

Correlation to South Carolina Science Academic Standards

CPO Science Physics: A First Course

Student Text and Investigation Manual

Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-01.01 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Apply established rules for significant digits, both in reading scientific instruments and in calculating derived quantities from measurement.	featured in ancillary component	

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P-01.02 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.	305 using a multimeter to measure current 307 using a multimeter to measure resistance	2 using timers and photogates 16 safety with simple machines 22 use spring scales 44 using a timer and photogates 46 using a timer and photogates 47 conduct the experiment you designed 48 demonstrate safe lab practices 59 use a multimeter 61 using a multimeter to measure resistance 62 use a multimeter to measure current 63 use a multimeter to measure resistance of a pot 64 use a multimeter to measure voltage drop 65 use a multimeter to measure voltage 66 use a multimeter to measure current 67 short circuits and lab safety

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					<p>70 capacitor safety</p> <p>74 use a multimeter to measure voltage</p> <p>85 use a multimeter to measure voltage</p> <p>86 use a timer and photogate to measure speed of rotor</p> <p>93 use a timer and photogate to measure the period of a pendulum</p> <p>96 use a timer and photogate to measure the natural frequency of an oscillator</p>

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P-01.03 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.	11	understand length measurement	1	collect accurate, precise data with electronic timer
				12	systems of measurement	7	collect precise data
				29	measuring mass	8	make mass measurements
				30	measuring force	10	make length measurement
				65	joule is a unit of energy	14	measure mass of car
				86	work and energy are measured in joules	17	measure string length
				89	units of power	19	measure the force
				177	joules and heat energy	22	measure force
				302	measuring electric current	23	measure the mass
				303	measuring voltage	27	how can photogate ensure consistent results?
				327	electrical power is measured in watts	28	measure height of track
						33	measure mass of ice and cup
						44	measure mass of car
		44	make a precise time measurement				
		46	measure mass of car				
		50	measure mass				
		50	measure volume				
		59	work with volts and amps				
		76	measure mass of capacitor				

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						78 estimate the precision of measurements
P-01.04 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations.	4 6 8 8 8 8 8 16 16 24	what is an experiment what is a variable control and experimental variables dependent variables independent variables designing experiments graphs and dependent variables graphs and independent variables importance of changing one variable at a time in an experiment	6 recognize and control variables 6 design a better experiment 13 design other experiments 15 design another experiment 27 identify and control variables 47 design an experiment 94 investigate variables and how they affect the period of a pendulum 94 design pendulum experiments

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P-01.05 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Organize and interpret the data from a controlled scientific investigation by using (including calculations in scientific notation, formulas, and dimensional analysis), graphs, tables, models, diagrams, and/or technology.	15	setting up unit conversions	4	construct a graph
				16	steps to follow for graph construction	6	use a data table
				16	constructing graphs	8	constant force data table
				19	mathematical descriptions	9	constant height data table
				25	constructing a graph	10	speed data table
				26	interpreting distance/time graph	11	find formula for acceleration
				34	mathematical model of acceleration	11	create a graph
				35	Newton's second law equation	13	collision data table
				41	average speed equation	13	derive a formula
				43	calculating weight	15	graph speed vs. height
				46	motion graphs	17	calculate mechanical advantage
				48	motion graphs	17	derive a formula to use with ropes and pulleys
				56	analyze a speed/distance graph	18	output and input work data table
				61	momentum equation	19	force vs. distance data table
				62	relating impulse and momentum conservation	20	graph work done vs. deflection of rubber band
				68	kinetic energy formula	21	graph speed vs. rubber band deflection
				86	the work equation	22	force data table
				89	the power equation	25	rolling friction data table
96	calculating mechanical advantage	25	graph friction vs. mass				

