

**Correlation to Arkansas Science Curriculum Framework: Physical Systems  
 Foundations of Physical Science with 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.	9	steps in the scientific method	7	doing a controlled experiment
				10	forming a hypothesis	7	compare results with hypothesis
				11	control and experimental variables	7	perform your own experiment
				19	design your own experiment	7	variables in an experiment
				26	independent and dependent variables	9	design three experiments and choose technology
				448	forming a hypothesis and testing through experimentation (#5)	10	conduct car/ramp experiment
				448	describe steps you would take to determine whether pH affects frog population	16	investigate Newton's 2nd law
				451	what is temperature	27	recognize variables
				451	what is temperature	34	investigate motion on a rollercoaster
				602	identify question, hypothesis, procedure, and results (#1)	75	perform self-designed experiment
						75	plan three experiments to determine which variable affects the period of a pendulum
						170	which method will give fastest dissolving rate?
						170	which factor will produce fastest dissolving rate?
						182	simulating the effect of acid rain on daphnia

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						188	conducting investigation of efficiency of immersion heater
						190	effect of changing mass on collected data
						193	conducting experiments on heat transfer
						205	investigating how specific heat of water regulates Earth's temperature
						211	determining whether distance from light source or axial tilt plays a more significant role in causing the seasons
						237	develop a research plan for studying volcanoes

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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.	12	writing lab procedures	7	variables in an experiment
				42	interpreting distance/time graph	25	create a mathematical model
				448	forming a hypothesis and testing through experimentation (#5)	27	find math rule for lever equilibrium
				459	heat equation	28	derive a math formula
				602	identify question, hypothesis, procedure, and results (#1)	41	drawing and interpreting circuit diagrams
				645	inverse square law	170	write a procedure
						171	average dissolving rate
						187	find equation for trend line
						196	writing a procedure for constructing a pointer for an aneroid barometer
						214	develop a procedure to create an underwater spring
						257	inverse square law

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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.	7 19 42 452	featured throughout CPO Science program experimentation begins with a question design your own experiment devise an experiment safety caution on heating jar	7 7 9 10 16 16 20 24 26 26 34 40 44 56	featured throughout CPO Science program design your own experiment perform your own experiment design three experiments using car and ramp conduct car/ramp experiment decide how to vary the force on the car for this experiment investigate Newton's 2nd law safety tip for car/ramp setup ropes and pulley safety what variables can be changed? safety tip for hanging weights from lever investigate motion on a rollercoaster electrical safety short circuit safety warning short circuit safety warning

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						58	short circuit safety warning
						75	perform self-designed experiment
						75	design pendulum experiment
						146	safety in the lab
						150	chemistry safety
						151	design experiment to find out if mass is conserved
						158	wear goggles and apron
						168	safety equipment
						170	what three factors influence dissolving rate?
						172	hot water safety
						180	safety tip for water testing
						182	simulating the effect of acid rain on daphnia
						182	safety tips for observing Daphnia
						186	thermometer safety
						188	heat safety
						188	conducting investigation of efficiency of immersion heater
						192	heat safety

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						193	conducting experiments on heat transfer
						202	safety in greenhouse gas investigation
						205	investigating how specific heat of water regulates Earth's temperature
						210	safety using light bulbs
						216	safety in swinging thermometers
						233	identifying how the earthquake model represents an earthquake
						256	safety in lab

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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.	5	make measurements with precision	5	making measurements with precision
				11	control and experimental variables	7	doing a controlled experiment
				20	how will speed change?	7	measure and record variables
				24	predicting speed from a graph	14	record three different time intervals
				26	independent and dependent variables	17	measure the force
				42	predict the speed of a car	17	measure the force
				435	making observations and asking questions	25	measure and record the force
				486	observing an aurora	25	collect force data
				630	what evidence was used to predict the existence of the Kuiper Belt?	27	recognize variables
				630	use the data to answer the questions	27	write down the number of weights you use
				630	use the data to answer the questions	30	measure height difference
				652	analysis with a spectrometer (#4)	36	make precise height measurements
						63	making measurements with precision
						75	make precise length measurements
						76	use data to predict best string length for a pendulum clock
						121	use graph to predict mass of six objects

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						146	record detailed observations
						150	record data as you perform experiment
						156	make predictions about solubility
						176	measure pH
						182	observing daphnia and recording movements and behavior
						190	effect of changing mass on collected data
						199	collecting Schönbein strips for detecting ozone
						201	predicting areas with high ozone concentration based on your data
						202	collecting data of temperature and sensations
						204	predicting what would happen if you place your ice/water test tube into a hot cup or a cold cup
						206	collecting temperature and time data
						210	collecting qualitative data of light intensity at scale distance from the sun

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						211 determining whether distance from light source or axial tilt plays a more significant role in causing the seasons  217 collecting wet and dry bulb temperature readings  239 estimating the number of meteor collisions on Earth during the last 3.5 billion years  242 predicting the results of the crystal-growing experiment  243 recording observations of crystal growing  251 recording the changes in the moon over a month	

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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.	24	interpretations of patterns in data	11	calculate % error
				27	reading a graph	15	interpret a speed vs. time graph
				78	analyze lever diagram	76	calculate % error
				435	making observations and asking questions	146	record detailed observations
				476	atmospheric pressure at various altitudes graph	197	calculating error between your barometer and a commercial barometer
				485	what percentage comes from this source? (problem 4)	199	importance of good record keeping in order to avoid error
				486	observing an aurora	199	collecting Schönbein strips for detecting ozone
				543	determining distance to an epicenter	202	collecting data of temperature and sensations
				547	what explains the difference in density? (#5)	217	determining relationship between temperature of the atmosphere and relative humidity
				605	how big is Earth?	218	interpreting Doppler radar images
				645	apparent brightness vs. distance graph	237	finding a pattern of volcanoes on a bathymetric map
				651	use the diagram to answer the questions (#2)	243	recording observations of crystal growing
				651	arrange the items in the table (#3)	251	recording the changes in the moon over a month
				651	use the diagram to answer the questions (#4)		

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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.	414	effect of electrical generating facilities on dissolved oxygen in water	21	construct reasonable explanation based on data
				443	impact of increased CO2 in oceans	35	study data and determine importance of height on speed of marble
				479	effects of CFC's on the ozone layer	45	analyze data and explain a rule
				482	effects of burning fossil fuels	178	predict the quality of surface water to be tested and justify your answer
				515	permafrost		

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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.	20	featured throughout CPO Science program  explain your reasoning	9  9  37  39  47  145  145  151  179  181  183	featured throughout CPO Science program  present conclusions to the class  reporting on an experiment  describe the flow of energy based on experimental graph  give a brief presentation to the class  present and defend an explanation  present findings and methods used  present findings to the class  present results to the class  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.	24	making a graph	13	graph distance vs. time
				24	interpretations of patterns in data	15	construct a quantitative graphical model
				26	creating graphs	15	interpret a speed vs. time graph
				27	how to read a graph	37	organize data into a graph of speed vs. height
				27	reading a graph	51	graph voltage vs. current
				41	make a graph	78	reading harmonic motion data tables and graphs
				78	analyze lever diagram	121	graph mass vs. volume
				476	atmospheric pressure at various altitudes graph	147	organize observations into a category table
				645	apparent brightness vs. distance graph	185	constructing a graph of drops of acid vs pH
				651	use the diagram to answer the questions (#2)	187	construct a graphical model
				651	arrange the items in the table (#3)	189	construct a temperature vs. time graph
				651	use the diagram to answer the questions (#4)	197	constructing a graph from atmospheric pressure data
						203	graphing water and ice temperature readings
						206	constructing a graph of time vs. temperature

