

# Correlation to Arkansas Science Curriculum Framework: Physical Systems

## Introduction to Earth and Space Science

### Student Text and Investigation Manual

Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
ES.1.01 Earth/Space Systems	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Understand that science is a process based on the scientific method which leads to a deeper understanding of real world situations.	3	what is temperature	18	investigating the effect of greenhouse gases
				92	forming a hypothesis and testing through experimentation (#5)	21	investigating how specific heat of water regulates Earth's temperature
				92	describe steps you would take to determine how pH affects frog population	22	analyzing data
				176	identify question, hypothesis, procedure, and results (#1)	24	developing a hypothesis
						27	determining whether distance from light source or axial tilt plays a more significant role in causing the seasons
						4	conducting investigation of efficiency of immersion heater
						43	analyzing results and drawing conclusions
						44	simulating the effect of acid rain on daphnia
						6	effect of changing mass on collected data
						61	develop a research plan for studying volcanoes
						9	conducting experiments on heat transfer

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ES.1.02 Earth/Space Systems	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Follow procedures for a scientific inquiry using step-by-step instructions, mathematical formulas, flow diagrams, and/or sketches.	11 92 176 219	heat equation forming a hypothesis and testing through experimentation (#5) identify question, hypothesis, procedure, and results (#1) inverse square law	12 18 22 24 3 30 43 81	writing a procedure for constructing a pointer for an aneroid barometer investigating the effect of greenhouse gases analyzing data developing a hypothesis find equation for trend line develop a procedure to create an underwater spring analyzing results and drawing conclusions inverse square law

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
ES.1.03 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Develop and implement a workable scientific inquiry independently and with a group using standard safety procedures.	4	featured throughout CPO Science program  safety caution on heating jar	18 2 21 26 32 4 4 42 44 44 57 8 80 9 vi	safety in greenhouse gas investigation thermometer safety investigating how specific heat of water regulates Earth's temperature safety using light bulbs safety in swinging thermometers heat safety conducting investigation of efficiency of immersion heater safety tip for water testing simulating the effect of acid rain on daphnia safety tips for observing Daphnia identifying how the earthquake model represents an earthquake heat safety safety in lab conducting experiments on heat transfer safety in the laboratory

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ES.1.04 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Evaluate the process that scientists use to construct and validate scientific theory, such as data collection, prediction, experimentation (controls and variables), bias elimination, and replication.	38 79 204 204 226	observing an aurora making observations and asking questions use the data to answer the questions what evidence was used to predict the existence of the Kuiper Belt? analysis with a spectrometer (#4)	15 17 18 20 22 26 27 33 44 6	collecting Schönbein strips for detecting ozone predicting areas with high ozone concentration based on your data collecting data of temperature and sensations predicting what would happen if you place your ice/water test tube into a hot cup or a cold cup collecting temperature and time data collecting qualitative data of light intensity at scale distance from the sun determining whether distance from light source or axial tilt plays a more significant role in causing the seasons collecting wet and dry bulb temperature readings observing daphnia and recording movements and behavior effect of changing mass on collected data

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						63	estimating the number of meteor collisions on Earth during the last 3.5 billion years
						66	predicting the results of the crystal-growing experiment
						67	recording observations of crystal growing
						75	recording the changes in the moon over a month

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
ES.1.05 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Make objective observations and perform error analysis on collected data.	28	atmospheric pressure at various altitudes graph	13	calculating error between your barometer and a commercial barometer
				37	what percentage comes from this source? (problem 4)	15	importance of good record keeping in order to avoid error
				38	observing an aurora	15	collecting Schönbein strips for detecting ozone
				79	making observations and asking questions	18	collecting data of temperature and sensations
				117	determining distance to an epicenter	33	determining relationship between temperature of the atmosphere and relative humidity
				121	what explains the difference in density? (#5)	34	interpreting Doppler radar images
				152	Moh's hardness scale	61	finding a pattern of volcanoes on a bathymetric map
				179	how big is Earth?	67	recording observations of crystal growing
				219	apparent brightness vs. distance graph	75	recording the changes in the moon over a month
				225	arrange the items in the table (#3)		
				225	use the diagram to answer the questions (#4)		
				225	use the diagram to answer the questions (#2)		