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				112	using a graph to find force vector components	27	graph launch angle vs. range
				118	Hooke's law equation	29	graph acceleration vs. steepness ratio
				141	projectile motion problems	29	find a mathematical name for the steepness ratio
				143	calculating angular speed	29	speed and height data table
				144	finding the circumference of a circle	29	calculate the ratio
				145	linear speed equation	31	calculate temperature of mixture
				153	equation for law of universal gravitation	45	make a graph of efficiency vs. speed
				179	the heat equation	47	analyze the results
				193	density formula	50	graph time vs. temperature
				208	pressure and temperature relationship	52	construct a graph
				308	equation for Ohm's law	69	calculate power used by the bulb
				342	equation for Coulomb's law	75	graph current vs. time for the capacitor
				419	harmonic motion graphs	75	derive a formula to calculate the charge
				420	finding the amplitude on a harmonic motion graph	76	calculate the number of electrons
				438	calculating wave speeds	86	graph voltage vs. speed
				439	equation for the speed of a wave	94	sketch harmonic motion graphs
				525	equation for the speed of light		

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					99 calculate natural frequency and period 154 calculate gear ratio 154 create a data table 154 analyze gear ratio data
P-01.06 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.		6 do results agree with hypothesis? 6 reflecting on the experiment 7 construct explanations supported by evidence 9 how do your observations support your answer? 11 what experimental data support answer? 47 construct a reasonable explanation 60 propose a relationship between power and voltage

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P-01.07 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Evaluate conclusions based on qualitative and quantitative data (including the impact of parallax, instrument malfunction, or human error) on experimental results.	10 what is a model	<p>3 car launching technique is a possible source of error</p> <p>4 car launching technique is a possible source of error</p> <p>6 reflecting on the experiment</p> <p>7 construct explanations supported by evidence</p> <p>9 how do your observations support your answer?</p> <p>11 what experimental data support answer?</p> <p>21 how close is your prediction to the actual measurement?</p> <p>26 spotting the landing point of the marble is tricky</p> <p>27 marble launching technique is a possible source of error</p> <p>47 construct a reasonable explanation</p> <p>60 propose a relationship between power and voltage</p>

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P-01.08 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).	105 engineering design cycle in action	86 what changes have the largest effect on voltage produced? 86 implement your generator design change ideas 86 what could you do to change the performance of the generator you built? 87 evaluate the effects your design change produced 87 measure voltage for each different generator 87 try your design change ideas 87 building different generators 87 build different generators
P-01.09 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Communicate and defend a scientific argument or conclusion.		67 explain what happened 154 create a report

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P-01.10 Physics	Scientific Inquiry	The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.	Use appropriate safety procedures when conducting investigations.		16 safety with simple machines 48 demonstrate safe lab practices 67 short circuits and lab safety 70 capacitor safety
P-02.01 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Represent vector quantities (including displacement, velocity, acceleration, and force) and use vector addition.	111 force vectors 112 resolving vectors 113 using a free-body diagram 115 finding resultant vector 136 working with velocity vector	23 draw a free body diagram 23 use force vectors

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P-02.02 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Apply formulas for velocity or speed and acceleration to one and two-dimensional problems.	17	constant speed	3	find the speed of the car
				17	speed of light	6	how can speed be measured?
				17	speed defined	7	measure the speed
				18	speed units	9	why did the speed change?
				18	calculating speed	10	find speed of car
				19	velocity defined	11	investigating net force and acceleration
				32	acceleration defined	21	measure speed of car
				33	acceleration and velocity	25	calculate speed of car
				40	velocity defined	44	experiment and find average speed
				45	skydiving and terminal speed	46	measure speed of car
				45	terminal speed		
				56	calculate speed from distance/time graph		
				136	speed vs. velocity		
143	angular speed						
P-02.03 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Interpret the velocity or speed and acceleration of one and two-dimensional motion on distance-time, velocity-time or speed-time, and acceleration-time graphs.	46	position vs. time graphs	4	position vs. time graph
				47	position vs. time graph for accelerating motion	11	speed vs. time graph
				48	speed vs. time graph		
				49	speed vs. time graph for accelerating motion		
				51	finding distance from a speed vs. time graph		