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						217 determining relationship between temperature of the atmosphere and relative humidity  218 interpreting Doppler radar images  237 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.	23	why make models?	13	graph distance vs. time
				24	scientific models	15	construct a quantitative graphical model
				24	what is a scientific model?	25	create a mathematical model
				24	making a graph	27	find math rule for lever equilibrium
				26	creating graphs	28	derive a math formula
				41	make a graph	37	organize data into a graph of speed vs. height
				42	interpreting distance/time graph	51	graph voltage vs. current
				459	heat equation	121	graph mass vs. volume
				485	computer modeling to predict greenhouse effects	147	organize observations into a category table
				494	modeling air currents	185	constructing a graph of drops of acid vs pH
				518	create a model (#1)	187	find equation for trend line
				524	model of Earth's history	187	construct a graphical model
				533	modeling plate boundaries	189	construct a temperature vs. time graph
				576	rock cycle model	197	constructing a graph from atmospheric pressure data
				614	solar system modeling	202	modeling the effect of greenhouse gases on Earth's temperature
				624	model of the sun's anatomy	203	graphing water and ice temperature readings
				645	inverse square law		

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						206 constructing a graph of time vs. temperature 212 modeling underwater rivers and waterfalls and springs 232 construct a model that simulates an earthquake 257 inverse square law 258 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.	10	process of reviewing hypothesis explained	35	what evidence is there in support of your hypothesis?
				521	relative dating and modern geology based on Steno's theories	39	critique group's explanation of energy transformations
				524	Kelvin's calculations of Earth's age	39	review energy theory in context of everyday scenarios
				528	theory of plate tectonics		
				529	critiquing Wegener's theories of continental drift	39	analyze energy transformations in different scenarios
				563	Darwin's theories of the Andes formation	77	show how energy loss data could be applied to designing a real clock
				566	what causes ice ages		
				611	theories of origin of the moon	77	compare law of conservation of energy to motion of pendulum
				612	early theories of the solar system	151	review your hypothesis
				647	Big Bang theory	171	did you prove or disprove your hypothesis?

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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.	332 528 529 529 612 648	plate tectonic history development of plate tectonic theory continental drift theory continental drift theory history changing ideas about the solar system development of Big Bang theory	230	investigate plate tectonics
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.	613 614 615 624 625	explanation and illustration of the solar system relative sizes and distances within the solar system classifying the planets features and diagram of the sun features and emissions of the sun	258 259 260	setting up a scale model of the solar system determining scale distances for the planets determining scale sizes of the planets

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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.	433 434 437 439 471 482 497 568 573 575	water quality standards importance of water analysis effects of acid rain on natural environments illustration of acid rain formation nitrogen cycle changes to the oceans due to increasing global temperatures water in the atmosphere affects weather patterns how urban sprawl changes local climate formation of igneous and sedimentary and metamorphic rocks identifying igneous and sedimentary and metamorphic rocks	178 242 244 246 247	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.	528 530 531 532	definition of plate tectonics sea-floor spreading and mid-ocean ridges magnetic patterns on the sea floor theory of plate tectonics	228	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.	554 559 561 570 571 572 573 575	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	237 242 244 246 247	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).	437 562 565 576	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.	440 441 442 496 510 511 530 531	supply of water to oceans sources of salts in the ocean composition of seawater descriptions of ocean currents and their effects on climate different types of deserts and how they are formed how tropical rainforests are formed sea-floor spreading and mid-ocean ridges magnetic patterns on the sea floor	207 212 215 223 228	research how large bodies of water affect climate investigate how the ocean's salinity affects its density understanding the Atlantic gyre research a particular biome listing which kind of plate boundary is associated with each geologic feature

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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).	524	table and description of the geologic time scale	230	predicting plate movement over 50 million years and the resultant land features
				528	predicting what Earth might look like in 50 million years		
				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	landforms shaped by water		
				564	changes in land features due to erosion		
				566	ice ages		
				566	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).	481	greenhouse conditions on Earth	209	investigating factors which cause the seasons
				485	research the density of Venus' and Mars' atmospheres	213	exploring how temperature-dependent layering creates currents
				485	Earth's internal energy	219	use radar to detect a tornado
				492	Earth's tilt causes seasons	220	using radar to track a hurricane
				493	convection currents in the atmosphere	223	research a particular biome
				495	global wind patterns		
				497	factors which influence the weather		
				497	water in the atmosphere affects weather patterns		
				499	cloud formation		
				502	effects of moving air masses		
				502	cold fronts		
				503	warm fronts		
				503	jet streams		
				505	description of thunderstorms		
				506	description of hurricanes		
				507	description of tornadoes		
				510	different types of deserts and how they are formed		

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				511	how tropical rainforests are formed		
				518	create a model to explain why Earth has seasons		
				615	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.	451	thermometers	186	accurately measuring temperature using thermometers
				452	thermometers	194	construct and use an aneroid barometer
				473	definition of atmospheric pressure	213	exploring how temperature-dependent layering creates currents
				474	measuring atmospheric pressure with barometers	217	finding relative humidity
				475	how atmospheric pressure changes with altitude	218	using Doppler radar images to detect and track storms
				476	graph showing atmospheric pressure vs. altitude	219	use radar to detect a tornado
				480	distribution of incoming solar radiation	220	using radar to track a hurricane
				480	transfer of energy in and out of Earth's atmosphere		
				481	Earth's "energy budget"		
				481	greenhouse conditions on Earth		
				485	research the density of Venus' and Mars' atmospheres		
				493	convection currents in the atmosphere		
				495	global wind patterns		
				497	factors which influence the weather		
				497	slingshot psychrometer		

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				498	phase changes in the atmosphere and dewpoint		
				499	cloud formation		
				501	forms of precipitation		
				502	effects of moving air masses		
				502	cold fronts		
				503	warm fronts		
				503	jet streams		
				505	description of thunderstorms		
				506	description of hurricanes		
				507	description of tornadoes		
				615	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.	485	computer modeling to predict greenhouse effects	207	research how large bodies of water affect climate
				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 desserts		
				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		
				648	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.	591	characteristics of the universe	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
				615	classifying the planets		
				622	descriptions of the sun and comparisons to other stars		
				624	features and diagram of the sun		
				625	features and emissions of the sun		
				633	what is a star?		
				635	size of the sun compare to other stars		
				637	H-R diagrams comparing temperature and brightness of stars		
				641	the existence of other planetary systems		
				642	what is a galaxy?		
				652	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.	633 635 636 643	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	251	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).	591 633 642 652	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).	594 595 596 597 598 634	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	264 268	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.	548	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).	333	problems with disposing of plastics	163	too much CO <sub>2</sub>
				355	recycling tires	163	consider a vehicle's fuel economy
				356	recycling discarded tires	163	research how trees offset accumulation of CO <sub>2</sub>
				364	petroleum	163	economic impact of end-product of combustion reaction
				368	limiting reactants	164	perform water quality tests
				379	research economic impact of fuel cells	178	wise use of water supply
				379	research fuel cells	178	predict the quality of surface water to be tested and justify your answer
				379	hydrogen-powered cars and the environment	178	predict the quality of surface water to be tested and justify your answer
				379	research environmental impact of fuel cells	179	maintaining water supply quality
				379	research fuel cells	179	address what you can do to maintain or improve the water quality at the test site
				392	storage of nuclear waste	180	perform water quality tests
				395	fossil fuels	180	save water for houseplants
				400	economic impact of reducing air pollution		
				400	economic impact of pollution		
				400	problems caused by airborne pollutants		