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ES.1.06 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Formulate valid conclusions.	31 34 67 87	effects of CFC's on the ozone layer effects of burning fossil fuels permafrost impact of increased CO2 in oceans	40	predict the quality of surface water to be tested and justify your answer
ES.1.07 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Communicate and defend in writing a scientific argument.		featured throughout CPO Science program	41 43 45	create water quality report write paragraph to explain results write summary of findings

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ES.1.08 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Critique and interpret scientific data on charts and graphs.	28	atmospheric pressure at various altitudes graph	13	constructing a graph from atmospheric pressure data
				152	Moh's hardness scale	19	graphing water and ice temperature readings
				219	apparent brightness vs. distance graph	22	constructing a graph of time vs. temperature
				225	arrange the items in the table (#3)	3	construct a graphical model
				225	use the diagram to answer the questions (#4)	33	determining relationship between temperature of the atmosphere and relative humidity
				225	use the diagram to answer the questions (#2)	34	interpreting Doppler radar images
						47	constructing a graph of drops of acid vs pH
						5	construct a temperature vs. time graph
						61	finding a pattern of volcanoes on a bathymetric map

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ES.1.09 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Recognize that theories are models and may be revised when new data is introduced.	11 37 46 70 98 107 150 188 198 219	heat equation computer modeling to predict greenhouse effects modeling air currents create a model (#1) model of Earth's history modeling plate boundaries rock cycle model solar system modeling model of the sun's anatomy inverse square law	13 18 19 22 28 3 3 47 5 56 81 82	constructing a graph from atmospheric pressure data modeling the effect of greenhouse gases on Earth's temperature graphing water and ice temperature readings constructing a graph of time vs. temperature modeling underwater rivers and waterfalls and springs find equation for trend line construct a graphical model constructing a graph of drops of acid vs pH construct a temperature vs. time graph construct a model that simulates an earthquake inverse square law setting up a scale model of the solar system

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ES.1.10 Earth/Space System	9-12	Students will demonstrate an understanding of the inquiry process through the study of Earth and space systems.	Understand the criteria for the formation of scientific theory and a scientific law.	95 98 102 103 137 140 185 186 221	relative dating and modern geology based on Steno's theories Kelvin's calculations of Earth's age theory of plate tectonics critiquing Wegener's theories of continental drift Darwin's theories of the Andes formation what causes ice ages theories of origin of the moon early theories of the solar system Big Bang theory		
ES.2.01 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Evaluate the historical and multicultural contributions to the scientific body of knowledge in the earth and space sciences. Topics may include expanding universe, plate tectonics, composition of the Earth and stars, and geologic time.	102 103 103 106 186 222	plate tectonic theory development history of continental drift theory continental drift theory development plate tectonic theory changing ideas about the solar system development of Big Bang theory	54	investigate plate tectonics

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ES.2.02 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Understand that the sun is the source of energy for the solar system.	187	explanation and illustration of the solar system	82	setting up a scale model of the solar system
				188	relative sizes and distances within the solar system	83	determining scale distances for the planets
				189	classifying the planets	84	determining scale sizes of the planets
				198	features and diagram of the sun		
				199	features and emissions of the sun		

