

**Correlation to Utah Science Core Curriculum**  
***Foundations of Physical Science with Earth and Space Science***  
**Student Text and Investigation Manual**

<b>Standard #: Curriculum</b>	<b>Standard</b>	<b>Objective</b>	<b>Indicator</b>	<b>Volume 1 Student Text Page</b>		<b>Volume 2 Investigation Manual Page</b>	
ess.I.1.a Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Describe the big bang theory and evidence supporting it.	Determine the motion of a star relative to Earth based on a red or blue shift in the wavelength of light from the star.	639	death of small to medium stars results in white dwarfs and planetary nebula and black dwarfs	264	using spectroscopy to analyze the light emitted by stars and identify most common elements
				640	death of massive stars results in supernovas and neutron stars and black holes		
				648	evidence for the Big Bang theory		
				649	evidence for the Big Bang theory		
ess.I.1.b Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Describe the big bang theory and evidence supporting it.	Explain how evidence of red and blue shifts is used to determine whether the universe is expanding or contracting.	639	death of small to medium stars results in white dwarfs and planetary nebula and black dwarfs	264	using spectroscopy to analyze the light emitted by stars and identify most common elements
				640	death of massive stars results in supernovas and neutron stars and black holes		
				648	evidence for the Big Bang theory		
				649	evidence for the Big Bang theory		

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ess.I.1.c Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Describe the big bang theory and evidence supporting it.	Describe the big bang theory and the red shift evidence that supports this theory.	648	evidence for the Big Bang theory	268	calculating the distance to stars and galaxies using apparent brightness and absolute brightness
ess.I.1.d Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Describe the big bang theory and evidence supporting it.	Investigate and report how science has changed the accepted ideas regarding the nature of the universe throughout history.	611	historical theories of the origin of the moon		
				612	historical theories about the solar system		
				621	historical theories of which objects were planets		
				647	the Big Bang theory of the origin of the universe		
ess.I.1.e Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Describe the big bang theory and evidence supporting it.	Provide an example of how technology has helped scientists investigate the universe.	594	history of the telescope	264	understand why spectroscopy is an important tool of astronomers
				595	types and uses of telescopes		
				596	types and uses of telescopes	268	measuring apparent brightness to calculate the distance to stars and galaxies
				597	satellites as tools of astronomy		
				598	spacecraft as tools of astronomy		
				634	the use of spectroscopy to analyze stars		

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ess.I.2.a Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Relate the structure and composition of the solar system to the processes that exist in the universe.	Compare the elements formed in the big bang (hydrogen, helium) with elements formed through nuclear fusion in stars.	640 640	death of massive stars birth of elements	
ess.I.2.b Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Relate the structure and composition of the solar system to the processes that exist in the universe.	Relate the life cycle of stars of various masses to the relative mass of elements produced.	638 639 640	the life cycle of stars description and illustration of the life cycle of stars elements formed by nuclear fusion in stars	255 observe and describe the appearance of the moon and Jupiter and its moons
ess.I.2.c Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Relate the structure and composition of the solar system to the processes that exist in the universe.	Explain the origin of the heavy elements on Earth (i.e., heavy elements were formed by fusion in ancient stars).	640 640	death of massive stars birth of elements	

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ess.I.2.d Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Relate the structure and composition of the solar system to the processes that exist in the universe.	Present evidence that the process that formed Earth's heavy elements continues in stars today.	638	the life cycle of stars	255 observe and describe the appearance of the moon and Jupiter and its moons
				639	description and illustration of the life cycle of stars	
				640	elements formed by nuclear fusion in stars	
				640	death of massive stars	
				640	birth of elements	
ess.I.2.e Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Relate the structure and composition of the solar system to the processes that exist in the universe.	Compare the life cycle of the sun to the life cycle of other stars.	615	classifying the planets	
				624	features and diagram of the sun	
				625	features and emissions of the sun	

