

Correlation to Ohio Science Academic Content Standards

Foundations of Physics

Student Text and Investigation Manual

Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
ES09_08 Earth and Space 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: are often initially rejected by the scientific establishment: sometimes spring from unexpected findings: and usually grow slowly ...	41	Galileo and Newton conducted experiments with balls on ramps	75	the discovery of atom's nucleus
				78	Newton's laws of motion		
				81	Newton's discovery of the connection between force and mass and acceleration		
				152	Sir Isaac Newton and law of universal gravitation		
				349	Galileo and telescopes		
				350	Newtonian reflecting telescope		
				382	Ben Franklin and current		
				420	Charles-Augustin de Coulomb		
				440	magnetism		
				447	history of magnetism		
				499	development of atomic theory		
				501	ancient Greeks' ideas of elements		
				580	Newton and classical physics		
				614	Marie Curie		
				615	Henri Bequerel and beta rays		

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INQ09_01 Scientific Inquiry	nine	Doing Scientific Inquiry	Distinguish between observations and inferences given a scientific situation.	498	listing different types of matter in your home	43 78 87 89 109 110 206	follow the scientific method observe what happens observe what happens to the motion observe the wave pulse record observations examine the effects of glow-in-the-dark material record your observations
INQ09_02 Scientific Inquiry	nine	Doing Scientific Inquiry	Research and apply appropriate safety precautions when designing and conducting scientific investigations.	543	featured throughout CPO Science program safety factors	79 129 131 150 159 160 176 176 185 192 206	safety note safety precautions safety precautions safety note safety note electromagnet safety safety note heat safety safety tip gas pressure safety note acid 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.	7	developing models to explain observations	13	create a graph
				11	Ptolemy model vs. Copernicus model of the solar system	13	compare prediction to measurement
				40	creating useful models	16	describe the graph
				40	making a good model	16	create a graph
				43	constructing a graph	22	create graphs
				44	using a graphical model to make a prediction and checking the model's accuracy	22	compare calculation with graph estimate
				44	graphical models	22	how do you measured positions compare to model?
				54	constructing a graph	22	uniform acceleration model
				55	create a graph from a data table	22	model for uniform accelerated motion
				60	creating the acceleration formula from experiments	24	create an algebraic model
				66	developing the formulas for a model of motion with constant acceleration	28	solve second law equation for string tension
				101	a model for friction	29	does experiment agree with prediction?
				102	a model for static friction	32	develop a model that predicts acceleration
				282	write a formula relating velocity of wave to period and wavelength	37	make a graph
				290	the process of digital sound reproduction	38	make a graph
				297	frequency spectrum	43	how does the measurement compare to your prediction?
						43	create algebraic model

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				312	light intensity follows an inverse square law	43	sketch four graphs
				330	optics and optical instruments	49	write a formula
				411	the waveform of AC electricity	56	create a graph
				492	the binary number system and its use in computers	66	create a graph of speed vs. position
						76	compare predicted mass to actual mass
						82	make three different graphs
						87	sketch a graph
						94	give an equation that describes your observations
						114	are there differences between your prediction and measurement?
						135	graph voltage vs. current
						136	graph voltage vs. current
						151	make a graph of voltage vs. time
						160	create a graph
						167	make a graph of voltage vs. number of magnets
						169	make a current vs. voltage graph for the diode
						189	Bernoulli's equation

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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.	25	accuracy and precision of measurements	2	significant digit practice
				28	expressing very large and very small numbers using scientific notation	6	collecting data with precision
				34	expressing numbers in scientific notation	8	scientific notation practice
						15	collect time data with precision
						18	collect time data with precision
						51	using scientific notation

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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.			13	is there a trend in measurements?
						15	record data in a table
				42	writing procedures in a lab notebook helps make sure your results are repeatable	17	use a data table
						18	record data
						21	record results in table
				43	graphs are a way of representing data	27	record position and time data
				44	using a graph to make predictions	29	record mass and force
				45	recognizing relationships between variables from graphs	63	as mechanical advantage increases what happens to length of pulled string?
				45	recognizing patterns using graphs	66	what does the graph tell you?
						66	record data in table
				54	understanding patterns in relationships between variables	70	record data in table
						82	record your data in table
				56	indicate relationships between variables in graphs	82	analyze data
						82	create data table for self-designed experiment
				142	finding x and y components of velocity for model rocket	122	communicate your findings
				246	understanding graphs of harmonic motion	122	present your findings
						133	did battery voltage change?
				246	understanding graphs of harmonic motion	175	display information you found for your element

