

Correlation to Ohio Science Academic Content Standards

CPO Science - Physics: A First Course

Student Text and Investigation Manual

Standard #: Section	Grade	Topic	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
INQ09_01 Scientific Inquiry	nine	Doing Scientific Inquiry	Distinguish between observations and inferences given a scientific situation.	8 22 scientific method scientific method in action	
INQ09_02 Scientific Inquiry	nine	Doing Scientific Inquiry	Research and apply appropriate safety precautions when designing and conducting scientific investigations.	featured throughout CPO Science program	featured throughout CPO Science program 16 safety with simple machines 48 demonstrate safe lab practices 67 short circuits and lab safety 70 capacitor safety

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INQ09_03 Scientific Inquiry	nine	Doing Scientific Inquiry	Construct, interpret and apply physical and conceptual models that represent or explain systems, objects, events or concepts.	10	what is a model	4	construct a graph
				16	constructing graphs	11	create a graph
				16	steps to follow for graph construction	11	find formula for acceleration
				19	mathematical models	13	derive a formula
				19	mathematical descriptions	15	graph speed vs. height
				25	constructing a graph	17	derive a formula to use with ropes and pulleys
				26	interpreting distance/time graph	17	calculate mechanical advantage
				34	mathematical model of acceleration	20	graph work done vs. deflection of rubber band
				35	Newton's second law equation	21	graph speed vs. rubber band deflection
				41	average speed equation	25	graph friction vs. mass
				43	calculating weight	27	graph launch angle vs. range
				46	motion graphs	29	find a mathematical name for the steepness ratio
				48	motion graphs	29	graph acceleration vs. steepness ratio
				61	momentum equation	29	calculate the ratio
				62	relating impulse and momentum conservation	31	calculate temperature of mixture
				68	kinetic energy formula	45	make a graph of efficiency vs. speed
				86	the work equation		
				89	the power equation		
				96	calculating mechanical advantage		

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				112	using a graph to find force vector components	50	graph time vs. temperature
				118	Hooke's law equation	52	construct a graph
				141	projectile motion problems	69	calculate power used by the bulb
				143	calculating angular speed		
				144	finding the circumference of a circle	75	derive a formula to calculate the charge
				145	linear speed equation	75	graph current vs. time for the capacitor
				153	equation for law of universal gravitation	76	calculate the number of electrons
				179	the heat equation	86	graph voltage vs. speed
				193	density formula	94	sketch harmonic motion graphs
				208	pressure and temperature relationship	99	calculate natural frequency and period
				308	equation for Ohm's law		
				342	equation for Coulomb's law	154	calculate gear ratio
				419	harmonic motion graphs		
				420	finding the amplitude on a harmonic motion graph		
				438	calculating wave speeds		
				439	equation for the speed of a wave		
				525	equation for the speed of light		

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INQ09_04 Scientific Inquiry	nine	Doing Scientific Inquiry	Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs.		<p>1 collect accurate, precise data with electronic timer</p> <p>7 collect precise data</p> <p>27 how can photogate ensure consistent results?</p> <p>78 estimate the precision of measurements</p>

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INQ09_05 Scientific Inquiry	nine	Doing Scientific Inquiry	Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology.	11	importance of units	computer spreadsheets and graphing software can be used throughout the curriculum for data analysis and presentation each investigation contains a "thinking about what you observed" section, and students must be able to communicate and defend their findings from the investigation		
				11	communicating via measurement			
				26	applying your knowledge: three opportunities to research topics and write reports			
				56	analyze a speed/distance graph			
				132	explain your answer using diagrams			
				132	applying your knowledge: two opportunities to research topics and write reports		6	use a data table
				163	applying your knowledge: two opportunities to research topics and write reports		8	constant force data table
				295	applying your knowledge: three opportunities to research topics and write reports		9	constant height data table
				10	speed data table			
					13	collision data table		
					18	output and input work data table		
					19	force vs. distance data table		
					22	force data table		
					25	rolling friction data table		
					29	speed and height data table		
					47	analyze the results		
					67	explain what happened		