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ess.I.2.f Earth Systems Science	Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.	Relate the structure and composition of the solar system to the processes that exist in the universe.	Relate the structure of the solar system to the forces acting upon it.	612	Johannes Kepler	256	simulate an object in orbit and investigate how orbital period varies within distance
				612	orbits of planets around the sun		
				613	Kepler's elliptically shaped orbits	258	setting up a scale model of the solar system
				613	explanation and illustration of the solar system	259	determining scale distances for the planets
				614	relative sizes and distances within the solar system	260	determining scale sizes of the planets
				616	classifying the planets		
				617	classifying the planets		
				618	comparing properties of the planets		
				619	asteroids and comets		
				620	meteors and meteorites and the Kuiper Belt		
621	is Pluto a planet						

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ess.II.1.a Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Describe the unique physical features of Earth's environment that make life on Earth possible.	Compare Earth's atmosphere, solar energy, and water to those of other planets and moons in the solar system.	472	comparison of Earth's atmosphere to other planets	256	simulate an object in orbit and investigate how orbital period varies within distance
				612	Johannes Kepler		
				612	orbits of planets around the sun		
				613	Kepler's elliptically shaped orbits		
				615	what makes Earth capable of supporting life		
				619	asteroids and comets		
				620	meteors and meteorites and the Kuiper Belt		
ess.II.1.b Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Describe the unique physical features of Earth's environment that make life on Earth possible.	Compare the conditions that currently support life on Earth to the conditions that exist on other planets in the solar system.	472	comparison of Earth's atmosphere to other planets		
				615	what makes Earth capable of supporting life		

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ess.II.1.c Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Describe the unique physical features of Earth's environment that make life on Earth possible.	Evaluate evidence for existence of life in other star systems, planets, or moons, either now or in the past.	641 the existence of other planetary systems	

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ess.II.2.a Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Analyze how ecosystems differ from each other due to abiotic and biotic factors.	Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.	436	nitrates and the nitrogen cycle	178	actions to take to improve water quality
				437	effects of acid rain on natural environments	198	detecting ozone which is a protective atmosphere gas against high energy radiation
				440	oceans in the water cycle		
				471	composition of Earth's atmosphere	217	finding relative humidity
				471	nitrogen cycle diagrammed		
				471	nitrogen cycle		
				472	the carbon cycle explained		
				477	ozone layer		
				479	ozone depletion		
				480	distribution of incoming solar radiation		
				481	Earth's "energy budget"		
				498	phase changes in the atmosphere and dewpoint		
				501	forms of precipitation		
				559	volcanoes and water vapor		

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ess.II.2.b Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Analyze how ecosystems differ from each other due to abiotic and biotic factors.	Observe and list biotic factors (e.g., plants, animals, organic matter) that affect a specific ecosystem (e.g., wetlands, deserts, aquatic).	509	descriptions and distribution of desert biomes	
				511	descriptions and distribution of tropical rainforest biomes	

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ess.II.2.c Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Analyze how ecosystems differ from each other due to abiotic and biotic factors.	Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.	414	effect of electrical generating facilities on dissolved oxygen in water	178	actions to take to improve water quality
				436	nitrates and the nitrogen cycle	178	predict the quality of surface water to be tested and justify your answer
				437	effects of acid rain on natural environments		
				439	illustration of acid rain formation		
				443	impact of increased CO <sub>2</sub> in oceans		
				471	nitrogen cycle diagrammed		
				471	nitrogen cycle		
				472	the carbon cycle explained		
				479	effects of CFC's on the ozone layer		
				482	effects of burning fossil fuels		
				482	changes to the oceans due to increasing global temperatures		
				509	descriptions and distribution of desert biomes		
				511	descriptions and distribution of tropical rainforest biomes		
				515	permafrost		

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				568 how urban sprawl changes local climate	
ess.II.2.d Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Analyze how ecosystems differ from each other due to abiotic and biotic factors.	Explain that energy enters the vast majority of Earth's ecosystems through photosynthesis, and compare the path of energy through two different ecosystems.	480 distribution of incoming solar radiation 481 Earth's "energy budget" 509 descriptions and distribution of desert biomes 511 descriptions and distribution of tropical rainforest biomes	

