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NGSS	Indiana's Academic Standards 2016 Earth & Space
	ES.1.1 Construct an explanation detailing how space can be studied by observing all frequencies of the electromagnetic radiation with differentiated telescopes and observational tools.
HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe	**ES.1.2** Describe the expanding universe theory, also known as the "Big Bang Theory," based on observed astronomical evidence including: The Doppler Effect, red shift, Hubble's Law, and the cosmic microwave background.
	ES.1.3 Create a diagram, flowchart, or explanation that details the cooling of energy into protons and early elements, and early elements into superstars and galaxies. Explain the role of gravitational attraction in the formation of stars and galaxies from clouds of these early elements.
HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements	**ES.1.4** Differentiate between the life cycles of stars of different masses found on the Hertzsprung-Russell Diagram. Differentiate between low, medium (including our sun), and high mass stars by what elements can be produced, and therefore whether or not they can achieve red giant phase or go supernova.
	ES.1.5 Illustrate the hierarchical relationship and scales of stars, planetary systems including multiple-star systems, star clusters, galaxies and galactic groups in the universe.
	ES.2.1 Construct a flowchart with diagrams and descriptions outlining the nebular theory of solar system formation. Include the formation of one or more stars, planetesimals, protoplanets, Jovian and terrestrial planets, and other objects including satellites and small bodies.

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	ES.2.2 Describe the characteristics of the various kinds of objects in the solar system including planets, satellites, comets, asteroids, and protoplanets. Recognize that planets have been identified orbiting stars other than the sun, or exist outside of solar systems orbiting no sun at all. Describe the organization of our solar system including terrestrial and Jovian planets, asteroid belts, and the Oort Cloud.
HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. **HS-ESS1-3.** Communicate scientific ideas about the way stars, over their life cycle, produce elements	**ES.2.3** Develop a model illustrating the layers and life span of the sun. Explain how nuclear fusion in the core produces elements and energy, which are both retained through convection and released to space, including Earth, through radiation. Additionally, elements heavier than iron cannot form in stars, and form only as a result of supernovae.
HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system	**ES.2.4** Use mathematical and/or computational representations to demonstrate the motions of the various kinds of objects in our solar system including planets, satellites, comets, and asteroids. Explain that Kepler's Laws determine the orbits of those objects and know that Kepler's Laws are a direct consequence of Newton's Law of Universal Gravitation together with his laws of motion.
	ES.2.5 Explain how scientific theory changes over time with the introduction of new information and observational data. Use works from ancient Greeks such as Ptolemy, and other astronomers including Copernicus, Brahe, Kepler, and Galileo to demonstrate the effect of observational data and scientific discussion on our understanding of the mechanics and motion of our solar system.

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	ES.3.1 Create flowcharts that show the exchange of carbon and oxygen between the lithosphere, hydrosphere, biosphere, and atmosphere, including carbon dioxide and methane. Explain how human activities such as farming and industry, temperature change in oceans, and natural processes such as volcanic eruptions can speed or slow the cycling from reservoirs within the solid earth and oceans into the atmosphere.
	ES.3.2 Create diagrams and flowcharts that show the cycling between the lithosphere, hydrosphere, biosphere, and atmosphere for nitrogen. Complete the same for phosphorus, excluding the atmosphere. Explain how human activities can alter the amounts of both phosphorus and nitrogen between these layers.
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	**ES.3.3** Analyze and explain how events on one side of the world can alter temperature and precipitation around the globe. Analyze and explain the possible effects of natural and human-driven processes on our atmosphere and climate.
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*	**ES.3.4** Evaluate the use of sustainable versus nonrenewable resources. Explain the consequences of overuse and continued increased consumption of limited resources. Analyze and evaluate the benefits of researching, designing, and developing sustainable resources for private use and industry.
	ES.4.1 Create a model that shows the composition, distribution, and circulation of gases in Earth's atmosphere. Show how carbon and oxygen cycles affect the composition through gas exchange with organisms, oceans, the solid earth, and industry.

