

EarthComm Correlation to Indiana State Academic Science Standards Grades 9-12

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	G1	G2	G3	U1	U2	U3	F1	F2	F3	N1	N2	N3	E1	E2	E3

Principles of Earth and Space Science

Students investigate, through laboratory and fieldwork, the universe, the Earth, and the processes that shape the Earth. They understand that the Earth operates as a collection of interconnected systems that may be changing or may be in equilibrium. Students connect the concepts of energy, matter, conservation, and gravitation to the Earth, solar system, and universe. Students utilize knowledge of the materials and processes of the Earth, planets, and stars in the context of the scales of time and size.

The Universe

ES.1.1 Understand and discuss the nebular theory concerning the formation of solar systems. Include in the discussion the roles of planetesimals and protoplanets.															XX		
ES.1.2 Differentiate between the different types of stars found on the Hertzsprung-Russell Diagram. Compare and contrast the evolution of stars of different masses. Understand and discuss the basics of the fusion processes that are the source of energy of stars.															XX		
ES.1.3 Compare and contrast the differences in size, temperature, and age between our sun and other stars.															XX		
ES.1.4 Describe Hubble's law. Identify and understand that the "Big Bang" theory is the most widely accepted theory explaining the formation of the universe.															XX		
ES.1.5 Understand and explain the relationship between planetary systems, stars, multiple-star systems, star clusters, galaxies, and galactic groups in the universe.															X		
ES.1.6 Discuss how manned and unmanned space vehicles can be used to increase our knowledge and understanding of the universe.															X		
ES.1.7 Describe the characteristics and 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 the planets.															XX	X	
ES.1.8 Discuss the role of sophisticated technology, such as telescopes, computers, space probes, and particle accelerators, in making computer simulations and mathematical models in order to form a scientific account of the universe.															X		
ES.1.9 Recognize and explain that the concept of conservation of energy is at the heart of advances in fields as diverse as the study of nuclear particles and the study of the origin of the universe.															X	X	

The Earth

ES.1.10 Recognize and describe that the earth sciences address planet-wide interacting systems, including the oceans, the air, the solid earth, and life on Earth, as well as interactions with the Solar System.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
ES.1.11 Examine the structure, composition, and function of the Earth's atmosphere. Include the role of living organisms in the cycling of atmospheric gases.	X							X		X						X	X
ES.1.12 Describe the role of photosynthetic plants in changing the Earth's atmosphere.								X		X							X
ES.1.13 Explain the importance of heat transfer between and within the atmosphere, land masses, and oceans.	X	X	X					X	X	X	X				X	X	X

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ES.1.14 Understand and explain the role of differential heating and the role of the Earth's rotation on the movement of air around the planet.							X	X	X					X	
ES.1.15 Understand and describe the origin, life cycle, behavior, and prediction of weather systems.							X	XX						X	
ES.1.16 Investigate the causes of severe weather, and propose appropriate safety measures that can be taken in the event of severe weather.							X	XX							
ES.1.17 Describe the development and dynamics of climatic changes over time, such as the cycles of glaciation.		X					X	X	XX					X	X
ES.1.18 Demonstrate the possible effects of atmospheric changes brought on by things such as acid rain, smoke, volcanic dust, greenhouse gases, and ozone depletion.	X							X	X					X	
ES.1.19 Identify and discuss the effects of gravity on the waters of the Earth. Include both the flow of streams and the movement of tides.							X					X			
ES.1.20 Describe the relationship among ground water, surface water, and glacial systems.									X			XX			
ES.1.21 Identify the various processes that are involved in the water cycle.							X	X	X			XX			
ES.1.22 Compare the properties of rocks and minerals and their uses.				X							XX				
Processes that Shape the Earth															
ES.1.23 Explain motions, transformations, and locations of materials in the Earth's lithosphere and interior. For example, describe the movement of the plates that make up the crust of the earth and the resulting formation of earthquakes, volcanoes, trenches, and mountains.	XX	XX	XX	XX					X		X			X	X
ES.1.24 Understand and discuss continental drift, sea-floor spreading, and plate tectonics. Include evidence that supports the movement of the plates, such as magnetic stripes on the ocean floor, fossil evidence on separate continents, and the continuity of geological features.	X	XX	X	X											X
ES.1.25 Investigate and discuss the origin of various landforms, such as mountains and rivers, and how they affect and are affected by human activities.				XX	XX	XX		X	X						
ES.1.26 Differentiate among the processes of weathering, erosion, transportation of materials, deposition, and soil formation.				X	X	X		X	XX		X				
ES.1.27 Illustrate the various processes that are involved in the rock cycle, and discuss how the total amount of material stays the same through formation, weathering, sedimentation, and reformation.				XX							X				
ES.1.28 Discuss geologic evidence, including fossils and radioactive dating, in relation to the Earth's past.				X											X
ES.1.29 Recognize and explain that in geologic change, the present arises from the materials of the past in ways that can be explained according to the same physical and chemical laws.	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Historical Perspectives of Earth and Space Science															