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ess.II.2.e Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Analyze how ecosystems differ from each other due to abiotic and biotic factors.	Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).	411	effects of PCB's in Great Lakes	178	predict the quality of surface water to be tested and justify your answer
				414	effect of electrical generating facilities on dissolved oxygen in water	178	predict the quality of surface water to be tested and justify your answer
				433	The Clean Water Act	179	address what you can do to maintain or improve the water quality at the test site
				435	water quality testing	182	investigate effect of acid rain on microorganisms
				436	water quality testing	182	the effects of acid rain on organisms in aquatic environments
				437	effects of acid rain on the soil		
				437	acid rain		
				437	acid rain explained		
				439	illustration of acid rain formation		
				443	impact of increased CO2 in oceans		
				443	impact of increased CO2 on oceans		
				444	pollution and the ocean food chain		
				445	pollution and the ocean food chain		
				448	research the issue of acid rain		
				479	effects of CFC's on the ozone layer		
				482	changes to the oceans due to increasing global temperatures		

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				482 effects of burning fossil fuels 515 permafrost 568 how urban sprawl changes local climate	

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ess.II.2.f Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Analyze how ecosystems differ from each other due to abiotic and biotic factors.	Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.	411	effects of PCB's in Great Lakes	178	actions to take to improve water quality
				414	effect of electrical generating facilities on dissolved oxygen in water	178	predict the quality of surface water to be tested and justify your answer
				433	The Clean Water Act	178	predict the quality of surface water to be tested and justify your answer
				435	water quality testing	179	address what you can do to maintain or improve the water quality at the test site
				436	nitrates and the nitrogen cycle	182	the effects of acid rain on organisms in aquatic environments
				436	water quality testing	182	the effects of acid rain on organisms in aquatic environments
				437	acid rain		
				437	acid rain		
				437	effects of acid rain on the soil		
				437	effects of acid rain on natural environments		
				438	causes and health effects of acid rain		
				439	illustration of acid rain formation		
				443	impact of increased CO2 on oceans		
				443	impact of increased CO2 on oceans		
				443	impact of increased CO2 in oceans		
				444	pollution and the ocean food chain		

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				445	
					pollution and the ocean food chain
				471	nitrogen cycle
				471	nitrogen cycle diagrammed
				472	the carbon cycle explained
				479	effects of CFC's on the ozone layer
				482	effects of burning fossil fuels
				482	changes to the oceans due to increasing global temperatures
				504	temperature inversion
				515	permafrost
				568	how urban sprawl changes local climate
				568	environmental impact of urban sprawl

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ess.II.3.a Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Examine Earth's diversity of life as it changes over time.	Observe and chart the diversity in a specific area.	509	descriptions and distribution of desert biomes	
				511	descriptions and distribution of tropical rainforest biomes	
ess.II.3.b Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Examine Earth's diversity of life as it changes over time.	Compare the diversity of life in various biomes specific to number of species, biomass, and type of organisms.	509	descriptions and distribution of desert biomes	
				511	descriptions and distribution of tropical rainforest biomes	

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ess.II.3.c Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Examine Earth's diversity of life as it changes over time.	Explain factors that contribute to the extinction of a species.	523 524 524 566 619	faunal succession extinction of the dinosaurs due to giant meteor hitting Earth table and description of the geologic time scale ice ages how an asteroid event may have caused the extinction of dinosaurs	
ess.II.3.d Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Examine Earth's diversity of life as it changes over time.	Compare evidence supporting various theories that explain the causes of large-scale extinctions in the past with factors causing the loss of species today.	524 566	table and description of the geologic time scale ice ages	