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				304	comparison of wave forms from guitar sounds	202	keep detailed notes as you work
				307	decibel level vs. frequency graph for human hearing		
				427	diagramming electric fields using field lines		
				443	diagramming magnetic fields using magnetic field lines		
				479	current vs.voltage graph for a transistor		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
INQ09_06 Scientific Inquiry	nine	Doing Scientific Inquiry	Draw logical conclusions based on scientific knowledge and evidence from investigations.	7	revising explanations through observation	16	what do the results tell you?
				8	refining theories based on observations	18	are the accelerations different?
				306	explain why hearing can be damaged by loud sounds	19	does the ball accelerate?
						43	what would happen if...?
						58	explain why the angular acceleration is different
						80	explain your observations
						87	explain how force applied causes the response
						90	explain why higher tension makes waves move faster
						92	explain how wind might cause big waves in water
						109	explain how the colored filters work
						132	what conclusions can you draw?
						133	analyze data and explain a rule

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PS12_05 Physical Science	twelve	Force and Motion	Use and apply the laws of motion to analyze, describe and predict the effects of forces on the motions of objects mathematically.	61	any acceleration must come from a force	26	study Newton's first law
				78	changes in motion only occur through force	27	collect data on Newton's first law
				79	all objects tend to resist changes in motion	27	explain how Newton's first law applies
				79	what systems in a car overcome the law of inertia	28	investigate Newton's second law
				80	seat belts and air bags and Newton's first law	30	Newton's third law and free body diagrams
				81	Newton's second law of motion	30	investigate Newton's third law
				83	finding the net force	31	draw free body diagrams and identify action-reaction pairs
				83	calculation using Newton's second law	45	balancing a specified force
				84	calculating net force	49	investigating centripetal force
				84	Newton's second law and dynamics problems	49	consider forces acting on the ball
				85	finding force from acceleration	53	relationship between force and torque
				85	force problems	77	relationship between force and motion and the second law
				85	if there is acceleration there must be force		
				86	zero acceleration means net zero force	84	restoring forces and equilibrium
				87	forces always occur in action-reaction pairs		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				87	explaining Newton's third law in terms of an astronaut moving through space		
				88	Newton's third law operates on pairs of objects		
				88	explaining Newton's third law in terms of moving a skateboard		
				89	solving problems with action-reaction forces		
				89	identifying which force is acting on which object		
				90	examples of Newton's third law		
				93	problems using Newton's first law and second law		
				94	seat belt problem		
				99	balanced force problems		
				102	the normal force as the reaction in an action-reaction pair		
				103	net force includes the force of friction		
				106	Newton's second law and net force		
				106	net force must be zero in equilibrium		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				107	net force of zero and free-body diagram		
				107	forces on a free-body diagram		
				108	use equilibrium to find an unknown force		
				108	equilibrium and Newton's second law		
				109	the force from a spring		
				109	restoring force of a spring		
				110	Hooke's law		
				110	restoring force of a spring		
				110	Hooke's law and restoring force of a spring		
				111	solid materials exert restoring force		
				111	understanding reaction forces in terms of springs and deformation		
				111	solid materials act like springs		
				112	analysis of forces on a bridge		
				116	calculate the acceleration of a toy		
				132	the force vector describes the strength and direction of a force		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				133	balancing forces in two dimensions		
				135	normal force of an inclined plane		
				136	calculating acceleration on a ramp		
				137	predicting motion in three dimensions and controlling force and acceleration in space missions		
				137	the vector form of Newton's second law		
				137	calculating acceleration from 3-D forces		
				139	determining position by triangulation and inertial navigation		
				141	calculate the net force		
				148	direction of force determines linear or rotational motion		
				149	calculating centripetal force		
				149	calculating centripetal force		
				150	formula for centripetal acceleration		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				150	using centripetal acceleration to create the feeling of gravity by rotating the space station		
				151	banked turns		
				155	centripetal force and the law of universal gravitation combine to form the orbit equation		
				156	satellites in orbit		
				158	calculating centripetal force		
				160	how torque and force differ		
				161	line of action and the torque created by a force		
				164	when force and lever arm are not perpendicular		
				168	Newton's first law and rotational inertia		
				169	Newton's second law applies to rotational motion		
				171	Newton's second law for rotational motion variables		
				174	compare force and torque		
				222	Newton's first law and momentum		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				224	momentum and Newton's third law		
				228	Newton's second law relating force and momentum		
				228	seat belts and air bags		
				229	momentum form of Newton's second law		
				234	gyroscopes and the space shuttle		
				238	cars that crumple in a collision		
				252	Newton's second law and natural frequency		
				425	electric forces always occur in pairs according to Newton's third law		
				442	torque between two magnets		
				460	orbital motion of a charge		
				548	Newton's third law and pressure in a fluid		
				550	pressure and the third law		
				557	pressure of gases		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS12_06 Physical Science	twelve	Force and Motion	Recognize that the nuclear forces that hold the nucleus of an atom together, at nuclear distances, are stronger than the electric forces that would make it fly apart.	419	differences between electric force and gravity		
				424	the strength of electric forces		
				426	gravity is far weaker than electric forces		
				428	comparison between electric fields and gravitational fields		
				568	forces in the atom		
				626	strong force and electromagnetic force in the nucleus		
				649	four forces in nature		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS12_07 Physical Science	twelve	Force and Motion	Recognize that nuclear forces are much stronger than electromagnetic forces, and electromagnetic forces are vastly stronger than gravitational forces. The strength of the nuclear forces explains why greater amounts of energy...	419 424 426 428 568 597 625 626 626 627 628 649	differences between electric force and gravity the strength of electric forces gravity is far weaker than electric forces comparison between electric fields and gravitational fields forces in the atom the energy of chemical bonds is described energy changes in nuclear reactions source of energy in nuclear reactions strong force and electromagnetic force in the nucleus energy of fusion reactions energy of fission reactions four forces in nature		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
PS12_08 Physical Science	twelve	Force and Motion	Describe how the observed wavelength of a wave depends upon the relative motion of the source and the observer (Doppler effect).	293	definition of the Doppler effect		
				294	Doppler effect and supersonic and subsonic motion		
				307	understanding of Doppler effect		
				638	Doppler effect and red shift		