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Students gain understanding of how the scientific enterprise operates through examples of historical events. Through the study of these events, they understand that new ideas are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from unexpected findings, and grow or transform slowly through the contributions of many different investigators.

ES.2.1 Understand and explain that Claudius Ptolemy, an astronomer living in the second century, devised a powerful mathematical model of the universe based on constant motion in perfect circles and circles on circles. Further understand that with the model, he was able to predict the motions of the sun, moon, and stars, and even of the irregular "wandering stars" now called planets.																
ES.2.2 Understand that and describe how in the sixteenth century the Polish astronomer Nicholas Copernicus suggested that all those same motions outlined by Ptolemy could be explained by imagining that Earth was turning on its axis once a day and orbiting around the sun once a year. Note that this explanation was rejected by nearly everyone because it violated common sense and required the universe to be unbelievably large. Also understand that Copernicus's ideas flew in the face of belief, universally held at the time, that Earth was at the center of the universe.																
ES.2.3 Understand that and describe how Johannes Kepler, a German astronomer who lived at about the same time as Galileo, used the unprecedented precise observational data of the Danish astronomer Tycho Brahe. Know that Kepler showed mathematically that Copernicus's idea of a sun-centered system worked better than any other system if uniform circular motion was replaced with variable-speed, but predictable, motion along off-center ellipses.													X	X		
ES.2.4 Explain that by using the newly invented telescope to study the sky, Galileo made many discoveries that supported the ideas of Copernicus. Recognize that it was Galileo who found the moons of Jupiter, sunspots, craters and mountains on the moon, the phases of Venus, and many more stars than were visible to the unaided eye.													X			
ES.2.5 Explain that the idea that Earth might be vastly older than most people believed made little headway in science until the work of Lyell and Hutton.				XX						X	X					
ES.2.6 Describe that early in the twentieth century the German scientist Alfred Wegener reintroduced the idea of moving continents, adding such evidence as the underwater shapes of the continents, the similarity of life forms and land forms in corresponding parts of Africa and South America, and the increasing separation of Greenland and Europe. Also know that very few contemporary scientists adopted his theory because Wegener was unable to propose a plausible mechanism for motion.		XX												X		
ES.2.7 Explain that the theory of plate tectonics was finally accepted by the scientific community in the 1960s when further evidence had accumulated in support of it. Understand that the theory was seen to provide an explanation for a diverse array of seemingly unrelated phenomena and there was a scientifically sound physical explanation of how such movement could occur.	X	XX	X												X	

Principles of Environmental Science

Students investigate, through laboratory and fieldwork, the concepts of environmental systems, populations, natural resources, and environmental hazards.