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					150 using computer spreadsheets 154 create a report 154 analyze gear ratio data 154 create a data table
INQ09_06 Scientific Inquiry	nine	Doing Scientific Inquiry	Draw logical conclusions based on scientific knowledge and evidence from investigations.		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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PS09_01 Physical Science	nine	Nature of Matter	Recognize that all atoms of the same element contain the same number of protons, and elements with the same number of protons may or may not have the same mass. Those with different masses (different numbers of neutrons) are called isotopes.	220	protons and neutrons and electrons	39	identify atomic number
				222	atomic number and mass number	39	identify mass number
				222	isotopes explained	39	investigate isotopes
				343	electrons and picture tubes	39	atomic structure
				347	electron motion and current		
PS09_02 Physical Science	nine	Nature of Matter	Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral.	220	subatomic particles and charge	72	investigate the nature of electric charge
				226	electrons and energy levels	140	electron configuration
				230	the Bohr model and electron shells		
				340	understanding electric charge		
				341	what causes shocks		
				341	charged objects and static electricity		
				354	understanding lightning		

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PS09_03 Physical Science	nine	Nature of Matter	Describe radioactive substances as unstable nuclei that undergo random spontaneous nuclear decay emitting particles and/or high energy wavelike radiation.	221 weak force explained 222 radioactive decay 267 nuclear reactions explained 268 nuclear reactions and energy 269 fusion reactions 270 fission reactions 270 radioactive materials	
PS09_04 Physical Science	nine	Nature of Matter	Show that when elements are listed in order according to the number of protons (called the atomic number), the repeating patterns of physical and chemical properties identify families of elements. Recognize repeating pattern of electron configurations.	226 electrons and energy levels 230 the Bohr model and electron shells	140 electron configuration
PS09_05 Physical Science	nine	Nature of Matter	Describe how ions are formed when an atom or a group of atoms acquire an unbalanced charge by gaining or losing one or more electrons.	227 electron interactions and chemical bonds 228 why chemical bonds form 260 electrons form chemical bonds	

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PS09_06 Physical Science	nine	Nature of Matter	Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals, water).	221 electromagnetic and strong force	40 find mass number of specific isotope

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Standard #: Section	Grade	Topic	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
PS09_07 Physical Science	nine	Nature of Matter	Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing chemical formulas and balanced equations)	227 electron interactions and chemical bonds 228 why chemical bonds form 260 electrons form chemical bonds 261 types of chemical bonds 262 difference between ionic compounds and covalent molecules 262 comparing covalent and ionic bonds 263 chemical reaction explained 264 writing chemical equations 264 products and reactants in chemistry 266 photosynthesis 267 nuclear reactions explained 268 nuclear reactions and energy 274 cooking and chemistry	

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PS09_09 Physical Science	nine	Nature of Matter	Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors, and semiconductors).	5	mass defined	30	mixing different samples of water
				167	what are elements	35	investigate density
				169	understanding mixtures	35	investigate mass and volume and density
				169	compare and contrast elements and compounds and molecules and mixtures		
				169	definition of compound		
				174	boiling and melting points		
				192	chemical properties of matter		
				192	physical properties of matter		
				193	density is a physical property of matter		
				194	why density varies		
				197	tensile strength		
				198	elasticity and brittleness and bending		
				200	density of fluids		
				201	comparing density of ice and water		
				201	comparing liquid and solid densities		
				202	buoyancy explained		
				206	viscosity explained		
				213	submarines and density		

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				263	physical and chemical changes
PS09_10 Physical Science	nine	Nature of Matter	Compare the conductivity of different materials and explain the role of electrons in the ability to conduct electricity.	182	thermal conductivity 58 investigate conductors and insulators
PS09_11 Physical Science	nine	Nature of Energy	Explain how thermal energy exists in the random motion and vibrations of atoms and molecules (kinetic energy). Recognize that the higher the temperature, the greater the molecular motion, and during changes of state the temp. remains constant.	172 174 174 176 176 177 181 183 184 185	kinetic theory and temperature interpreting a heating curve diagram heat energy and molecular motion flow of thermal energy is heat understanding the difference between heat and temperature heat and work heat conduction natural and forced convection thermal radiation heat transfer is everywhere 30 investigating heat transfer 30 investigate difference between temperature and heat

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PS09_12 Physical Science	nine	Nature of Energy	Explain how an object's kinetic energy depends on its mass and its speed.	66 energy is stored work 67 potential energy explained 68 potential to kinetic energy conversions 68 kinetic energy explained 70 potential to kinetic energy conversions 70 law of conservation of energy 71 using energy conservation to solve problems 117 potential and kinetic energy in a spring 249 mechanical systems and energy 249 energy flow diagram for mechanical 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