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ES.2.03 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Explain how Earth's energy and materials are conserved, interrelated, and recycled; include ores, and the following cycles-- Water, oxygen, carbon, and nitrogen.	23 34 49 77 78 81 83 142 147 149	nitrogen cycle changes to the oceans due to increasing global temperatures water in the atmosphere affects weather patterns water quality standards importance of water analysis effects of acid rain on natural environments illustration of acid rain formation how urban sprawl changes local climate formation of igneous and sedimentary and metamorphic rocks identifying igneous and sedimentary and metamorphic rocks	40 66 68 70 71	actions to take to improve water quality understanding how igneous rocks are formed and growing crystals to investigate their formation understanding how sedimentary rocks are formed and creating sedimentary deposits to investigate them understanding and investigating how metamorphic rocks are formed interpreting how different rock formations were formed
ES.2.04 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Explain the features of the Earth's composition and geological phenomena. Utilize the plate tectonics, the continental drift, and the sea-floor spreading theories.	102 104 105 106	definition of plate tectonics sea-floor spreading and mid-ocean ridges magnetic patterns on the sea floor theory of plate tectonics	52	listing which kind of plate boundary is associated with each geologic feature

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ES.2.05 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Analyze the composition and categorize types of rocks and minerals. Use Moh's Hardness Scale and the rock cycle.	128 133 135 144 145 146 147 149	properties of volcanically formed rock types of volcanic rock describing volcanic rock properties of minerals common minerals Mohs hardness scale formation of igneous and sedimentary and metamorphic rocks identifying igneous and sedimentary and metamorphic rocks	61 66 68 70 71	examining the magma chemistry of volcanoes and how it relates to a volcano's location understanding how igneous rocks are formed and growing crystals to investigate their formation understanding how sedimentary rocks are formed and creating sedimentary deposits to investigate them understanding and investigating how metamorphic rocks are formed interpreting how different rock formations were formed
ES.2.06 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Perform chemical analysis and classification of soil samples (pH or NPK).	81 136 139 150	effects of acid rain on the soil constructive and destructive processes formation of soil the rock cycle		

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ES.2.07 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Examine origins of the natural land divisions of Arkansas in view of the earth formations (soil and rock) peculiar to that division.		featured in ancillary component		
ES.2.08 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Investigate the characteristics of oceans such as composition, features, waves, and energy transfer resulting from the currents.	48	descriptions of ocean currents and their effects on climate	23	research how large bodies of water affect climate
				62	different types of deserts and how they are formed	28	investigate how the ocean's salinity affects its density
				63	how tropical rainforests are formed	31	understanding the Atlantic gyre
				84	supply of water to oceans	39	research a particular biome
				85	sources of salts in the ocean	52	listing which kind of plate boundary is associated with each geologic feature
				86	composition of seawater		
				104	sea-floor spreading and mid-ocean ridges		
				105	magnetic patterns on the sea floor		

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ES.2.09 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Evaluate the physical interactions of water with the Earth (glaciers, erosion, and leaching).	98	table and description of the geologic time scale	54	predicting plate movement over 50 million years and the resultant land features
				102	predicting what Earth might look like in 50 million years		
				108	land features resulting from divergent plate boundaries		
				109	resulting land features from subduction		
				110	land features resulting from transform plate boundaries		
				121	predict separation of North America and Europe in 75 million years		
				122	predict effects of divergent plate boundaries on Great Rift Valley		
				137	mountain-building		
				138	landforms shaped by water		
				138	changes in land features due to erosion		
				140	ice ages		
				140	effect of glaciers on land		

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ES.2.10 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Evaluate weather and climate, globally and locally, as a result of a complex exchange of heat energy (clouds, solar radiation, ocean currents, gases, Coriolis effect, human activities, jet stream, El Nino, ect).	33	greenhouse conditions on Earth	25	investigating factors which cause the seasons
				37	research the density of Venus' and Mars' atmospheres	29	exploring how temperature-dependent layering creates currents
				37	Earth's internal energy	35	use radar to detect a tornado
				44	Earth's tilt causes seasons	36	using radar to track a hurricane
				45	convection currents in the atmosphere	39	research a particular biome
				47	global wind patterns		
				49	factors which influence the weather		
				49	water in the atmosphere affects weather patterns		
				51	cloud formation		
				54	effects of moving air masses		
				54	cold fronts		
				55	warm fronts		
				55	jet streams		
				57	description of thunderstorms		
				58	description of hurricanes		
				59	description of tornadoes		
				62	different types of deserts and how they are formed		