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P-02.04 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Interpret the resulting motion of objects by applying Newton's three laws of motion: inertia; the relationship among net force, mass, and acceleration (using $F = ma$); and action and reaction forces.	29	Newton's first law	8 investigate Newton's first law of motion
				35	quantitative understanding of second law	10 investigate Newton's second law of motion
				35	Newton's second law	12 investigate Newton's 3rd law of motion
				36	applying Newton's second law properly	13 relate Newton's 3rd law of motion to car collisions
				37	using second law formula	
				52	action-reaction pairs	23 Newton's second law of motion
				59	Newton's third law	25 apply Newton's second law of motion
				60	sorting out force pairs	
				78	third law and rockets	29 apply Newton's second law of motion
				117	Newton's third law and springs	95 Newton's 2nd law of motion and natural frequency
				128	the third law and physics of walls	
				158	Newton's third law and helicopters	
				424	Newton's second law and oscillators	

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P-02.05 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Explain the factors that influence the dynamics of falling objects and projectiles.	39 calculations pertaining to free fall 39 effect of gravity on motion 52 acceleration shown through strobe photography 88 work and gravity 137 projectile explained 138 free fall component of a trajectory 402 gravitational field	26 investigate projectile motion
P-02.06 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Apply formulas for velocity and acceleration to solve problems related to projectile motion.	39 calculations pertaining to free fall 39 effect of gravity on motion 52 acceleration shown through strobe photography 88 work and gravity 137 projectile explained 138 free fall component of a trajectory 402 gravitational field	26 investigate projectile motion

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P-02.07 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Use a free-body diagram to determine the net force and component forces acting upon an object.	36 113 balanced and unbalanced forces drawing free body diagrams	23 draw free body diagram
P-02.08 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Distinguish between static and kinetic friction and the factors that affect the motion of objects.	45 94 101 119 119 120 122 123 418 effects of air resistance friction and machines friction explained cause of friction friction explained static and sliding friction reducing friction useful friction friction and damping	24 investigate effect of friction
P-02.09 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Explain how torque is affected by the magnitude, direction, and point of application of force.	124 124 124 125 125 126 torque causes objects to rotate torque explained comparing torque and force torque is not work calculating torque solving problems with torque	

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P-02.10 Physics		The student will demonstrate an understanding of the principles of force and motion and relationships between them.	Explain the relationships among speed, velocity, acceleration, and force in rotational systems.	127 rotational equilibrium 147 centripetal force 148 centripetal force 154 understanding orbital motion	
P-03.01 Physics		The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy.	Apply energy formulas to determine potential and kinetic energy and explain the transformation from one to the other.	67 calculating potential energy 68 calculating kinetic energy 68 potential to kinetic energy conversions 69 kinetic energy and stopping distance of a car 70 potential to kinetic energy conversions 117 potential and kinetic energy in a spring 249 mechanical systems and energy	15 calculate potential energy of car 24 calculate kinetic energy of sled 47 calculate energy

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P-03.02 Physics		The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy.	Apply the law of conservation of energy to the transfer of mechanical energy through work.	10 conservation of energy 66 energy is stored work 67 potential energy explained 68 kinetic energy explained 70 law of conservation of energy 71 using energy conservation to solve problems 240 energy and systems 243 energy flow diagrams 249 energy flow diagram for mechanical systems 251 energy flow in natural systems	14 investigate exchange of energy in car and track system 15 apply law of energy conservation 19 investigate concept of energy as stored work 42 model how atoms exchange energy 45 describe energy changes 46 investigate energy flow in a system 47 draw an energy flow diagram 57 draw energy flow diagram of the circuit

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P-03.03 Physics		The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy.	Explain, both conceptually and quantitatively, how energy can transfer from one system to another (including work, power, and efficiency).	86	calculating work	45	calculate efficiency of the experimental system		
				88	calculating work				
				89	calculating power			45	graph efficiency vs. speed
				90	maximum power output of a person			45	investigate efficiency
				102	efficiency explained				
				244	power explained				
				245	three ways to look at power				
				246	efficiency explained				
				247	efficiency of a heat engine				
				248	efficiency of living things				
				250	power in human technology				
				252	power in natural systems				
				254	wave power				
				254	tidal power				
				334	efficiency of gasoline engine				
				334	efficiency of electric motors				