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Standard #: Section	Grade	Topic	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
PS09_13 Physical Science	nine	Nature of Energy	Demonstrate that near Earth's surface an object's gravitational potential energy depends upon its weight and height above a reference surface.	67 potential energy explained 68 potential to kinetic energy conversions 68 kinetic energy explained 70 potential to kinetic energy conversions 70 law of conservation of energy 71 using energy conservation to solve problems 117 potential and kinetic energy in a spring 249 mechanical systems and energy 249 energy flow diagram for mechanical systems	14 investigate exchange of energy in car and track system 15 apply law of energy conservation
PS09_14 Physical Science	nine	Nature of Energy	Summarize how nuclear reactions convert a small amount of matter into a large amount of energy. (Fission involves the splitting of a large nucleus into smaller nuclei; fusion is the joining of two small nuclei into a larger nucleus at high energies).	269 fusion reactions 270 fission reactions 271 types of radioactivity	51 investigate concepts of radioactivity

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PS09_15 Physical Science	nine	Nature of Energy	Trace the transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.	9 10 240 241 243 251	42 45 46 47 47 48 57
PS09_16 Physical Science	nine	Nature of Energy	Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels).	265	48 50

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PS09_17 Physical Science	nine	Nature of Energy	Demonstrate that thermal energy can be transferred by conduction, convection or radiation (e.g., through materials by the collision of particles, moving air masses or across empty space by forms of electromagnetic radiation).	181 heat conduction 183 natural and forced convection 184 thermal radiation	30 investigating heat transfer
PS09_18 Physical Science	nine	Nature of Energy	Demonstrate that electromagnetic radiation is a form of energy. Recognize that spectrum (e.g., radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays).	435 waves and technology 523 electromagnetic spectrum 524 wavelength and frequency of visible light 526 low-energy electromagnetic waves 527 high-energy electromagnetic waves 536 the electromagnetic spectrum 537 infrared telescopes	111 mixing primary colors of light 123 investigate visible light wavelengths

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PS09_19 Physical Science	nine	Nature of Energy	Show how the properties of a wave depend on the properties of the medium through which it travels. Recognize that electromagnetic waves can be propagated without a medium.	435	waves and technology	98	study waves on a string
				435	how to recognize waves	99	explore transverse waves
				436	longitudinal waves	100	study water waves
				436	transverse waves	124	relating transverse waves on a spring to light waves
				440	standing waves on a vibrating string		
			459	sound waves and different media			

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PS09_20 Physical Science	nine	Nature of Energy	Describe how waves can superimpose on one another when propagated in the same medium. Analyze conditions in which waves can bend around corners, reflect off surfaces, are absorbed, and change direction and speed when entering a different material.	442	reflected waves	106	investigate interference and beats
				442	refracted waves	113	investigate law of reflection
				443	diffraction explained	113	use a mirror to observe reflected light
				443	absorption explained	114	use results to derive law of reflection
				445	destructive interference	114	use a prism to investigate light rays
				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
				502	the law of reflection		
				503	understanding refraction		
				504	angles of incidence and refraction		
				512	magnification		
				528	diffraction and light		
				529	interference of light waves		
				530	diffraction gratings and spectrometers		

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PS09_21 Physical Science	nine	Forces and Motion	Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration and time.	17	constant speed	3	find the speed of the car
				17	speed of light	4	position vs. time graph
				17	speed defined	6	how can speed be measured?
				18	calculating speed	7	measure the speed
				18	speed units	9	why did the speed change?
				19	velocity defined	10	find speed of car
				32	acceleration defined	11	investigating net force and acceleration
				32	acceleration of sports cars	11	speed vs. time graph
				33	acceleration and velocity	11	find acceleration of car
				33	calculating acceleration	11	compare and contrast speed and acceleration
				35	changes in speed or direction always involve acceleration	21	measure speed of car
				36	zero acceleration explained	25	calculate speed of car
				40	acceleration of falling objects	25	calculate acceleration of car
				40	velocity defined	28	calculate acceleration
				45	terminal speed	28	investigate acceleration on a ramp
				45	skydiving and terminal speed	44	experiment and find average speed
				46	position vs. time graphs	46	measure speed of car
				47	position vs. time graph for accelerating motion		
48	speed vs. time graph						