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				63	how tropical rainforests are formed		
				70	create a model to explain why Earth has seasons		
				189	greenhouse conditions on Venus		

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ES.2.11 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Given measurements of weather conditions, relate them to the temperature, pressure, density, ideal gas law, and buoyancy of air.	3	thermometers	10	construct and use an aneroid barometer
				4	thermometers	2	accurately measuring temperature using thermometers
				25	definition of atmospheric pressure	29	exploring how temperature-dependent layering creates currents
				26	measuring atmospheric pressure with barometers	33	finding relative humidity
				27	how atmospheric pressure changes with altitude	34	using Doppler radar images to detect and track storms
				28	graph showing atmospheric pressure vs. altitude	35	use radar to detect a tornado
				32	distribution of incoming solar radiation	36	using radar to track a hurricane
				32	transfer of energy in and out of Earth's atmosphere		
				33	Earth's "energy budget"		
				33	greenhouse conditions on Earth		
				37	research the density of Venus' and Mars' atmospheres		
				45	convection currents in the atmosphere		
				47	global wind patterns		
				49	factors which influence the weather		
				49	slingshot psychrometer		

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				50	phase changes in the atmosphere and dewpoint		
				51	cloud formation		
				53	forms of precipitation		
				54	cold fronts		
				54	effects of moving air masses		
				55	warm fronts		
				55	jet streams		
				57	description of thunderstorms		
				58	description of hurricanes		
				59	description of tornadoes		
				189	greenhouse conditions on Venus		

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ES.2.12 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Interpret the features on weather maps and predict future conditions.	37	computer modeling to predict greenhouse effects	23	research how large bodies of water affect climate
				43	Earth's temperature varies with latitude		
				48	effects of the Gulf Stream on climate of Great Britain		
				62	effect of cold ocean currents on formation of fog desserts		
				63	effect of warm ocean currents on formation of tropical rainforest		
				65	effect of large bodies of water on climate		
				67	alpine tundra occurs at high altitudes		
				222	the Doppler effect		

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ES.2.13 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Compare Earth's sun to other stars in size, mass, temperature, energy source, position on HR diagram, and stages in a star's existence.	165	characteristics of the universe	82	setting up a scale model of the solar system
				187	explanation and illustration of the solar system	83	determining scale distances for the planets
				188	relative sizes and distances within the solar system	84	determining scale sizes of the planets
				189	classifying the planets		
				196	descriptions of the sun and comparisons to other stars		
				198	features and diagram of the sun		
				199	features and emissions of the sun		
				207	what is a star?		
				209	size of the sun compare to other stars		
				211	H-R diagrams comparing temperature and brightness of stars		
				215	the existence of other planetary systems		
				216	what is a galaxy?		
				226	research and describe astronomical objects		

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ES.2.14 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Locate common constellations.	207 209 210 217	the appearance of constellations in the night sky differences in colors of stars is related to their temperatures brightness of stars' appearance the appearance of the disk of the Milky Way in the night sky	75	tracking the moon's phases in the night sky
ES.2.15 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Describe the organization of the known universe (solar system, galaxy, cluster, supercluster).	165 207 216 226	characteristics of the universe what is a star? what is a galaxy? research and describe astronomical objects		

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ES.2.16 Earth/Space System	9-12	Students will explore, demonstrate, communicate, apply and evaluate knowledge of the properties of Earth and space Systems.	Analyze the impact of modern technology on the study of the Earth and universe (telescopes, space probes, robotic arms, weather satellites, Doppler radar, sonar, seismographs).	168 169 170 171 172 208	history of the telescope types and uses of telescopes types and uses of telescopes satellites as tools of astronomy spacecraft as tools of astronomy the use of spectroscopy to analyze stars	88 92	understand why spectroscopy is an important tool of astronomers measuring apparent brightness to calculate the distance to stars and galaxies
ES.3.01 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Analyze the role science plays in every day life and compare different careers in the Earth/space sciences.	122	describe the work of a geologist and paleontologist and seismologist		