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	ES.4.2 Create models to demonstrate the circulation, retention, and reflection of heat in regards to the atmosphere, solid land, and bodies of water including lakes and oceans. Demonstrate the effects of cities, various terrain, cloud cover, sea ice, and open water on albedo. Examine local and global heat exchanges, including land & sea breezes, lake effects, urban heat islands, and thermohaline circulation.
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity	**ES.4.3** Create a presentation that demonstrates the process of the water cycle on both local and global scales. Illustrate the process of water cycling both from the solid earth to the atmosphere and around the solid earth. Examine the interaction of ground water, surface water, and ocean circulation. Illustrate the effects of human activity on water systems.
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity	**ES.4.4** Create a model to demonstrate how the Coriolis effect influences the global circulation of the atmosphere. Explain how changes in the circulation of the atmosphere and oceans can create events such as El Niño and La Niña.
	ES.4.5 Chart and explain the changes in weather as it relates to humidity, air pressure, and temperature. Explain how these factors result in local wind patterns and cloud cover. Explain the origin, life cycle, and behavior of weather systems, especially severe weather. Create an emergency plan for severe storms, both summer and winter.

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	ES.4.6 Differentiate between weather and climate. Examine long term, natural climate change and periods of glaciation as influenced by Milankovitch Cycles due to the gravity of other solar system bodies (obliquity and precession of axis and eccentricity of orbit). Explain how these are different from any short term (less than thousands of years) changes to climate.
	ES.4.7 Create diagrams or models to demonstrate the effect of the gravitational pull of the sun and moon on Earth's oceans. Explain the difference between daily (high and low) tides and monthly (spring and neap) tides. Explain how monthly tides relate to the revolution of the moon, and therefore its phases.
	ES.5.1 Construct a lab to analyze minerals based on their physical and chemical properties. Explain how rocks may contain many minerals, one mineral, or no minerals, and minerals can be made of either single elements (such as gold) or compounds (such a silicates).
	ES.5.2 Create a rock cycle flowchart or diagram that demonstrates the processes involved in the formation, breakdown, and reformation of igneous, sedimentary, and metamorphic rock. Show how each type can melt and reform igneous rock, undergo the various metamorphic processes, and undergo physical and chemical weathering to form sedimentary rock.
	ES.5.3 Construct a model that demonstrates the difference between weathering, erosion, transportation of material, deposition, and new soil and sedimentary rock formation. Differentiate between types of physical and chemical weathering.

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	ES.5.4 Differentiate between relative and absolute geological time. Detail how sedimentary rock can be dated based on relative-age dating and positioning, while igneous formations can be radiometrically dated. Differentiate between radiocarbon dating used for organic materials and other types of radiometric dating for inorganic rock formation.
	ES.5.5 Create a timeline detailing the processes that have occurred in Indiana to create mostly sedimentary bedrock. Explain how changing sea levels, climate, and glaciation have shaped Indiana geology.
	ES.5.6 Create models or diagrams to show how plate movement and sea level changes have changed continental land masses over time. Include the creation and destruction of inland seas, sedimentary rock formations including evaporites and biochemical formations, and the shaping and destruction of surface features.
	ES.6.1 Construct a diagram or model that identifies and describes the physical and chemical properties of the crust, mantle, outer core, and inner core of Earth.
	ES.6.2 Explain how Earth's fluid outer core creates the magnetosphere and how this helps protect both humans and technology (such as satellites) from solar winds.

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HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks	**ES.6.3** Construct a diagram and explanation showing the convection of Earth's mantle and its impact on the movements of tectonic plates. Explain how the decay of radioactive isotopes and residual energy from Earth's original formation provide the heat to fuel this convective process, which, along with ridge push and slab pull, drive the movements of tectonic plates.
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks	**ES.6.4** Create a timeline to show the development of modern tectonic plate theory. Identify and explain how the evidence from the theory of continental drift, seafloor spreading, and paleomagnetism built upon each other to support tectonic plate theory.
	ES.6.5 Create models that demonstrate different types of orogeny resulting from plate tectonics. Show how the interactions between oceanic and continental plates create different geological features (such as volcanic island arcs or high altitude plateaus) depending on what types of plates are involved in the motions along different plate boundaries.
	ES.6.6 Create models and differentiate between shield, composite, and cinder cone volcanoes. Explain how volcanoes form, how the chemical composition of lava affects the type of volcanoes formed, and how the location (such as hot spots or along continental or oceanic margins) can affect the types of magma present.
	ES.6.7 Use models, diagrams, and captions to explain how tectonic motion creates earthquakes and tsunamis. Using resources such as indianamap.org, analyze how close the school is to known faults and liquefaction potential. Differentiate between intraplate fault zones such as the Wabash Valley Fault System and the more commonly discussed faults along tectonic margins.

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	ES.6.8 Create an action plan detailing what to do in an emergency if an earthquake occurred near the school or home. Detail what should be kept in an earthquake preparation kit, how to prepare homes for earthquake safety, and what actions should be taken during and after an earthquake to ensure personal safety.

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