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
				414	effect of electrical generating facilities on dissolved oxygen in water	182	investigate effect of acid rain on microorganisms
				432	water cycle and conservation	182	the effects of acid rain on organisms in aquatic environments
				433	The Clean Water Act	182	the effects of acid rain on organisms in aquatic environments
				433	wise use of water		
				435	water quality testing	201	research the causes of ozone in the lower atmosphere
				435	water usage and quality		
				436	water quality testing		
				436	effect of excess nitrates on environment		
				437	acid rain		
				437	acid rain explained		
				437	acid rain		
				438	causes and health effects of acid rain		
				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		
				445	pollution and the ocean food chain		

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
				448	research the issue of acid rain		
				448	research economic impact of producing gases that cause acid rain		
				479	effects of CFC's on the ozone layer		
				482	effects of burning fossil fuels		
				504	temperature inversion		
				515	permafrost		

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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).	414	effect of electrical generating facilities on dissolved oxygen in water	178	actions to take to improve water quality
				437	effects of acid rain on natural environments	178	predict the quality of surface water to be tested and justify your answer
				437	acid rain explained	182	investigate effect of acid rain on microorganisms
				443	impact of increased CO2 in oceans	185	effect of ocean on carbon dioxide levels in the atmosphere
				448	research the issue of acid rain	202	investigate the temperature effects of greenhouse gases
				471	nitrogen cycle		
				479	effects of CFC's on the ozone layer		
				481	greenhouse effect and greenhouse gasses		
				482	effects of burning fossil fuels		
				515	permafrost		

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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	featured throughout CPO Science program	25	featured throughout CPO Science program
				19	controlling variables in experiments	27	create a mathematical model
				20	did you run a controlled experiment?	28	find math rule for lever equilibrium
				42	what factors could explain the variability in their data?	169	derive a math formula
				459	interpreting distance/time graph	169	why was plain water tested?
				645	heat equation	171	what does the word control mean?
					inverse square law	187	average dissolving rate
						257	find equation for trend line
							inverse square law

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
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.).	24 497 594	using an electronic timer sling psychrometer telescopes	7 12 14 16 17 18 30 44 46 48 50 158 186 188 192 194 210 216 218	use a ruler to make a measurement using photogates using photogates use a force scale use photogates to study car on ramp use a balance to find mass of car use force scale using electrical meter using electrical meter using electrical meter using electrical meter use a thermometer use a thermometer use a thermometer and immersion heater use a timer and thermometer aneroid barometer use a multimeter and solar cell use a sling psychrometer Doppler radar

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						228 reading a bathymetric map 252 using a telescope	

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
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.	7 19 42 288	experimentation begins with a question design your own experiment devise an experiment find the thickness of a single card	7 7 9 9 9 10 10 12 16 16 26 30 34 75	perform your own experiment design your own experiment design three experiments using car and ramp conduct three experiments with appropriate equipment design three experiments and choose equipment selecting ramp and photogates conduct car/ramp experiment select equipment and set up experiment investigate Newton's 2nd law decide how to vary the force on the car for this experiment what variables can be changed? rigging block and tackle investigate motion on a rollercoaster perform self-designed experiment

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
						75	design pendulum experiment
						145	plan a procedure and select necessary equipment
						145	carry out procedure and select equipment
						151	plan procedures and select materials
						151	design experiment to find out if mass is conserved
						151	select materials from list
						170	what three factors influence dissolving rate?
						178	visit local water supply and perform testing
						182	simulating the effect of acid rain on daphnia
						188	conducting investigation of efficiency of immersion heater
						193	conducting experiments on heat transfer
						194	design and construct an aneroid barometer
						198	making qualitative observations of the amount of ozone present in the school environment

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						205 investigating how specific heat of water regulates Earth's temperature  209 measuring the intensity of light using an electric meter and solar cell and light bulb  233 identifying how the earthquake model represents an earthquake  252 identifying the parts of a refracting telescope and making observations of the moon's surface	

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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).	51 180 258 278 389 407 415 415 429 435 438 460	what is equilibrium? harmonic motion in natural systems optical systems system of classifying matter atoms and nuclear energy a solute and a solvent make up a system solubility equilibrium equilibrium and solubility the water cycle pond ecosystem and water quality acid rain formation system thermal equilibrium	84 158 198	waves in motion energy in chemical reactions food energy

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
PS.1.01 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Understand that science is a process based on the scientific method which leads to a deeper understanding of real world situations.	58	Newton on a skateboard	6	asking questions and learning about natural world
				78	describe a problem that would be solved by an engineer	7	variables in an experiment
				120	circuits in your house	39	study energy transformations in daily life scenarios
				448	forming a hypothesis and testing through experimentation (#5)	179	researching and preparing for a field trip to test surface water
				452	balloons expands or contracts due to thermal expansion	201	suggesting ways that ozone concentrations could be reduced
				454	temperature vs. thermal energy for a cup or pot of soup	204	connecting the latent heat investigation to Earth
				461	understanding thermal energy through cocoa example	215	the food paradox of the oceans
				465	examples of reflectors and absorbers	218	understanding Doppler radar
				473	why do ears pop		
				473	why do ears pop		
				476	atmospheric pressure in Denver		
				490	using the North Star to estimate your latitude		
				504	meteorologists use atmospheric pressure data to understand movement of weather systems		

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
				509	how do animals survive in the desert		
				536	analogy of plate movements		
				602	identify question, hypothesis, procedure, and results (#1)		
				648	evidence for Big Bang theory		

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PS.1.02 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Follow procedures for a scientific inquiry using step-by-step instructions, mathematical formulas, flow diagrams, and/or sketches.	12	writing lab procedures	7 9 10 10 12 16 30 34 40 75 145 151 170 182 188	perform your own experiment conduct three experiments with appropriate equipment conduct car/ramp experiment selecting ramp and photogates select equipment and set up experiment investigate Newton's 2nd law rigging block and tackle investigate motion on a rollercoaster choose circuit parts to light a bulb perform self-designed experiment carry out procedure and select equipment select materials from list write a procedure simulating the effect of acid rain on daphnia conducting investigation of efficiency of immersion heater

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						193 conducting experiments on heat transfer 196 writing a procedure for constructing a pointer for an aneroid barometer 205 investigating how specific heat of water regulates Earth's temperature 209 measuring the intensity of light using an electric meter and solar cell and light bulb 214 develop a procedure to create an underwater spring 252 identifying the parts of a refracting telescope and making observations of the moon's surface	