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ess.II.3.e Earth Systems Science	Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.	Examine Earth's diversity of life as it changes over time.	Evaluate the biological, esthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.	333	problems with disposing of plastics	163	economic impact of end-product of combustion reaction
				355	recycling tires	163	too much CO <sub>2</sub>
				356	recycling discarded tires	163	consider a vehicle's fuel economy
				364	petroleum	163	research how trees offset accumulation of CO <sub>2</sub>
				368	limiting reactants	163	research how trees offset accumulation of CO <sub>2</sub>
				379	research economic impact of fuel cells	163	research how trees offset accumulation of CO <sub>2</sub>
				379	research environmental impact of fuel cells	163	can trees compensate for manmade CO <sub>2</sub> from vehicles and industry?
				379	hydrogen-powered cars and the environment	164	perform water quality tests
				379	research fuel cells	178	wise use of water supply
				392	storage of nuclear waste	179	maintaining water supply quality
				395	fossil fuels	180	save water for houseplants
				400	economic impact of reducing air pollution	180	perform water quality tests
				400	economic impact of pollution	182	investigate effect of acid rain on microorganisms
				400	problems caused by airborne pollutants	201	research the causes of ozone in the lower atmosphere
				414	effect of electrical generating facilities on dissolved oxygen in water		
				432	water cycle and conservation		
				433	wise use of water		

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				435 water usage and quality 436 effect of excess nitrates on environment 437 acid rain explained 448 research the issue of acid rain 448 research economic impact of producing gases that cause acid rain	
ess.III.1.a Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Explain the evidence that supports the theory of plate tectonics.	Define and describe the location of the major plates and plate boundaries.	533 describing plate boundaries 534 divergent plate boundaries 535 convergent plate boundaries 536 transform plate boundaries	229 identifying tectonic plates and plate boundaries

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ess.III.1.b Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Explain the evidence that supports the theory of plate tectonics.	Compare the movement and results of movement along convergent, divergent, and transform plate boundaries.	528	definition of plate tectonics	228 listing which kind of plate boundary is associated with each geologic feature
				530	sea-floor spreading and mid-ocean ridges	
				531	magnetic patterns on the sea floor	
				532	theory of plate tectonics	

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ess.III.1.c Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Explain the evidence that supports the theory of plate tectonics.	Relate the location of earthquakes and volcanoes to plate boundaries.	528	predicting what Earth might look like in 50 million years	229	identifying tectonic plates and plate boundaries
				533	describing plate boundaries	230	predicting plate movement over 50 million years and the resultant land features
				534	land features resulting from divergent plate boundaries	237	finding a pattern of volcanoes related to the locations of plate boundaries
				534	divergent plate boundaries		
				535	resulting land features from subduction		
				535	convergent plate boundaries		
				536	transform plate boundaries		
				536	land features resulting from transform plate boundaries		
				547	predict separation of North America and Europe in 75 million years		
				548	predict effects of divergent plate boundaries on Great Rift Valley		
				551	structure of a volcano		
				554	figure showing structure of different types of volcanoes		

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				555 formation of shield volcanoes due to hot spots	
				556 formation of stratovolcanoes due to subduction	
				563 mountain-building	
				564 changes in land features due to erosion	
				566 effect of glaciers on land	
ess.III.1.d Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Explain the evidence that supports the theory of plate tectonics.	Explain Alfred Wegener's continental drift hypothesis, his evidence, and why it was not accepted in his time.	529 critiquing Wegener's theories of continental drift  612 early theories of the solar system	39 critique group's explanation of energy transformations  77 show how energy loss data could be applied to designing a real clock

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ess.III.1.e Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Explain the evidence that supports the theory of plate tectonics.	Evaluate the evidence for the current theory of plate tectonics.	528	definition of plate tectonics	228	listing which kind of plate boundary is associated with each geologic feature
				530	sea-floor spreading and mid-ocean ridges		
				531	magnetic patterns on the sea floor		
				532	theory of plate tectonics		
ess.III.2.a Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.	Identify the energy sources that cause material to move within Earth.	525	formation of Earth's layers	240	estimating the effects of meteor impacts on Earth
				526	description of Earth's layers	241	identifying which geologic features on Earth were caused by meteors
				552	formation of magma in Earth's mantle		
				555	formation of Hawaiian Islands due to volcanic activity		
				558	volcanoes shape the Earth		
				563	constructive process of mountain building		
				564	the destructive process of erosion		
				565	wind erosion		