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P-03.04 Physics		The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy.	Explain, both conceptually and quantitatively, the factors that influence periodic motion.	414 a pendulum's cycle 414 understanding a cycle 416 frequency explained 416 period is the time for one cycle 417 frequency is the inverse of period 418 amplitude explained 430 identify period and frequency and cycle and amplitude	92 explore the meaning of amplitude 92 explore the meaning of cycle 92 explore harmonic motion using a pendulum 93 measure the period of a pendulum 94 investigate harmonic motion with a pendulum
P-03.05 Physics		The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy.	Explain the factors involved in producing a change in momentum (including impulse and the law of conservation of momentum in both linear and rotary systems).	61 momentum is calculated with velocity – not speed 63 law of conservation of momentum 64 using momentum conservation to solve problems 74 momentum and collisions 77 momentum and car safety	13 apply the law of conservation of momentum
P-03.06 Physics		The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy.	Compare elastic and inelastic collisions in terms of conservation laws.	73 elastic and inelastic collisions 74 momentum conservation in collisions 75 forces in collisions	13 investigate collisions with the energy car

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P-04.01 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Recognize the characteristics of static charge and explain how a static charge is generated.	340 understanding electric charge 341 what causes shocks 341 charged objects and static electricity 354 understanding lightning	72 investigate the nature of electric charge
P-04.02 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Use diagrams to illustrate an electric field (including point charges and electric field lines).	404 the electric field	89 understand and investigate electric and gravitational fields

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P-04.03 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Summarize current, potential difference, and resistance in terms of electrons.	298	electric current	58	measure voltage
				300	resistors	59	measure current
				302	current in simple circuits	60	measure voltage
				303	understanding voltage	61	investigate resistance
				305	measuring current with a multimeter	62	investigate Ohm's law
				306	understanding electrical resistance	63	investigate resistance and potentiometers
				307	measuring resistance	63	use Ohm's law
				308	Ohm's law	65	measure the voltage
				309	resistance of common objects	66	current in a series circuit
				311	resistors	67	Ohm's law and short circuits
				319	resistance in a series circuit	74	investigate the flow of electric charge
				319	current in a series circuit	75	work with Ohm's law
				320	voltage in a series circuit		
				321	Ohm's law and voltage drops		
				323	current in a parallel circuit		
				324	voltage in a parallel circuit		
				346	charge and current		
				349	voltage and charge		
351	voltage and capacitors						

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P-04.04 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Compare how current, voltage, and resistance are measured in a series and in a parallel electric circuit and identify the appropriate units of measurement.	302 measuring electric current 303 measuring voltage 318 series circuits 323 parallel circuits 325 comparing series and parallel circuits 326 parallel circuits in homes	59 work with volts and amps 65 investigate series circuits 66 investigate series circuits 68 compare series and parallel circuits 68 investigate parallel circuits
P-04.05 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Analyze the relationships among voltage, resistance, and current in a complex circuit by using Ohm's law to calculate voltage, resistance, and current at each resistor, any branch, and the overall circuit.	308 Ohm's law 321 Ohm's law and voltage drops 325 comparing series and parallel circuits	62 investigate Ohm's law 63 use Ohm's law 64 investigating voltage drops 67 Ohm's law and short circuits 68 compare series and parallel circuits 75 work with Ohm's law
P-04.06 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Differentiate between alternating current (AC) and direct current (DC) in electrical circuits.	330 alternating current 330 direct current	

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P-04.07 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Carry out calculations for electric power and electric energy for circuits.	328 calculating power in a circuit	69 finding power used by a circuit 70 explain what you observed in terms of energy and power 71 calculate energy and power
P-04.08 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Summarize the function of electrical safety components (including fuses, surge protectors, and breakers).	326 understanding short circuits 332 electrical safety and ground fault interrupt outlets 332 electrical safety and circuit breakers 353 capacitor safety	67 understand why short circuits are dangerous 67 investigate short circuits and learn how to avoid
P-04.09 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Explain the effects of magnetic forces on the production of electrical currents and on current carrying wires and moving charges.	364 electromagnets 365 building an electromagnet 380 effect of current on a compass 387 electromagnetic induction explained 522 electromagnetic waves	80 compare magnetic force and electric current in an electromagnet 80 explore properties of electromagnets 81 find relationship between current and magnetic field 85 investigate electromagnetic induction