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
PS.1.03 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Develop and implement a workable scientific inquiry independently and with a group using standard safety procedures.	7	experimentation begins with a question	7	design your own experiment
				9	steps in the scientific method	7	compare results with hypothesis
				10	forming a hypothesis	7	doing a controlled experiment
				11	control and experimental variables	9	design three experiments and choose technology
				19	design your own experiment	9	design three experiments using car and ramp
				19	design your own experiment	9	design three experiments and choose equipment
				26	independent and dependent variables	16	decide how to vary the force on the car for this experiment
				42	devise an experiment	20	safety tip for car/ramp setup
				288	find the thickness of a single card	24	ropes and pulley safety
				448	describe steps you would take to determine whether pH affects frog population	26	safety tip for hanging weights from lever
				452	safety caution on heating jar	26	what variables can be changed?
						27	recognize variables
						40	electrical safety
						44	short circuit safety warning
		56	short circuit safety warning				

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
						58	short circuit safety warning
						75	plan three experiments to determine which variable affects the period of a pendulum
						75	design pendulum experiment
						145	plan a procedure and select necessary equipment
						146	safety in the lab
						150	chemistry safety
						151	plan procedures and select materials
						151	design experiment to find out if mass is conserved
						158	wear goggles and apron
						168	safety equipment
						170	what three factors influence dissolving rate?
						170	which factor will produce fastest dissolving rate?
						172	hot water safety
						180	safety tip for water testing
						182	safety tips for observing Daphnia
						186	thermometer safety

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
						188	heat safety
						190	effect of changing mass on collected data
						192	heat safety
						194	design and construct an aneroid barometer
						202	safety in greenhouse gas investigation
						210	safety using light bulbs
						211	determining whether distance from light source or axial tilt plays a more significant role in causing the seasons
						216	safety in swinging thermometers
						233	identifying how the earthquake model represents an earthquake
						237	develop a research plan for studying volcanoes
						256	safety in lab

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PS.1.04 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	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.	11	control and experimental variables		
				12	importance of reliable and accurate data collection	4	data tables and graphs can be created on computer or graphing calculator
				20	how will speed change?	4	difference between precise and accurate data
				24	predicting speed from a graph	6	electronic timer and release technique
				26	independent and dependent variables	7	doing a controlled experiment
				42	predict the speed of a car	7	record time interval
				42	interpreting distance/time graph	9	collect speed data
				435	making observations and asking questions	9	construct a data table
				459	heat equation	12	understand and use data table
				486	observing an aurora	14	record three different time intervals
				630	what evidence was used to predict the existence of the Kuiper Belt?	17	record times
				630	use the data to answer the questions	17	record results in data table
				645	inverse square law	18	organize different combinations of data
				652	analysis with a spectrometer (#4)	24	use data table to record results
						24	collect weight data
						25	collect force data
						25	create a mathematical model

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						27	use data table to record results
						27	recognize variables
						27	write down the number of weights you use
						27	find math rule for lever equilibrium
						28	derive a math formula
						30	record ropes and pulley data in table
						36	collect precise speed and height data
						36	organize data into a table
						75	collect mass and amplitude data
						75	create data table for self-designed experiment
						76	use data to predict best string length for a pendulum clock
						121	use graph to predict mass of six objects
						146	record detailed observations
						150	record data as you perform experiment
						151	design a data table
						156	make predictions about solubility

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						157	add new rules to list based on findings
						171	use data table for observations
						171	collect time data and record observations
						181	organize water quality data into a table
						182	observing daphnia and recording movements and behavior
						182	making detailed observations
						184	collecting pH readings while adding carbon dioxide
						186	collecting temperature data
						187	find equation for trend line
						189	collecting time and temperature data
						190	effect of changing mass on collected data
						193	collecting and recording time and temperature data
						197	evaluating your aneroid barometer design
						199	collecting Schönbein strips for detecting ozone

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
						201	predicting areas with high ozone concentration based on your data
						202	collecting data of temperature and sensations
						204	predicting what would happen if you place your ice/water test tube into a hot cup or a cold cup
						206	collecting temperature and time data
						210	collecting qualitative data of light intensity at scale distance from the sun
						211	determining whether distance from light source or axial tilt plays a more significant role in causing the seasons
						217	collecting wet and dry bulb temperature readings
						239	estimating the number of meteor collisions on Earth during the last 3.5 billion years
						242	predicting the results of the crystal-growing experiment
						243	recording observations of crystal growing

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						249	using your sundial to collect accurate data
						251	recording the changes in the moon over a month
						253	calibrating your telescope
						257	inverse square law

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PS.1.05 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Make objective observations and perform error analysis on collected data.	5	measuring distance	6	compare results with other groups
				11	controlling variables in experiments	11	graph speed vs. position
				19	did you run a controlled experiment?	11	analyze speed change of car
				20	what factors could explain the variability in their data?	18	study data table for relationship between force and motion
				42	analyze a speed/distance graph	25	analyze block and tackle data
						27	analyze lever equilibrium data
						35	does data support hypothesis?
						45	did battery voltage change?
						76	analyze pendulum data
						147	students analyze chemical change lab results
						169	why was plain water tested?
						169	what does the word control mean?
						171	average dissolving rate
						186	measure temperature

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PS.1.06 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Formulate valid conclusions.			21 35 45	construct reasonable explanation based on data study data and determine importance of height on speed of marble analyze data and explain a rule

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PS.1.07 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Communicate and defend in writing a scientific argument.	20	explain your reasoning	9	present conclusions to the class
						9	reporting on an experiment
						15	discuss and test ideas with your group
						19	explain how you arrived at your answer
						29	discuss what you learned about gears
						37	describe the flow of energy based on experimental graph
						39	give a brief presentation to the class
						47	discuss an explanation with your group
						47	present and defend an explanation
						129	explain your answer and justify
						145	present findings and methods used
						151	present results to the class
						179	create water quality report
						181	write paragraph to explain results
						183	write summary of findings

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PS.1.08 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Critique and interpret scientific data on charts and graphs.	24	making a graph	6	compare results with other groups
				24	interpretations of patterns in data	11	graph speed vs. position
				26	creating graphs	11	analyze speed change of car
				27	reading a graph	13	graph distance vs. time
				41	make a graph	15	construct a quantitative graphical model
				42	interpreting distance/time graph	15	interpret a speed vs. time graph
				42	analyze a speed/distance graph	18	study data table for relationship between force and motion
				78	analyze lever diagram	25	create a mathematical model
				459	heat equation	25	analyze block and tackle data
				476	atmospheric pressure at various altitudes graph	27	analyze lever equilibrium data
				645	inverse square law	27	find math rule for lever equilibrium
				645	apparent brightness vs. distance graph	28	derive a math formula
				651	use the diagram to answer the questions (#2)	35	does data support hypothesis?
				651	arrange the items in the table (#3)	37	organize data into a graph of speed vs. height
				651	use the diagram to answer the questions (#4)	45	did battery voltage change?
						51	graph voltage vs. current

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						76	analyze pendulum data
						121	graph mass vs. volume
						147	organize observations into a category table
						147	students analyze chemical change lab results
						171	average dissolving rate
						185	constructing a graph of drops of acid vs pH
						187	construct a graphical model
						187	find equation for trend line
						189	construct a temperature vs. time graph
						197	constructing a graph from atmospheric pressure data
						203	graphing water and ice temperature readings
						206	constructing a graph of time vs. temperature
						217	determining relationship between temperature of the atmosphere and relative humidity
						218	interpreting Doppler radar images

