3.4B Describe how the sizes of earthquakes and volcanoes are measured or characterized. • E3.4C Describe the effects of earthquakes and volcanic eruptions on humans. • E3.4d Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes. • E3.4e Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems. • E3.4f Explain why fences are offset after an earthquake, using the elastic rebound theory. • E3.2B Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (P) and secondary (S) seismic wave arrivals. • E3.2d Explain the uncertainties associated with models of the interior of the Earth and how these models are validated. • E3.2A Describe the interior of the Earth (in terms of crust, mantle, and inner and outer cores) and where the magnetic field of the Earth is generated.	• Map reading • Data analysis • Earth's Interior Drawings • Earthquake location activities • Profile diagrams of volcanoes depict their shape, size and internal structure.	• Asthenosphere • body waves • continental crust • convection • crust • earthquakes • elastic rebound theory • gravity • inner core • intensity • internal sources of energy • lithosphere • lower mantle • magnetic field • magnitude • modeling • mantle convection • oceanic crust • outer core • plates • P-waves • radioactive decay • reflection • seismology • surface waves • S-waves • thermal energy • upper mantle • volcanoes	• Tests • PowerPoint on Volcanoes & Earthquakes effects on humans	• Geoscience CDs: Volcanoes, Plate Tectonics, Earthquakes • Large Paper for Model	

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November	• E2.2A Describe the Earth's principal sources of internal and external energy (e.g., radioactive decay, gravity, solar energy). • E3.2C Describe the differences between oceanic and continental crust (including density, age, composition). • E3.3A Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface. • E3.3B Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density. • E3.3C Describe the motion history of geologic features (e.g., plates, Hawaii) using equations relating rate, time, and distance. • E3.3d Distinguish plate boundaries by the pattern of depth and magnitude of earthquakes. • E3.r3e Predict the temperature distribution in the lithosphere as a function of distance from the mid-ocean ridge and how it relates to ocean depth. • *E3.r3f Describe how the direction and rate of movement for the North American plate has affected the local climate over the last 600 million years.*	• Plate tectonic maps with symbols of plate boundaries and relative motion arrows.	• chemical composition • continental collision • density • earthquakes • explosivity • magma • mid-ocean ridges • molten rock • mountain belts • mountain ranges • oceanic plates • plate boundaries • plate collision • plate tectonics theory • sea floor spreading • subduction zones • tectonic plates • transform faults	• Tests	• Geoscienc e CDs: Volcanoes, Plate Tectonics, Earthquake s Large Paper for Model	

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December	• E3.4A Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries. • E3.2B Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (P) and secondary (S) seismic wave arrivals. • E3.4B Describe how the sizes of earthquakes and volcanoes are measured or characterized. • E3.4C Describe the effects of earthquakes and volcanic eruptions on humans. • E3.4d Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes. • E3.4e Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems. • E3.4f Explain why fences are offset after an earthquake, using the elastic rebound theory.	• Mineral ID lab • Rock ID lab • Notes with hands on rock/mineral classification • Rock Cycle Diagrams • Discussion (possible research) on rock/mineral uses	• contact metamorphism • cooling • crystallization • deposition • erosion • extrusive • foliation • grain shape • grain size • igneous rocks • intrusive • magma • metamorphic rocks • metamorphism • molten rock • non-foliated texture • plate tectonic context • regional metamorphism • rock cycle • rock sequence • sedimentary rocks • sedimentation • weathering	• Mineral ID lab • Rock ID lab • Tests	• Mineral samples • Rock Samples (Igneous, Sedimentary, Metamorphic) • Eye-clops for crystal structure	

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January	• E4.1A Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability). • E4.1B Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs • E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.	• Water cycle drawings/ models • Michigan Glacier analysis • Groundwater basin discovery (map reading) • Flooding data analysis	• aquifers • freshwater reservoirs • glaciers • groundwater • hydrogeology • hydrosphere • inputs • land use • outputs • recharge • residence times • rivers • streams • surface water lakes • sustainability • water quality • wetlands	• Tests	•	• Semester Exams during this month