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ess.III.2.b Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.	Model the movement of materials within Earth.	525	formation of Earth's layers	
				526	description of Earth's layers	
				533	activity of Earth's crust at plate boundaries	
				534	balance of creating and consuming Earth's crust	
				552	formation of magma in Earth's mantle	
				562	constructive and destructive processes	
ess.III.2.c Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.	Model the movement and interaction of plates.	528	definition of plate tectonics	228 listing which kind of plate boundary is associated with each geologic feature
				530	sea-floor spreading and mid-ocean ridges	
				531	magnetic patterns on the sea floor	
				532	theory of plate tectonics	

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ess.III.2.d Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.	Relate the movement and interaction of plates to volcanic eruptions, mountain building, and climate changes.	528	predicting what Earth might look like in 50 million years	230	predicting plate movement over 50 million years and the resultant land features
				534	land features resulting from divergent plate boundaries		
				535	resulting land features from subduction		
				536	land features resulting from transform plate boundaries		
				547	predict separation of North America and Europe in 75 million years		
				548	predict effects of divergent plate boundaries on Great Rift Valley		
				563	mountain-building		
				564	changes in land features due to erosion		
				566	effect of glaciers on land		

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ess.III.2.e Earth Systems Science	Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.	Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.	Predict the effects of plate movement on other Earth systems.	528	definition of plate tectonics	
				532	theory of plate tectonics	
ess.IV.1.a Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.	Identify the reservoirs of Earth's water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally, and graph or chart relative amounts in global reservoirs.	440	supply of water to oceans	
				440	oceans in the water cycle	
				559	volcanoes and water vapor	

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ess.IV.1.b Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.	Illustrate the movement of water on Earth and describe how the processes that move water (e.g., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.	440 497 498 501 559 564	oceans in the water cycle water in the atmosphere affects weather patterns phase changes in the atmosphere and dewpoint forms of precipitation volcanoes and water vapor landforms shaped by water	217 finding relative humidity

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ess.IV.1.c Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.	Relate the physical and chemical properties of water to a water pollution issue.	403	water structure and its function as a solvent	178	predict the quality of surface water to be tested and justify your answer
				403	a water molecule is v-shaped		
				409	why water is called the universal solvent		
				411	effects of PCB's in Great Lakes		
				433	The Clean Water Act		
				435	water quality testing		
				436	water quality testing		
				437	acid rain		
				443	impact of increased CO2 on oceans		
				444	pollution and the ocean food chain		
445	pollution and the ocean food chain	179	address what you can do to maintain or improve the water quality at the test site				
		182	the effects of acid rain on organisms in aquatic environments				

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ess.IV.1.d Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.	Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.	411	effects of PCB's in Great Lakes	178	predict the quality of surface water to be tested and justify your answer
				414	effect of electrical generating facilities on dissolved oxygen in water	178	predict the quality of surface water to be tested and justify your answer
				433	The Clean Water Act		
				433	water quality standards		
				434	importance of water analysis	179	address what you can do to maintain or improve the water quality at the test site
				435	water quality testing		
				436	water quality testing	182	the effects of acid rain on organisms in aquatic environments
				437	acid rain		
				443	impact of increased CO2 in oceans		
				443	impact of increased CO2 on oceans		
				444	pollution and the ocean food chain		
				445	pollution and the ocean food chain		
				479	effects of CFC's on the ozone layer		
				482	effects of burning fossil fuels		
				515	permafrost		

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ess.IV.1.e Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.	Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.	414	effect of electrical generating facilities on dissolved oxygen in water	178	actions to take to improve water quality
				433	water quality standards	178	predict the quality of surface water to be tested and justify your answer
				434	importance of water analysis		
				436	nitrates and the nitrogen cycle		
				437	effects of acid rain on natural environments		
				443	impact of increased CO <sub>2</sub> in oceans		
				471	nitrogen cycle diagrammed		
				471	nitrogen cycle		
				472	the carbon cycle explained		
				479	effects of CFC's on the ozone layer		
				482	effects of burning fossil fuels		
515	permafrost						