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						237	finding a pattern of volcanoes on a bathymetric map
						257	inverse square law
PS.1.09 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Recognize that theories are models and may be revised when new data is introduced.	521	relative dating and modern geology based on Steno's theories	39	critique group's explanation of energy transformations
				524	Kelvin's calculations of Earth's age	39	review energy theory in context of everyday scenarios
				528	theory of plate tectonics	39	analyze energy transformations in different scenarios
				529	critiquing Wegener's theories of continental drift	77	show how energy loss data could be applied to designing a real clock
				563	Darwin's theories of the Andes formation	77	compare law of conservation of energy to motion of pendulum
				566	what causes ice ages	157	add new rules to list based on findings
				611	theories of origin of the moon	197	evaluating your aneroid barometer design
				612	early theories of the solar system		
				647	Big Bang theory		

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PS.1.10 Physical Systems	9-12	Students will demonstrate an understanding of physical systems as a process of inquiry.	Understand the criteria for the formation of scientific theory and a scientific law.	521	relative dating and modern geology based on Steno's theories	39	critique group's explanation of energy transformations
				524	Kelvin's calculations of Earth's age	39	review energy theory in context of everyday scenarios
				528	theory of plate tectonics	39	analyze energy transformations in different scenarios
				529	critiquing Wegener's theories of continental drift	77	show how energy loss data could be applied to designing a real clock
				563	Darwin's theories of the Andes formation	77	compare law of conservation of energy to motion of pendulum
				566	what causes ice ages		
				611	theories of origin of the moon		
				612	early theories of the solar system		
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PS.2.01 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Evaluate the historical and multi-cultural contributions to the scientific body of knowledge in physical systems (nature of light, falling objects, expanding universe, model of the atom, quantum physics, periodic table). Construct time lines.	34 45 45 54 55 73 86 105 107 110 115 131 160 312 312 320 321 321 332	Aristotle vs. Newton Newton's Principia Newton's Laws of Motion Newton and the force of gravity Newton and the apple legend Leonardo DaVinci James Watt Benjamin Franklin Charles-Augustin Coulomb research Franklin's electricity experiments Volta's batteries Georg Ohm's work with circuits Faraday's contributions contributions of Fermi Dalton's contributions the quests of alchemists Mendeleev's periodic table contributions of Mendeleev Linus Pauling and electronegativities	198	contributions of Schönbein

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				363	Antoine Lavoisier		
				370	research Lavoisier's contributions		
				391	scientific discovery and the atomic age		
				393	Marie and Pierre Curie		
				393	accomplishments of Marie Curie		
				393	contributions of Marie and Pierre Curie		
				400	research the Clean Air Act of 1970 and 1990		
				448	research local water supply history		
				455	contributions of Joule		
				457	Joseph Black		
				468	research the history of heat and temperature		
				583	history of calendars		
				585	counting the days in a year		
				586	the history of clocks and the division of time		
				589	ancient beliefs about solar eclipses		
				594	history of the telescope		

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PS.2.02 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Classify matter into elements, compounds, and mixtures. Classify mixtures as heterogeneous or homogeneous and separate mixtures into pure substances using procedures such as distillation or chromatography.	278	pure substances cannot be separated by physical means	114	investigating a mixture
				278	mixtures can be separated by physical means	114	separating a homogeneous mixture
				279	summary of matter classification	114	investigate a homogeneous mixture
				288	create a poster of matter classification	132	comparing atoms
				311	all matter is formed from atoms	169	investigate solutions and colloids and suspensions
				311	all matter is formed from atoms		
				407	solutions are mixtures		
				408	colloids and suspensions		
426	mixtures and emulsifying agents						

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PS.2.03 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Explore various physical and chemical properties of matter such as density, specific heat, viscosity, buoyancy, and reactivity.	281	volume and mass contrasted	116	mass and volume measurements
				284	melting and boiling points	119	melting point of ice
				284	melting and boiling point explained	124	build a density column
				285	table of melting and boiling points	126	investigating buoyancy with clay boats
				291	density explained	128	use CPO viscometer to study viscosity
				291	density is independent of amount of substance	205	investigating how the high specific heat of water helps regulate Earth's temperature
				292	hardness is a physical property of matter	212	investigate density changes in the oceans as the cause of ocean layering
				292	elasticity is a physical property of matter		
				293	brittleness is a physical property of matter		
				294	tensile strength is a physical property of matter		
				294	malleability is a physical property of matter		
				295	relationship between mass volume and density		
				296	density of liquid water vs. ice		
				297	buoyancy explained		
				298	sinking and floating		
				302	viscosity of motor oils		

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
				305	viscosity of glue mixtures		
				456	definition of specific heat		
				458	water's specific heat helps regulate Earth's temperature		
				459	heat equation		
PS.2.04 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Distinguish between physical and chemical changes that affect everyday life, such as hot and cold packs, light sticks, rusting, fireworks display, and water displacement.	294	development of Kevlar brand fiber	146	investigate and observe chemical and physical changes in the lab
				353	physical and chemical changes and digestion		
				355	physical and chemical changes in tire recycling		
				357	combustion reaction		
				361	heartburn reaction		
				372	determine if changes are chemical or physical		
				457	engineers use specific heat of substances to design better products		

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PS.2.05 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Use models to show the structure and behavior of matter (includes Rutherford's Gold Foil Experiment, sub-atomic particles, electron energy levels, quantum theory, and organic molecules).	311	location/size/charge of subatomic particles	130	investigate Rutherford's gold foil experiment
				311	protons/neutrons/electrons	132	building atom models
				313	development of atomic theory	133	identify atomic number
				315	atomic number discussed	133	identify mass number
				315	atoms of same element have same atomic number	133	identify element symbol and name
				316	mass number discussed	133	location of electrons in atom
				318	proton/electron attraction	133	protons and neutrons
				322	mass number on the periodic table	136	atomic number
				322	mass number on the periodic table	136	mass number
				322	atomic mass on the periodic table	136	model stable and neutral atoms
				322	atomic number on the periodic table	137	importance of atomic number
				322	chemical symbols and element names	137	build atomic models
				324	research and create a poster to illustrate development of atomic model	140	find the number of electrons in outermost level
				388	showing valence electrons in a diagram	140	review subatomic particles

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PS.2.06 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Understand the rationale of the periodic charts.	320 321 321 329 330 332 332 335	groups of elements groups of elements and valence shells studying the periodic table periodic table columns and valence electrons bonding and periodic table position periodic table and electronegativities metals nonmetals and metalloids periodic table and oxidation numbers	133 136 141 142	using the periodic table building and studying the periodic table build model of Na and Cl atoms and explain why they bond to form a molecule arrangement of electrons and groups of elements
PS.2.07 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Explain the relationship among mole, chemical bonding, and molecular geometry within chemical compounds.	324 324 335 343 364 411	which element is more likely to combine with other elements? use the periodic table to predict chemical formulas chemical bonding and the periodic table what is a mole? carbon chains explanation and examples of molarity calculations	141 162	modeling a chemical bond carbon reactions and the environment