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P-04.10 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Distinguish between the function of motors and generators on the basis of the use of electricity and magnetism by each.	385	how an electric motor works	83	build a simple electric motor
				386	how a battery-powered electric motor works	84	build an electric motor and perform experiments
				389	how a generator works	87	investigate how generators work
P-04.11 Physics		The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them.	Predict the cost of operating an electrical device by determining the amount of electrical power and electrical energy in the circuit.	328	calculating power in a circuit	69	finding power used by a circuit
						70	explain what you observed in terms of energy and power
						71	calculate energy and power

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P-05.01 Physics		The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves.	Analyze the relationships among the properties of waves (including energy, frequency, amplitude, wavelength, period, phase, and speed).	414 a pendulum's cycle 414 understanding a cycle 416 frequency explained 416 period is the time for one cycle 417 frequency is the inverse of period 418 amplitude explained 430 identify period and frequency and cycle and amplitude 434 waves transmit energy 437 frequency and amplitude and wavelength of waves 438 the speed of waves 447 waves and energy 456 speed of sound 461 wavelength of sound 468 pitch and the musical scale	92 explore the meaning of amplitude 92 explore the meaning of cycle 92 explore harmonic motion using a pendulum 93 measure the period of a pendulum 94 investigate harmonic motion with a pendulum 101 investigate standing waves and frequency
P-05.02 Physics		The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves.	Compare the properties of electromagnetic and mechanical waves.	435 waves and technology	

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P-05.03 Physics		The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves.	Analyze wave behaviors (including reflection, refraction, diffraction, and constructive and destructive interference).	442	reflected waves	106	investigate interference and beats
				442	refracted waves	113	use a mirror to observe reflected light
				443	diffraction explained	114	use a prism to investigate light rays
				445	destructive interference	115	investigate refraction
				445	constructive interference	119	investigate lenses and magnification
				469	frequency of sound and beats	120	using a mirror to reflect light
				482	reflection of light	120	investigate reflection of light
				482	refraction of light	121	investigate refraction of light
				499	mirrors reflect light	121	use a lens to refract light
				501	reflection explained	122	investigate diffraction of light
				503	index of refraction		
				503	understanding refraction		
				504	angles of incidence and refraction		
				528	diffraction and light		
				529	interference of light waves		
				530	diffraction gratings and spectrometers		

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P-05.04 Physics		The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves.	Distinguish the different properties of waves across the range of the electromagnetic spectrum.	435 waves and technology 483 white light is a mixture of colors 523 electromagnetic spectrum 524 wavelength and frequency of visible light 536 the electromagnetic spectrum	111 mixing primary colors of light 122 observe white light through diffraction glasses 123 investigate visible light wavelengths
P-05.05 Physics		The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves.	Illustrate the interaction of light waves with optical lenses and mirrors by using Snell's law and ray diagrams.	499 mirrors reflect light 502 drawing a ray diagram 502 the law of reflection 508 ray diagram of an image in a mirror 510 ray diagram for a converging lens 511 the image formed by a lens	113 construct ray diagrams 113 investigate law of reflection 113 use a mirror to observe reflected light 114 construct ray diagrams 114 use results to derive law of reflection 114 use a prism to investigate light rays 115 investigate refraction 119 investigate lenses and magnification 120 using a mirror to reflect light 121 use a lens to refract light

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P-05.06 Physics		The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves.	Summarize the operation of lasers and compare them to incandescent light.	446 how a laser works	
P-06.01 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Summarize the production of sound and its speed and transmission through various media.	415 sound is a wave 435 how to recognize waves 454 sound is a wave 458 how sound is recorded 459 sound is a wave 459 sound waves and different media	104 properties of sound waves 105 investigate sound wave interference
P-06.02 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Explain how frequency and intensity affect the parts of the sonic spectrum.	456 speed of sound 468 pitch and the musical scale	

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-06.03 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Explain pitch, loudness, and tonal quality in terms of wave characteristics that determine what is heard.	455 the decibel scale 455 acoustics 456 speed of sound 461 how a French horn works 462 acoustics of concert halls 467 how the ear works 468 pitch and the musical scale	
P-06.04 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Compare intensity and loudness.	421 circular motion and phase 422 harmonic motion that is out of phase 425 period and natural frequency 446 natural frequency and resonance 455 the decibel scale 471 harmonics and instruments	96 explore natural frequency of an oscillator 101 investigate standing waves 102 harmonics and standing wave patterns 109 harmonics and musical instruments
P-06.05 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Apply formulas to determine the relative intensity of sound.	455 the decibel scale 455 acoustics 461 how a French horn works 462 acoustics of concert halls	