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February	• E5.1A Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe. • E5.1b Describe how the Big Bang theory accounts for the formation of the universe. • E5.1c Explain how observations of the cosmic microwave background have helped determine the age of the universe. • E5.1d Differentiate between the cosmological and Doppler red shift. • E5.2A Identify patterns in solar activities (sunspot cycle, solar flares, solar wind). • E5.2B Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances. • E5.2C Describe how nuclear fusion produces energy in the Sun. • E5.2D Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.	• Solar System Models • Sun observation • Data analysis	• auroras • Hertzsprung-Russell (H-R) diagram • life cycle of stars • nuclear fusion • nuclear reactions • power disturbances • radio and satellite communication • release of energy • solar energy • solar flares • solar wind • source of chemical elements • spontaneous nuclear reaction • star composition • star destruction • star equilibrium • star formation • star size • star system • star temperature • star types • stellar energy • stellar evolution • sunspot cycle	• test • solar system / galaxy models	• Riverside Scientific CDs	•

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March	• E5.2e Explain how the Hertzsprung-Russell (H-R) diagram can be used to deduce other parameters (distance). • E5.2f Explain how you can infer the temperature, life span, and mass of a star from its color. Use the H-R diagram to explain the life cycles of stars. • E5.2g Explain how the balance between fusion and gravity controls the evolution of a star (equilibrium). • E5.2h Compare the evolution paths of low-, moderate-, and high-mass stars using the H-R diagram.	• Nigh Sky observations • Sunspot / Magnetic disturbance activity / analysis • Light spectrum demonstration	• age of universe • big bang theory • cosmic background radiation • cosmological red shift • Doppler red shift • expanding universe • light spectrum • Milky Way Galaxy • motion of solar system • nebular cloud • scale of universe • spiral arm • structure of universe	• Sunspot / Magnetic disturbance activity / analysis • Tests	• Telescope • Stellarium • Black light • Diffusion Grating	•

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April	• E5.4B Describe natural mechanisms that could result in significant changes in climate (e.g., major volcanic eruptions, changes in sunlight received by the earth, meteorite impacts). • E5.4D Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere). • E5.4e Based on evidence from historical climate research (e.g., fossils, varves, ice core data) and climate change models, explain how the current melting of polar ice caps can impact the climatic system . • E5.4f Describe geologic evidence that implies climates were significantly colder at times in the geologic record (e.g., geomorphology, striations, and fossils). • E5.4g Compare and contrast the heat-trapping mechanisms of the major greenhouse gases resulting from emissions (carbon dioxide, methane, nitrous oxide, fluorocarbons) as well as their abundance and heat-trapping capacity. • E5.r4h Use oxygen isotope data to estimate paleotemperature. • E5.r4i Explain the causes of short-term climate changes such as catastrophic volcanic eruptions and impact of solar system objects.	• Climate drawings • Climate and biomes comparisons • Predict climates/temperatures/rain fall of cities based on geologic location	• atmospheric change • climatic zones • climate change • climate change models • climate system • coral bleaching • emissions • human industrialization • hydrosphere • ice core • ozone • polar ice caps • shoreline impacts • thermal energy • trapping mechanisms • water vapor	• tests	• internet • weather maps • Riverside Scientific CDs	•

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May/June	• E4.2A Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape. • E4.2B Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO2 reservoir. • E4.2c Explain the dynamics (including ocean-atmosphere interactions) of the El Niño-Southern Oscillation (ENSO) and its effect on continental climates. • E4.2d Identify factors affecting seawater density and salinity and describe how density affects oceanic layering and currents. • E4.2e Explain the differences between maritime and continental climates with regard to oceanic currents. • E4.2f Explain how the Coriolis effect controls oceanic circulation. • *E4.r2g Explain how El Niño affects economies (e.g., in South America).* • E4.3A Describe the various conditions of formation associated with severe weather (thunderstorms, tornadoes, hurricanes, floods, waves, and drought). • E4.3B Describe the damage resulting from and the social impact of thunderstorms, tornadoes, hurricanes, and floods. • E4.3C Describe severe weather and flood safety and mitigation. • E4.3D Describe the seasonal variations in severe weather. E4.3E Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes).	• Weather map analysis • Comparing weather data and predictions from different weather forcust sources. • Twister Essay	• adiabatic cooling • advection • air density • air masses • blizzards • clouds • conduction • convection • convergence • downbursts • drought • flooding • frontal boundaries • frontal wedging • fronts • hail • hurricanes • lightning • maritime climates • precipitation • prevailing winds • severe weather • thunderstorms • tornadoes • UV radiation • waves • wind shear	• Tests • Twister Essay	• Weather maps • Riverside Scientific CDs	• Second Semester Exam prep and test in June