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PS.2.08 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Demonstrate the relationships between kinetic theory and the states of matter (gas laws).	284	changes of state	118	observe melting process and study quantitatively
				285	characteristics of matter related to its state	119	adding heat energy to melt an ice cube
				299	Charles' law	119	energy and phase changes
				300	Boyle's law		
				451	increasing temperature means increasing motion of molecules	203	investigate the temperature/time curves as water is cooled through a phase change to ice
				451	temperature is a measure of average kinetic energy		
				452	molecular motion increases when temperature increases	204	compare the shape of the water line and the ice line on the temperature/time graph
				498	phases changes in the atmosphere		

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PS.2.09 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Understand the representation of and energetics of chemical reactions (equation writing, types of reactions, stoichiometry, reaction rates, equilibria and electrochemistry).	336	writing a chemical formula	143	name chemical compounds
				338	summary of chemical formula writing rules	143	predict chemical formulas
				339	naming compounds	145	determine empirical formula
				359	balancing chemical equations	148	reactants and products
				364	formation of petroleum is a very slow chemical reaction	149	balance these equations
				371	which of the equations is balanced?	149	practice balancing equations
				375	synthesis or addition reactions	152	predict how much product formed given the reactants
				376	decomposition reactions	152	write the balanced equation
				377	double displacement reactions	156	investigate double displacement reactions
				377	single displacement reactions	156	predict products in a double displacement reaction
				422	acids and bases and enzymes in digestion	157	predict the products of double displacement reactions

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PS.2.10 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Understand the nature of solutions (solubility, concentrations, pH, acids/bases, colligative properties, and buffer solutions).	403	why water is a nearly universal solvent	170	design experiments to explore dissolving rate
				409	polar solutes	171	investigate the dissolving process
				409	dissolution at the molecular level	171	what happened at the molecular level?
				409	dissolution of ionic compounds	175	solubility and pressure
				410	dissolution of covalent compounds	176	investigate acids and bases
				412	solubility value	181	water quality testing
				414	pressure and the solubility of gases	181	water quality testing
				414	effect of pressure on solubility of gasses	181	testing pH of tap water samples
				416	SCUBA diving and effects of pressure on gasses in the bloodstream	184	determining pH of water as carbon dioxide dissolves
				417	H and OH ions		
				417	define and compare acids and bases		
				417	acids and bases compared/contrasted		
				417	properties of acids		
				417	dissolution of acids in water		
				418	dissolution of bases in water		
				418	strong vs. weak acids		

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				418	properties of bases		
				419	strong vs. weak bases		
				419	weak and strong acids and bases		
				419	neutralization of acids and bases		
				420	defining and determining pH		
				420	pH and pH scale		
				421	pH of substances you use or consume		
				421	table of pH of common substances		
				423	electrolytes and nonelectrolytes		
				423	electrolytes and nonelectrolytes		
				423	acids and bases are electrolytes		

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PS.2.11 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Define the four fundamental forces in nature (gravitational, electromagnetic, weak nuclear and strong nuclear).	52	gravity depends on mass	20	investigate effect of gravity on motion
				52	the effect of gravity		
				54	Newton's law of universal gravitation	136	strong force
				55	calculating gravitational force between objects	257	relating the relationship between orbital speed and distance to the equation of universal gravitation
				106	electrical force is incredibly strong!		
				106	electrical forces		
				389	electromagnetic force		
				389	strong nuclear force		
				389	forces in the nucleus		
				606	Newton's law of universal gravitation		

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PS.2.12 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Analyze the aspects of motion (frame of reference, speed, velocity, acceleration, relativity, time and displacement), and distinguish between average, constant and instantaneous motion. (demonstrate and evaluate motion graphically.)	13	speed is relative	8	calculating speed
				14	how to calculate speed	9	collect data and calculate speed of car
				15	compare and contrast speed and velocity	10	calculate speed of the car
				18	what is the speed of an object that is standing still?	12	calculate speed of moving car
				20	calculate speed of car	12	model the car's motion graphically
				20	find speed of bumblebee	12	find speed of car at different positions
				24	accurate speed measurements	13	make a position vs. time graph
				25	conceptual models of motion	14	calculate acceleration of car on ramp
				29	position vs. time graph discussion	14	acceleration is the rate at which speed changes
				30	position vs. time graphs	14	calculate speed of car at two places on the ramp
				32	average speed vs. instantaneous	15	make a speed vs. time graph
				32	average speed discussed	15	make a speed vs. time graph
				35	how to calculate acceleration	17	explore 2nd law and acceleration
				36	examples of acceleration	17	calculate speed of car
				37	speed vs. time graph discussion	36	find speed of marble
				37	speed vs. time graphs		
				41	find acceleration of car		

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
				42	calculate speed from distance/time graph		
				49	link between force and acceleration		
				53	acceleration due to gravity		
PS.2.13 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Investigate the aspects of two-dimensional motion (circular, rotational and projectile), momentum and impulse.	60	law of conservation of momentum		
				60	how to calculate momentum		
				64	calculate momentum		
PS.2.14 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Apply the laws of conservation to interactions of matter (momentum, angular momentum, mass/energy, and electric charge).	60	law of conservation of momentum	37	investigating conservation of energy with rollercoaster
				88	potential and kinetic energy explained	38	conservation of energy and energy transformations
				90	conservation of energy explained		
				92	energy transformations and conservation	150	investigate conservation of mass in effervescent tablet reaction
				93	different forms of energy described		
				96	prove that energy is conserved		
				363	history of law of conservation of mass		

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PS.2.15 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Explain the relationship of matter and energy ( $E=mc^2$ ).	623  633	nuclear fusion on the sun produces energy from matter  Einstein's equation		
PS.2.16 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Recognize the relationships of forces and motion, applying Newton's laws, and diagrams to analyze the forces on a system.	45 45 45 46 48 49 49 51 59 64	Newton's third law summarized Newton's second law summarized Newton's first law summarized force has potential to change motion Newton's first law in detail force is related to acceleration Newton's second law in detail balanced and unbalanced forces Newton's third law in detail solving problems using $f=ma$	14 16 16 16 19 19 20 22 23	exploring acceleration on a ramp 2nd law unbalanced forces and acceleration of car thinking about force discover 2nd law of motion find correct relationship between force mass and acceleration force and motion with car and ramp car and ramp and Newton's 3rd law using 3rd law to explain common phenomena

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PS.2.17 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Examine the types of waves (transverse, longitudinal, standing, circular, electromagnetic), properties and characteristics of waves (reflection, refraction, diffraction, interference, pitch, frequency, and velocity), and how waves transfer energy.	195	waves transmit energy	82	study wave pulses on elastic cord
				196	waves are all around us	83	measure speed of a wave pulse
				197	transverse and longitudinal waves	83	find speed of a wave
				198	frequency and wavelength and amplitude	84	make different types of waves in a ripple tank
				201	reflection in water waves and light waves	85	observing reflection in water waves
				201	waves and reflection	86	investigate frequency and wavelength
				201	waves and refraction	86	adjust frequency of a standing wave
				202	refraction and eyeglasses	87	investigating resonance
				204	resonance explained	88	natural frequency and resonance of standing waves on a string
				205	standing waves on a string	90	what is sound and how do we hear it?
				206	constructive and destructive interference	95	investigate interference with sound waves
				210	can wave interference sink a ship?	96	investigating sound resonance
				210	natural frequency of a building and earthquakes	101	examine light through diffraction grating
				215	properties of sound waves	102	polarization of a spring wave
				219	frequency of sound and pitch	102	polarization of water waves
				221	importance of wavelength of sound waves		
				223	interference of sound waves		