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
P-06.06 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Apply formulas in order to solve for resonant wavelengths in problems involving open and closed tubes.	425	period and natural frequency	96	explore natural frequency of an oscillator
				426	resonance explained	101	investigate standing waves
				446	natural frequency and resonance	103	explore the concept of resonance
				463	standing waves and resonance		
P-06.07 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Explain the relationship among frequency, fundamental tones, and harmonics in producing music.	455	acoustics	102	harmonics and standing wave patterns
				461	how a French horn works	109	harmonics and musical instruments
				462	acoustics of concert halls		
				471	harmonics and instruments		
P-06.08 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Explain how musical instruments produce resonance and standing waves.	425	period and natural frequency	96	explore natural frequency of an oscillator
				426	resonance explained	101	investigate standing waves
				446	natural frequency and resonance	103	explore the concept of resonance
				463	standing waves and resonance		
P-06.09 Physics		The student will demonstrate an understanding of the properties and behaviors of sound.	Explain how the variables of length, width, tension, and density affect the resonant frequency, harmonics, and pitch of a vibrating string.	425	period and natural frequency	96	explore natural frequency of an oscillator
				446	natural frequency and resonance	101	investigate standing waves

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-07.01 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Explain the particulate nature of light as evidenced in the photoelectric effect.	486 photons 533 photon theory of light	
P-07.02 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Use the inverse square law to determine the change in intensity of light with distance	480 light intensity and the inverse square law	
P-07.03 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Illustrate the polarization of light.	531 polarization	125 explore polarization of light 126 explore the concept of polarization of light
P-07.04 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Summarize the operation of fiber optics in terms of total internal reflection.	505 fiber optics	

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
P-07.05 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Summarize image formation in microscopes and telescopes (including reflecting and refracting).	482	refraction of light	113	investigate law of reflection
				482	reflection of light	113	use a mirror to observe reflected light
				499	mirrors reflect light	114	use results to derive law of reflection
				501	reflection explained	114	use a prism to investigate light rays
				502	the law of reflection	115	investigate refraction
				503	understanding refraction	119	investigate lenses and magnification
				504	angles of incidence and refraction	120	using a mirror to reflect light
P-07.06 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Summarize the production of continuous, emission, or absorption spectra.	483	white light is a mixture of colors	120	investigate reflection of light
				523	electromagnetic spectrum	121	investigate refraction of light
				524	wavelength and frequency of visible light	121	use a lens to refract light
				536	the electromagnetic spectrum	111	mixing primary colors of light
						122	observe white light through diffraction glasses
						123	investigate visible light wavelengths

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-07.07 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Compare color by transmission to color by reflection.	478 seeing and reflected light 483 color and light 484 how the human eye sees light 485 how the human eye sees color 488 the CMYK color process 489 the RGB color process 524 energy and color of light	111 reasearch and explain how the eye works 111 colors of light 111 investigate the RGB model of color 112 investigate the CMYK model of color 123 measure wavelengths of visible light using a spectrometer 123 how colors of light relate to frequency and wavelength
P-07.08 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Compare color mixing in pigments to color mixing in light.	488 the CMYK color process 489 the RGB color process	111 investigate the RGB model of color 112 investigate the CMYK model of color
P-07.09 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Illustrate the diffraction and interference of light.	528 diffraction and light 529 interference of light waves 530 diffraction gratings and spectrometers	122 investigate diffraction of light
P-07.10 Physics		The student will demonstrate an understanding of the properties and behaviors of light and optics.	Identify the parts of the eye and explain their function in image formation.	484 how the human eye sees light	111 reasearch and explain how the eye works