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ess.IV.2.a Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Analyze the physical and biological dynamics of the oceans.	Describe the physical dynamics of the oceans (e.g., wave action, ocean currents, El Nino, tides).	496	descriptions of ocean currents and their effects on climate	207	research how large bodies of water affect climate
				508	causes and effects of the El Nino Southern Oscillation	215	understanding the Atlantic gyre
ess.IV.2.b Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Analyze the physical and biological dynamics of the oceans.	Determine how physical properties of oceans affect organisms (e.g., salinity, depth, tides, temperature).	440	supply of water to oceans	212	investigate how the ocean's salinity affects its density
				441	sources of salts in the ocean		
				442	composition of seawater		

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ess.IV.2.c Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Analyze the physical and biological dynamics of the oceans.	Model energy flow in ocean ecosystems.	440 supply of water to oceans	
ess.IV.2.d Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Analyze the physical and biological dynamics of the oceans.	Research and report on changing ocean levels over geologic time, and relate changes in ocean level to changes in the water cycle.	440 supply of water to oceans 497 water in the atmosphere affects weather patterns 564 landforms shaped by water	

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ess.IV.2.e Earth Systems Science	Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.	Analyze the physical and biological dynamics of the oceans.	Describe how changing sea levels could affect life on Earth.	439	illustration of acid rain formation	
				482	changes to the oceans due to increasing global temperatures	
				568	how urban sprawl changes local climate	
ess.V.1.a Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Describe how matter in the atmosphere cycles through other Earth systems.	Trace movement of a carbon atom from the atmosphere through a plant, animal, and decomposer, and back into the atmosphere.	361	chemical reactions in living systems	162 investigating combustion reactions
				364	carbon chains	162 structure of fossil fuels
				378	combustion reactions	162 importance of fossil fuels
				378	consumer chemistry	162 carbon reactions and the environment
				381	MRE ration heater reaction	
				394	photosynthesis and carbon reactions	
				395	chemistry of the atmosphere	
				395	chemistry of the atmosphere	
				395	fossil fuels and carbon reactions	
				397	carbon reactions	
				438	chemical reactions and the formation of acid rain	

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ess.V.1.b Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Describe how matter in the atmosphere cycles through other Earth systems.	Diagram the nitrogen cycle and provide examples of human actions that affect this cycle (e.g., fertilizers, crop rotation, fossil fuel combustion).	436	nitrates and the nitrogen cycle	178	actions to take to improve water quality
				437	effects of acid rain on natural environments		
				471	nitrogen cycle diagrammed		
				471	nitrogen cycle		
				472	the carbon cycle explained		
ess.V.1.c Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Describe how matter in the atmosphere cycles through other Earth systems.	Interpret evidence suggesting that humans are influencing the carbon cycle.	436	nitrates and the nitrogen cycle	178	actions to take to improve water quality
				437	effects of acid rain on natural environments		
				471	nitrogen cycle diagrammed		
				471	nitrogen cycle		
				472	the carbon cycle explained		
				481	greenhouse effect and greenhouse gasses		
		202	investigate the temperature effects of greenhouse gases				

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ess.V.1.d Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Describe how matter in the atmosphere cycles through other Earth systems.	Research ways the biosphere, hydrosphere, and lithosphere interact with the atmosphere (e.g., volcanic eruptions putting ash and gases into the atmosphere, hurricanes, changes in vegetation).	439	illustration of acid rain formation	207	research how large bodies of water affect climate
				482	changes to the oceans due to increasing global temperatures	236	understanding the Volcanic Explosivity Index
				491	Earth's temperature varies with latitude		
				496	effects of the Gulf Stream on climate of Great Britain		
				510	effect of cold ocean currents on formation of fog deserts		
				511	effect of warm ocean currents on formation of tropical rainforest		
				513	effect of large bodies of water on climate		
				515	alpine tundra occurs at high altitudes		
				554	types and shapes of volcanoes		
				555	shield volcanoes		
				556	stratovolcanoes		
				568	how urban sprawl changes local climate		