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				49 speed vs. time graph for accelerating motion 51 finding distance from a speed vs. time graph 56 calculate speed from distance/time graph 136 speed vs. velocity 143 angular speed 149 acceleration and circular motion	
PS09_22 Physical Science	nine	Forces and Motion	Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced force acts on it.	28 force defined 29 Newton's first law 31 net force explained 36 balanced and unbalanced forces 37 net force and second law calculating 116 when net force is zero	8 investigate Newton's first law of motion 11 investigate net force 22 when net force is zero

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PS09_23 Physical Science	nine	Forces and Motion	Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object.	35	quantitative understanding of second law	10	investigate Newton's second law of motion
				35	Newton's second law	23	Newton's second law of motion
				36	applying Newton's second law properly	25	apply Newton's second law of motion
				37	using second law formula	29	apply Newton's second law of motion
				63	applying third law	95	Newton's 2nd law of motion and natural frequency
				77	car crash safety		
				79	Newton's laws and space travel		
				424	Newton's second law and oscillators		
PS09_24 Physical Science	nine	Forces and Motion	Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object.	52	action-reaction pairs	12	investigate Newton's 3rd law of motion
				59	Newton's third law	13	relate Newton's 3rd law of motion to car collisions
				60	sorting out force pairs		
				78	third law and rockets		
				117	Newton's third law and springs		
				128	the third law and physics of walls		
				158	Newton's third law and helicopters		

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PS09_25 Physical Science	nine	Forces and Motion	Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight).	45	effects of air resistance	24
				94	friction and machines	
				101	friction explained	
				119	cause of friction	
				119	friction explained	
				120	static and sliding friction	
				122	reducing friction	
				123	useful friction	
418	friction and damping	investigate effect of friction				

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PS09_26 Physical Science	nine	Historical Perspectives and Scientific Revolutions	Use historical examples to explain how new ideas are limited by the context in which they are conceived; ar often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly...	28	Newton and the history of physics
				52	contributions of Harold Edgerton
				52	history of high-speed photography
				79	contributions of Robert Goddard
				166	Robert Brown and Brownian motion
				167	history of atomic theory
				218	contributions of John Dalton
				218	atomic theory
				219	contributions of Rutherford
				219	contributions of J. J. Thomson
				219	development of atom models
				230	contributions of Bohr
				231	Pauli's contributions
				231	contributions of Schrödinger
232	contributions of Heisenberg				

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PS09_27 Physical Science	nine	Historical Perspectives and Scientific Revolutions	Describe advances and issues in physical science that have important, long-lasting effects on science and society (e.g., atomic theory, quantum theory, Newtonian mechanics, nuclear energy, nanotechnology, plastics and ceramics and communication tech.)	28 72 167 218 219 224	Newton's idea of force energy usage and conservation history of atomic theory atomic theory development of atom models development of periodic table
ST09_01 Science and Technology	nine	Understanding Technology	Describe means of comparing the benefits with the risks of technology and how science can inform public policy.	72	energy usage and conservation

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ST09_02 Science and Technology	nine	Abilities To Do Technological Design	Identify a problem or need, propose designs and choose among alternative solutions for the problem.	105 engineering design cycle in action	<p>86 what changes have the largest effect on voltage produced?</p> <p>86 implement your generator design change ideas</p> <p>86 what could you do to change the performance of the generator you built?</p> <p>87 evaluate the effects your design change produced</p> <p>87 measure voltage for each different generator</p> <p>87 try your design change ideas</p> <p>87 building different generators</p> <p>87 build different generators</p>

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ST09_03 Science and Technology	nine	Abilities To Do Technological Design	Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined.	105 engineering design cycle in action	<p>47 suggest a design modification</p> <p>86 implement your generator design change ideas</p> <p>86 what could you do to change the performance of the generator you built?</p> <p>86 explain and communicate your findings</p> <p>86 what changes have the largest effect on voltage produced?</p> <p>87 try your design change ideas</p> <p>87 building different generators</p> <p>87 build different generators</p> <p>87 explain the relationship between voltage and magnet configuration</p> <p>87 evaluate the effects your design change produced</p> <p>87 measure voltage for each different generator</p>