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ES.3.02 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Evaluate long range plans for resource use and by-product disposal in terms of environmental, economic and political impact (human activities vs. resource quality).	31	effects of CFC's on the ozone layer	17	research the causes of ozone in the lower atmosphere
				34	effects of burning fossil fuels	40	predict the quality of surface water to be tested and justify your answer
				56	temperature inversion		
				67	permafrost		
				76	water cycle and conservation	40	predict the quality of surface water to be tested and justify your answer
				77	The Clean Water Act		
				77	wise use of water	40	wise use of water supply
				79	water usage and quality	41	address what you can do to maintain or improve the water quality at the test site
				79	water quality testing		
				80	effect of excess nitrates on environment		
				80	water quality testing	41	maintaining water supply quality
				81	acid rain	42	save water for houseplants
				81	acid rain		
				81	acid rain explained	42	perform water quality tests
				82	causes and health effects of acid rain	44	investigate effect of acid rain on microorganisms
				87	impact of increased CO2 on oceans	44	the effects of acid rain on organisms in aquatic environments
				87	impact of increased CO2 on oceans		
				87	impact of increased CO2 in oceans	44	the effects of acid rain on organisms in aquatic environments

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				88	pollution and the ocean food chain		
				89	pollution and the ocean food chain		
				92	research economic impact of producing gases that cause acid rain		
				92	research the issue of acid rain		
ES.3.03 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Assess current world issues applying scientific themes (e.g., global changes in climate, ozone depletion, UV radiation, natural resources, use of technology, and public policy).	23	nitrogen cycle	18	investigate the temperature effects of greenhouse gases
				31	effects of CFC's on the ozone layer	40	predict the quality of surface water to be tested and justify your answer
				33	greenhouse effect and greenhouse gasses	40	actions to take to improve water quality
				34	effects of burning fossil fuels	44	investigate effect of acid rain on microorganisms
				67	permafrost	47	effect of ocean on carbon dioxide levels in the atmosphere
				81	effects of acid rain on natural environments		
				81	acid rain explained		
				87	impact of increased CO2 in oceans		
				92	research the issue of acid rain		

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ES.3.04 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Understand that mathematics is the precise language of communication and problem solving in science.	11 219	featured throughout CPO Science program heat equation inverse square law	3 81	find equation for trend line inverse square law
ES.3.05 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Apply technology as appropriate tools for solving problems (electronic balances, computers, digital cameras, pH meters, spectrophotometers , telescopes, barometers, ect.).	49 168	sling psychrometer telescopes	10 2 26 32 34 4 52 76 8	aneroid barometer use a thermometer use a multimeter and solar cell use a sling psychrometer Doppler radar use a thermometer and immersion heater reading a bathymetric map using a telescope use a timer and thermometer

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ES.3.06 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Assess the connections between pure science and applied science to the world of work by performing labs and activities common to the Earth/space sciences.			10 14 21 25 4 40 44 57 76 9	design and construct an aneroid barometer making qualitative observations of the amount of ozone present in the school environment investigating how specific heat of water regulates Earth's temperature measuring the intensity of light using an electric meter and solar cell and light bulb conducting investigation of efficiency of immersion heater visit local water supply and perform testing simulating the effect of acid rain on daphnia identifying how the earthquake model represents an earthquake identifying the parts of a refracting telescope and making observations of the moon's surface conducting experiments on heat transfer

**Correlation to Arkansas Science Curriculum Framework: Physical Systems**  
***Introduction to Earth and Space Science***  
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ES.3.07 Earth/Space System	9-12	Students will demonstrate an understanding of the connections and applications of Earth/space systems.	Understand broad themes of Project 2061. Such themes include systems, patterns of change, interactions, energy equilibrium, models, and scale (relative dimensions such as solar system size).	12 73 79 82	thermal equilibrium the water cycle pond ecosystem and water quality acid rain formation system		