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ess.V.2.a Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	Define ozone and compare its effects in the lower and upper atmosphere.	471	composition of Earth's atmosphere	198	detecting ozone which is a protective atmosphere gas against high energy radiation
			477	ozone layer			
			479	ozone depletion			
			483	global temperature changing over time			
			485	computer modeling to predict greenhouse effects			
			528	Earth's surface is changing			
ess.V.2.b Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	Describe the role of living organisms in producing the ozone layer and how the ozone layer affected the development of life on Earth.	471	composition of Earth's atmosphere	198	detecting ozone which is a protective atmosphere gas against high energy radiation
			477	ozone layer			
			479	ozone depletion			
ess.V.2.c Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	Compare the rate at which CO <sub>2</sub> is put into the atmosphere to the rate at which it is removed through the carbon cycle.	436	nitrites and the nitrogen cycle	178	actions to take to improve water quality
			437	effects of acid rain on natural environments			
			471	nitrogen cycle diagrammed			
			471	nitrogen cycle			
			472	the carbon cycle explained			

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ess.V.2.d Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	Analyze data relating to the concentration of atmospheric CO <sub>2</sub> over the past 100 years.	481	greenhouse effect and greenhouse gasses	185	effect of ocean on carbon dioxide levels in the atmosphere
						202	investigate the temperature effects of greenhouse gases
ess.V.2.e Earth Systems Science	Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.	Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of Earth's history.	Research, evaluate, and report on international efforts to protect the atmosphere.	379	hydrogen-powered cars and the environment	163	too much CO <sub>2</sub>
				395	fossil fuels	182	the effects of acid rain on organisms in aquatic environments
				436	effect of excess nitrates on environment		
				437	acid rain		
				438	causes and health effects of acid rain		
				443	impact of increased CO <sub>2</sub> on oceans		
				504	temperature inversion		
ess.VI.1.a Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	Illustrate the distribution of energy coming from the sun that is reflected, changed into heat, or stored by plants.	480	distribution of incoming solar radiation		
				481	Earth's "energy budget"		
				485	Earth's internal energy		

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ess.VI.1.b Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	Describe the pathways for converting and storing light energy as chemical energy (e.g., light energy converted to chemical energy stored in plants, plants become fossil fuel).	480	distribution of incoming solar radiation	
				481	Earth's "energy budget"	
ess.VI.1.c Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	Investigate the conversion of light energy from the sun into heat energy by various Earth materials.	480	distribution of incoming solar radiation	
				481	Earth's "energy budget"	
				485	Earth's internal energy	

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ess.VI.1.d Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	Demonstrate how absorbed solar energy eventually leaves the Earth system as heat radiating to space.	462	heat transfer through air	192	investigate convection in liquids
				462	densely packed solids are good conductors of heat		
				463	convection currents and weather		
				463	warming hands over candle		
				464	convection currents in water		
				465	solid road surface emits radiation		
				465	transfer of heat by radiation		
				480	distribution of incoming solar radiation		
				481	Earth's "energy budget"		
				482	global warming and heat transfer by radiation		
				485	Earth's internal energy		
				493	apply knowledge of heat transfer to different situations		

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ess.VI.1.e Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	Construct a model that demonstrates the reduction of heat loss due to a greenhouse effect.	481 greenhouse effect and greenhouse gasses	185 effect of ocean on carbon dioxide levels in the atmosphere  202 investigate the temperature effects of greenhouse gases