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				225	consonance and dissonance and beats	103	polarization of light
				237	microwave ovens	108	explore refraction with a prism
				237	light waves and the electromagnetic spectrum		
				237	radio and television signals		
				240	polarization of light		
				242	properties of light waves		
				250	identify uses of electromagnetic waves		
				261	refraction and lenses		
				272	identify uses of electromagnetic waves		
				480	electromagnetic radiation		
				480	energy and radiation relationships		
				626	the sun's energy reaches Earth in the form of electromagnetic waves		

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PS.2.18 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Investigate the properties and characteristics of light and different optical systems (lenses, mirrors, polarization filters, fiber optics, and lasers).	237	visible light and the electromagnetic spectrum	106	tracing incident and reflected rays
				242	color and frequency of light waves	107	investigate how light interacts with mirrors
				258	forming images with lenses	108	explore refraction with lenses
				258	refraction in optical systems	108	investigate how light interacts with a prism
				263	index of refraction	108	tracing incident and refracted rays
				263	index of refraction		
				273	find the angle of reflection	134	investigating visible light with a spectrometer
				480	absorption and emission	253	using a retractive telescope
						265	an element's spectral lines correspond to specific wavelengths of light
PS.2.20 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Investigate the electromagnetic spectrum and the derivation of emission and absorption spectra.	234	electrons and energy levels and light emission	100	study what makes light
				234	what makes light?	101	observing white light through diffraction grating
				237	visible light and the electromagnetic spectrum	134	investigating visible light with a spectrometer
				479	ultraviolet and infrared light	265	an element's spectral lines correspond to specific wavelengths of light

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PS.2.21 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Examine the properties of sound (pitch, frequency, and intensity) and other related aspects (earthquakes, shock waves, SONAR).	213	how the ear works	90	investigate human perception of sound
				217	loudness and decibels	90	investigate human perception of sound
				219	frequency of sound and pitch	90	what is sound and how do we hear it?
				220	voice recognition programs	94	does sound behave like other waves?
				220	sonograms	98	investigate sound and music
				222	effect of temperature on speed of sound wave	232	create a model that simulates an earthquake and discover some of the conditions that affect its timing, duration, and intensity
				222	effect of medium on speed of sound wave		
				226	musical instruments		
				537	conversion of energy in rocks causes seismic waves		
				537	causes and descriptions of earthquakes		
				538	seismic waves		
				539	earthquakes rating scales		

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PS.2.22 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Investigate electric and magnetic interactions and fields (poles, magnetic domains, charges, field lines, potential difference, force and Coulomb's Law).	105 106 107 108 108 114 159 163 164 166 166 168 170 171	charge is a fundamental property of matter static charge discussed explanation of coulomb electroscopes how an electroscope works voltage is related to potential energy magnetism explained understanding magnetic fields what is an electromagnet? increased current vs. strength of magnetic field building an electromagnet how electric motors work dissecting an electric motor electromagnetic induction explained	42 66 67 68 73 73	investigate electric charge build an electromagnet find out what happens to strength of electromagnet when current is increased investigate how an electric motor works use magnetic induction to create an electric field exploring electric generators
PS.2.23 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Distinguish between direct and alternating current.	101	concept of electric current	46	investigate concept of electric current

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PS.2.24 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Analyze and evaluate the parameters of circuits applying Ohm's Law and use appropriate data collections and calculations (current, resistance, and voltage).	101 114 115 117 119 123 131 132 136	concept of electric current voltage and potential energy how to measure voltage electrical current explained how to measure current understand the concept of electrical resistance Ohm's law explained using Ohm's law to analyze circuits potentiometer explained	44 46 48 50	investigate concept of voltage investigate concept of electric current measuring resistance Ohm's law
PS.2.25 Physical Systems	9-12	Students will explore, demonstrate, communicate, apply, and evaluate the knowledge of physical systems.	Analyze the interdependent fields of electricity and magnetism (electromagnets, motors, generators, and transformers).	168 170 171	how electric motors work dissecting an electric motor electromagnetic induction explained	68 73 73	investigate how an electric motor works use magnetic induction to create an electric field exploring electric generators

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PS.3.01 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Analyze the role science plays in everyday life and compare different careers in the physical sciences.	452	civil engineers and bridge design	6	asking questions and learning about natural world
				457	engineers design better products when they know specific heat	178	water quality specialist
				473	why do ears pop	215	the food paradox of the oceans
				504	meteorologists use atmospheric pressure data to understand movement of weather systems	222	zoo exhibit designers
				542	seismologists		
				548	describe the work of a geologist and paleontologist and seismologist		
				561	volcanologists		
				648	evidence for Big Bang theory		

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PS.3.02 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Evaluate long range plans for resource use and by-product disposal in terms of environmental, economic, and political impact.	333	problems with disposing of plastics	163	too much CO <sub>2</sub>
				355	recycling tires	163	research how trees offset accumulation of CO <sub>2</sub>
				356	recycling discarded tires	163	consider a vehicle's fuel economy
				364	petroleum	163	economic impact of end-product of combustion reaction
				368	limiting reactants	164	perform water quality tests
				379	hydrogen-powered cars and the environment	178	predict the quality of surface water to be tested and justify your answer
				379	research economic impact of fuel cells	178	wise use of water supply
				379	research environmental impact of fuel cells	178	predict the quality of surface water to be tested and justify your answer
				379	research fuel cells	179	maintaining water supply quality
				379	research fuel cells	179	address what you can do to maintain or improve the water quality at the test site
				392	storage of nuclear waste	180	perform water quality tests
				395	fossil fuels		
				400	problems caused by airborne pollutants		
				400	economic impact of pollution		
				400	economic impact of reducing air pollution		
				411	effects of PCB's in Great Lakes		
				414	effect of electrical generating facilities on dissolved oxygen in water		

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
				414	effect of electrical generating facilities on dissolved oxygen in water	180	save water for houseplants
				432	water cycle and conservation	182	investigate effect of acid rain on microorganisms
				433	wise use of water	182	the effects of acid rain on organisms in aquatic environments
				433	The Clean Water Act		
				435	water quality testing	182	the effects of acid rain on organisms in aquatic environments
				435	water usage and quality		
				436	effect of excess nitrates on environment	201	research the causes of ozone in the lower atmosphere
				436	water quality testing		
				437	effects of acid rain on natural environments		
				437	acid rain explained		
				437	acid rain		
				437	acid rain		
				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		

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				444	pollution and the ocean food chain		
				445	pollution and the ocean food chain		
				448	research economic impact of producing gases that cause acid rain		
				448	research the issue of acid rain		
				471	nitrogen cycle		
				479	effects of CFC's on the ozone layer		
				482	changes to the oceans due to increasing global temperatures		
				482	effects of burning fossil fuels		
				504	temperature inversion		
				515	permafrost		
				568	how urban sprawl changes local climate		