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-08.01 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Compare the strong and weak nuclear forces in terms of their roles in radioactivity.	221 weak force explained 221 electromagnetic and strong force 222 radioactive decay 270 radioactive materials	40 find mass number of specific isotope
P-08.02 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Compare the nuclear binding energy to the energy released during a nuclear reaction, given the atomic masses of the constituent particles.	267 nuclear reactions explained 268 nuclear reactions and energy 269 fusion reactions 270 fission reactions	
P-08.03 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Predict the resulting isotope of a given alpha, beta, or gamma emission.	272 half-life	52 investigate concept of half-life
P-08.04 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Apply appropriate procedures to balance nuclear equations (including fusion, fission, alpha decay, beta decay, and electron capture).	267 nuclear reactions explained 268 nuclear reactions and energy 269 fusion reactions 270 fission reactions	
P-08.05 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Interpret a representative nuclear decay series.	271 types of radioactivity 272 half-life	51 investigate concepts of radioactivity 52 investigate concept of half-life

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-08.06 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Explain the relationship between mass and energy that is represented in the equation $E = mc^2$ according to Einstein's special theory of relativity.	280 meaning of Einstein's formula	
P-08.07 Physics		The student will demonstrate an understanding of nuclear physics and modern physics.	Compare the value of time, length, and momentum in the reference frame of an object moving at relativistic velocity to those values measured in the reference frame of an observer by applying Einstein's special theory of relativity.	284 theory of special relativity	53 explore the concept of relativity 55 a thought experiment on Einstein's theories
P-09.01 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Predict the behavior of fluids (including changing forces) in pneumatic and hydraulic systems.	203 pressure and fluids 204 pressure, energy, and force in fluids 206 fluid viscosity	
P-09.02 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Apply appropriate procedures to solve problems involving pressure, force, volume, and area.	196 quantitative understanding of stress 203 pressure explained	35 investigate pressure

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-09.03 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Explain the factors that affect buoyancy.	202 buoyancy explained	
P-09.04 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Explain how the rate of flow of a fluid is affected by the size of the pipe, friction, and the viscosity of the fluid.	205 Bernoulli's principle	37 investigate Bernoulli's principle 38 applying Bernoulli's equation
P-09.05 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Explain how depth and fluid density affect pressure.	199 thermal expansion 203 pressure and fluids 204 pressure, energy, and force in fluids 206 fluid viscosity	

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-09.06 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Apply fluid formulas to solve problems involving work and power.	86 calculating work 88 calculating work 89 calculating power 90 maximum power output of a person 244 power explained 245 three ways to look at power 250 power in human technology 252 power in natural systems 254 wave power 254 tidal power	
P-09.07 Physics		The student will demonstrate an understanding of the principles of fluid mechanics.	Exemplify the relationship between velocity and pressure by using Bernoulli's principle.	205 Bernoulli's principle	37 investigate Bernoulli's principle 38 applying Bernoulli's equation
P-10.01 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Summarize the first and second laws of thermodynamics.	94 work and simple machines 101 output work is always less than input work	18 compare and contrast input and output work 44 friction and energy dissipation 47 investigate friction as a part of energy flow

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-10.02 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Explain the relationship among internal energy, heat, and work.	86 calculating work 88 calculating work 177 heat and work 242 generation of heat from frictional motion	44 friction and energy dissipation 47 investigate friction as a part of energy flow
P-10.03 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Exemplify the concept of entropy.	94 work and simple machines 101 output work is always less than input work	18 compare and contrast input and output work
P-10.04 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Explain thermal expansion in solids, liquids, and gases in terms of kinetic theory and the unique behavior of water.	182 thermal conductivity	
P-10.05 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Differentiate heat and temperature in terms of molecular motion.	176 understanding the difference between heat and temperature	30 investigate difference between temperature and heat
P-10.06 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Summarize the concepts involved in phase change.	174 phase changes	33 investigate energy and phase changes 34 apply concept of energy and phase changes

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Standard #: Course	Topic	Standard	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
P-10.07 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Apply the concepts of heat capacity, specific heat, and heat exchange to solve calorimetry problems.	177 calories explained 178 specific heat explained 179 the heat equation	32 investigate concept of specific heat
P-10.08 Physics		The student will demonstrate an understanding of the principles of thermodynamics.	Summarize the functioning of heat transfer mechanisms (including engines and refrigeration systems).	176 flow of thermal energy is heat 177 heat and work 185 heat transfer is everywhere	