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ess.VI.1.f Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.	Research global changes and relate them to Earth systems (e.g., global warming, solar fluctuations).	414	effect of electrical generating facilities on dissolved oxygen in water	178	predict the quality of surface water to be tested and justify your answer
				443	impact of increased CO2 in oceans	207	research how large bodies of water affect climate
				479	effects of CFC's on the ozone layer	207	research how large bodies of water affect climate
				481	global warming	213	exploring how temperature-dependent layering creates currents
				482	effects of burning fossil fuels	215	understanding the Atlantic gyre
				485	computer modeling to predict greenhouse effects		
				491	Earth's temperature varies with latitude		
				493	convection currents in the atmosphere		
				494	the Coriolis effect		
				495	global wind patterns		
				496	descriptions of ocean currents and their effects on climate		
				496	effects of the Gulf Stream on climate of Great Britain		
				502	cold fronts		
				502	effects of moving air masses		
				503	jet streams		

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				503	warm fronts
				504	rotation of air masses due to Coriolis effect
				510	effect of cold ocean currents on formation of fog deserts
				511	effect of warm ocean currents on formation of tropical rainforest
				513	effect of large bodies of water on climate
				515	permafrost
				515	alpine tundra occurs at high altitudes

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ess.VI.2.a Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Relate energy sources and transformation to the effects on Earth systems.	Describe the difference between climate and weather, and how technology is used to monitor changes in each.	451	thermometers	186	accurately measuring temperature using thermometers
				452	thermometers	194	construct and use an aneroid barometer
				474	measuring atmospheric pressure with barometers	207	research how large bodies of water affect climate
				480	transfer of energy in and out of Earth's atmosphere	207	research how large bodies of water affect climate
				485	computer modeling to predict greenhouse effects	215	understanding the Atlantic gyre
				491	Earth's temperature varies with latitude	218	using Doppler radar images to detect and track storms
				495	global wind patterns	219	use radar to detect a tornado
				496	effects of the Gulf Stream on climate of Great Britain	220	using radar to track a hurricane
				496	descriptions of ocean currents and their effects on climate		
				497	factors which influence the weather		
				497	sling psychrometer		
				499	cloud formation		
				502	cold fronts		
				502	effects of moving air masses		
				503	warm fronts		
				503	jet streams		

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				505 description of thunderstorms 506 description of hurricanes 507 description of tornadoes 510 effect of cold ocean currents on formation of fog deserts 511 effect of warm ocean currents on formation of tropical rainforest 513 effect of large bodies of water on climate 515 alpine tundra occurs at high altitudes	
ess.VI.2.b Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Relate energy sources and transformation to the effects on Earth systems.	Describe the effect of solar energy on the determination of climate and weather (e.g., El Nino, solar intensity).	492 Earth's tilt causes seasons 493 convection currents in the atmosphere 495 global wind patterns 502 cold fronts 502 effects of moving air masses 503 warm fronts 503 jet streams 508 causes and effects of the El Nino Southern Oscillation 518 create a model to explain why Earth has seasons	209 investigating factors which cause the seasons 213 exploring how temperature-dependent layering creates currents

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ess.VI.2.c Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Relate energy sources and transformation to the effects on Earth systems.	Explain how uneven heating at the equator and polar regions creates atmospheric and oceanic convection currents that move heat energy around Earth.	493 convection currents in the atmosphere	213 exploring how temperature-dependent layering creates currents
ess.VI.2.d Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Relate energy sources and transformation to the effects on Earth systems.	Describe the Coriolis effect and its role in global wind and ocean current patterns.	494 504 the Coriolis effect rotation of air masses due to Coriolis effect	

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ess.VI.2.e Earth Systems Science	Students will understand the source and distribution of energy on Earth and its effects on Earth systems.	Relate energy sources and transformation to the effects on Earth systems.	Relate how weather patterns are the result of interactions among ocean currents, air currents, and topography.	495	global wind patterns	207	research how large bodies of water affect climate
				496	descriptions of ocean currents and their effects on climate	215	understanding the Atlantic gyre
				497	water in the atmosphere affects weather patterns	219	use radar to detect a tornado
				497	factors which influence the weather	220	using radar to track a hurricane
				499	cloud formation		
				502	cold fronts		
				502	effects of moving air masses		
				503	warm fronts		
				503	jet streams		
				505	description of thunderstorms		
				506	description of hurricanes		
				507	description of tornadoes		