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PS.3.03 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Assess current world issues applying scientific themes (suggested issues: global changes in climate, ozone depletion, UV radiation, natural resources, use of technology, and public policy).	379	hydrogen-powered cars and the environment	161	research pros and cons of uses for radioactive elements
				393	carbon dating	163	too much CO2
				393	radioisotopes in science and medicine	182	investigate effect of acid rain on microorganisms
				395	fossil fuels		
				400	research pros and cons of nuclear technology		
				436	effect of excess nitrates on environment		
				437	acid rain explained		
				448	research the issue of acid rain		
				485	computer modeling to predict greenhouse effects		

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PS.3.04 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Understand that mathematics is the precise language of communication and problem solving in science (conversions logarithms, inverse square law, ect). (Measure and calculate using SI units.)	6	scientists use metric units	12	make metric length measurement
				18	perform dimensional analysis calculations	21	think about percent change
				19	convert from english to metric	25	create a mathematical model
				42	interpreting distance/time graph	27	find math rule for lever equilibrium
				78	use and understand mass measurements	28	derive a math formula
				459	heat equation	116	measuring mass
				592	unit conversion in calculating light years	171	average dissolving rate
				629	converting light years to astronomical units	187	find equation for trend line
				645	inverse square law	257	inverse square law
						258	determining scale distances

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PS.3.05 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Apply technology as appropriate tools for solving problems (electronic balances, computers, pH meters, spectrophotometers , multimeters, etc).	24	using an electronic timer		<p>data tables and graphs can be created on computer or graphing calculator</p> <p>12 using photogates</p> <p>14 using photogates</p> <p>17 use photogates to study car on ramp</p> <p>18 use a balance to find mass of car</p> <p>44 using electrical meter</p> <p>46 using electrical meter</p> <p>48 using electrical meter</p> <p>50 using electrical meter</p> <p>210 use a multimeter and solar cell</p>

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PS.3.06 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Assess the connections between pure science and applied science to the world of work by performing labs and activities common to the physical sciences.	9	steps in the scientific method	7	compare results with hypothesis
				10	forming a hypothesis	7	perform your own experiment
				11	control and experimental variables	7	doing a controlled experiment
				19	design your own experiment	9	conduct three experiments with appropriate equipment
				26	independent and dependent variables	10	conduct car/ramp experiment
				73	relationship between science and technology	10	selecting ramp and photogates
				448	describe steps you would take to determine whether pH affects frog population	12	select equipment and set up experiment
				530	using echo sounders to map the sea floor	16	investigate Newton's 2nd law
				597	using satellite technology	27	recognize variables
				599	space shuttle	30	rigging block and tackle
						34	investigate motion on a rollercoaster
						40	choose circuit parts to light a bulb
						70	using engineering design cycle
		75	plan three experiments to determine which variable affects the period of a pendulum				

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						75	perform self-designed experiment
						145	carry out procedure and select equipment
						151	select materials from list
						170	which factor will produce fastest dissolving rate?
						182	simulating the effect of acid rain on daphnia
						188	conducting investigation of efficiency of immersion heater
						190	effect of changing mass on collected data
						193	conducting experiments on heat transfer
						205	investigating how specific heat of water regulates Earth's temperature
						209	measuring the intensity of light using an electric meter and solar cell and light bulb
						211	determining whether distance from light source or axial tilt plays a more significant role in causing the seasons
						237	develop a research plan for studying volcanoes

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						252	identifying the parts of a refracting telescope and making observations of the moon's surface

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Standard #: Strand	Grades	Content Standard	Student Learning Expectation	student text pg	detail	investigation pg	detail
PS.3.07 Physical Systems	9-12	Students will demonstrate an understanding of the connections and applications of physical science.	Understand broad themes of Project 2061. Such themes include systems, patterns of change, interactions, energy equilibrium, models, and scale (e.g., relative dimensions such as solar system size). (See <a href="http://www.project2061.org/">http://www.project2061.org/</a> )	23	why make models?	13	graph distance vs. time
				24	making a graph	15	construct a quantitative graphical model
				24	what is a scientific model?	25	create a mathematical model
				24	scientific models	27	find math rule for lever equilibrium
				26	creating graphs	28	derive a math formula
				41	make a graph	36	investigate energy conservation
				42	interpreting distance/time graph	37	organize data into a graph of speed vs. height
				51	what is equilibrium?	39	study energy transformations in daily life scenarios
				58	Newton on a skateboard	51	graph voltage vs. current
				59	equilibrium/action reaction	68	form and function of different electric motor configurations
				60	conservation of momentum	84	waves in motion
				78	describe a problem that would be solved by an engineer	87	changing frequency in standing waves
				80	form and function of wheelbarrow and sailboat and human jaw	108	form and function of human eye, prism, and lenses
				90	conservation of energy	121	graph mass vs. volume
				120	circuits in your house	147	organize observations into a category table
				164	electromagnets reverse current and switch polarity		
				180	harmonic motion in natural systems		
				258	optical systems		
				261	change in optical systems		

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				278	system of classifying matter	150	investigate conservation of mass
				363	conservation of mass	151	does your experiment agree with law of conservation of mass?
				363	conservation of mass		
				389	atoms and nuclear energy	158	energy in chemical reactions
				407	a solute and a solvent make up a system	179	researching and preparing for a field trip to test surface water
				415	equilibrium and solubility		
				415	solubility equilibrium		
				422	change in pH values	185	constructing a graph of drops of acid vs pH
				429	the water cycle	187	construct a graphical model
				435	pond ecosystem and water quality	187	find equation for trend line
				438	acid rain formation system	189	construct a temperature vs. time graph
				452	balloons expands or contracts due to thermal expansion	197	evaluating the relationship between atmospheric pressure and weather
				454	temperature vs. thermal energy for a cup or pot of soup	197	constructing a graph from atmospheric pressure data
				459	heat equation	198	food energy
				460	thermal equilibrium		
				461	understanding thermal energy through cocoa example	201	suggesting ways that ozone concentrations could be reduced
				463	convection and sea breezes		

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				465	examples of reflectors and absorbers	202	modeling the effect of greenhouse gases on Earth's temperature
				473	why do ears pop		
				476	atmospheric pressure in Denver	203	graphing water and ice temperature readings
				485	computer modeling to predict greenhouse effects	204	connecting the latent heat investigation to Earth
				489	patterns of heating and cooling on Earth	206	constructing a graph of time vs. temperature
				490	using the North Star to estimate your latitude	212	modeling underwater rivers and waterfalls and springs
				494	modeling air currents	218	understanding Doppler radar
				508	patterns in storm activity across the globe	231	evaluating your completed bathymetric map
				509	how do animals survive in the desert?		
				509	how do animals survive in the desert	232	construct a model that simulates an earthquake
				512	how do savanna animals survive the periodic fires?	247	evaluate your ability to interpret rock formations
				518	create a model (#1)	257	inverse square law
				524	model of Earth's history	258	setting up a scale model of the solar system
				533	modeling plate boundaries		
				533	patterns of earthquakes and volcanoes		
				536	analogy of plate movements		

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				540	boundaries of tectonic plates		
				553	the Ring of Fire		
				576	rock cycle model		
				584	lunar cycles		
				609	tides		
				614	solar system modeling		
				624	model of the sun's anatomy		
				637	categorizing stars with H-R diagrams		
				645	inverse square law		