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Environmental Systems															
Env.1.1 Know and describe how ecosystems can be reasonably stable over hundreds or thousands of years. Consider as an example the ecosystem of the Great Plains prior to the advent of the horse in Native American Plains societies, from then until the advent of agriculture, and well into the present.														X	X
Env.1.2 Understand and describe that if a disaster — such as flood or fire — occurs, the damaged ecosystem is likely to recover in stages that eventually result in a system similar to the original one.					X	X		X							
Env.1.3 Understand and explain that ecosystems have cyclic fluctuations such as seasonal changes or changes in population, as a result of migrations.					X	X									
Env.1.4 Understand and explain that human beings are part of Earth's ecosystems and give examples of how human activities can, deliberately or inadvertently, alter ecosystems.					X	X				X	X	X		X	
Env.1.5 Explain how the size and rate of growth of the human population in any location is affected by economic, political, religious, technological, and environmental factors, some of which are influenced by the size and rate of growth of the population.					X									X	
Env.1.6 Describe and give examples about how the decisions of one generation both provide and limit the range of possibilities open to the next generation.				X	X	X				X	X	X	X	X	
Env.1.7 Recognize and explain that in evolutionary change, the present arises from the materials of the past and in ways that can be explained, such as the formation of soil from rocks and dead organic matter.				X	X	X			X	X	X		X	X	X
Env.1.8 Recognize and describe the difference between systems in equilibrium and systems in disequilibrium.	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Env.1.9 Diagram the cycling of carbon, nitrogen, phosphorus, and water.												X		X	
Env.1.10 Identify and measure biological, chemical, and physical factors within an ecosystem.						X								X	X
Env.1.11 Locate, identify, and explain the role of the major Earth biomes and discuss how the abiotic and biotic factors interact within these ecosystems.														X	XX
Env.1.12 Explain the process of succession, both primary and secondary, in terrestrial and aquatic ecosystems.							X							X	XX
Flow of Matter and Energy															
Env.1.13 Understand and describe how layers of energy-rich organic material have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. Recognize that by burning these fossil fuels, people are passing stored energy back into the environment as heat and releasing large amounts of carbon dioxide.				X							XX	X			
Env.1.14 Recognize and explain that the amount of life any environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms.										X					X
Env.1.15 Describe how the chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways.													X		X

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Env.1.16 Cite examples of how all fuels have advantages and disadvantages that society must question when considering the trade-offs among them, such as how energy use contributes to the rising standard of living in the industrially developing nations. However, explain that this energy use also leads to more rapid depletion of Earth's energy resources and to environmental risks associated with the use of fossil and nuclear fuels.										XX						
Env.1.17 Describe how decisions to slow the depletion of energy sources through efficient technology can be made at many levels, from personal to national, and they always involve trade-offs of economic costs and social values.										XX	X					
Env.1.18 Illustrate the flow of energy through various trophic levels of food chains and food webs within an ecosystem. Describe how each link in a food web stores some energy in newly made structures and how much of the energy is dissipated into the environment as heat. Understand that a continual input of energy from sunlight is needed to keep the process going.							X			XX						
Populations																
Env.1.19 Demonstrate and explain how factors such as birth rate, death rate, and migration rate determine growth rates of populations.																X
Env.1.20 Demonstrate how resources, such as food supply, influence populations.				X	X	X										X
Natural Resources																
Env.1.21 Differentiate between renewable and nonrenewable resources, and compare and contrast the pros and cons of using nonrenewable resources.				X	X	X	X		X	XX	XX	XX				
Env.1.22 Demonstrate a knowledge of the distribution of natural resources in the U.S. and the world, and explain how natural resources influence relationships among nations.				X	X					XX	XX	XX				
Env.1.23 Recognize and describe the role of natural resources in providing the raw materials for an industrial society.				X	X	X	X			XX	XX	XX				
Env.1.24 Give examples of the various forms and uses of fossil fuels and nuclear energy in our society.										XX	X					
Env.1.25 Recognize and describe alternative sources of energy provided by water, the atmosphere, and the sun.							X			XX	XX	XX	X	X		
Env.1.26 Identify specific tools and technologies used to adapt and alter environments and natural resources in order to meet human physical and cultural needs.				X	X	X				X	X			X		
Env.1.27 Understand and describe the concept of integrated natural resource management and the values of managing natural resources as an ecological unit.				X	X	X	X		X	XX	XX	XX				
Env.1.28 Understand and describe the concept and the importance of natural and human recycling in conserving our natural resources.				X	X	X				XX	XX	XX				
Env.1.29 Recognize and describe important environmental legislation, such as the Clean Air Act and the Clean Water Act.					X					X		X				
Environmental Hazards																
Env.1.30 Describe how agricultural technology requires trade-offs between increased production and environmental harm and between efficient production and social values.					X	X				X	X	X				

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Env.1.31 Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost. Also understand also that waste management requires social and technological innovations because waste-disposal problems are political and economic as well as technical.				X	X	X				X	X	X			
Env.1.32 Understand and describe how nuclear reactions release energy without the combustion products of burning fuels, but that the radioactivity of fuels and by-products poses other risks which may last for thousands of years.										X					
Env.1.33 Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people.	X		X		X			X		X	X				
Env.1.34 Differentiate between natural pollution and pollution caused by humans and give examples of each.										X	X	X			
Env.1.35 Compare and contrast the beneficial and harmful effects of an environmental stressor, such as herbicides and pesticides, on plants and animals. Give examples of secondary effects on other environmental components.												X		X	X