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PS12_10 Physical Science	twelve	Nature of Energy	Explain the characteristics of isotopes. The nuclei of radioactive isotopes are unstable and spontaneously decay emitting particles and/or wavelike radiation.	502	elements past #92 are radioactive and decay	194	isotopes
				570	use of radioactive isotopes in medicine	209	radioactive decay and half life
				570	radioactive isotopes	210	simulate radioactive decay
				570	isotopes explained	211	types of radiation
				571	atomic mass of stable isotopes	213	explore radioactive isotopes
				572	chart of stable isotopes	213	fusion and fission
				573	fusion		
				588	carbon isotopes		
				614	three kinds of radioactivity		
				614	radioactive decay		
				615	alpha and beta and gamma radiation		
				616	energy and radioactivity		
				617	half-life		
				618	half-life calculation		
				620	danger of gamma rays and alpha particles		
				622	x-ray machines		
				623	CAT scans		
				627	fusion reactions		
				628	fission reactions		
				632	nuclear energy		

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
				634	three kinds of radioactive decay		
				635	differences between fission and fusion		
				636	half-life of nitrogen-13		
PS12_11 Physical Science	twelve	Nature of Energy	Use the predictability of decay rates and the concept of half-life to explain how radioactive substances can be used in estimating the age of materials.	614	three kinds of radioactivity	209	radioactive decay and half life
				615	alpha and beta and gamma radiation	210	simulate radioactive decay
				617	half-life	211	types of radiation
				618	carbon dating		
				618	half-life calculation		
				620	danger of gamma rays and alpha particles		
				634	three kinds of radioactive decay		
				636	half-life of nitrogen-13		

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PS12_12 Physical Science	twelve	Nature of Energy	Describe how different atomic energy levels are associated with the electron configurations of atoms and electron configurations (and/or conformations) of molecules.	574 576 576 577 577 578 579 582 584 588	Neils Bohr's theory quantum states Neils Bohr energy levels and quantum states energy levels explain spectral lines quantum state holds one electron quantum states are called orbitals in chemistry quantum theory quantum theory and probability quantum states and energy levels	197 203	quantum theory and electrons electrons and energy levels

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PS12_13 Physical Science	twelve	Nature of Energy	Explain how atoms and molecules can gain or lose energy in particular discrete amounts (quanta or packets); therefore they can only absorb or emit light at the wavelengths corresponding to these amounts.	362	diffraction patterns and the spectrometer	110	all light is produced by atoms
				574	emission/absorption spectrum	197	absorption and emission of light by atomic electrons
				575	spectrum of hydrogen	197	quantum physics
				580	comparing classical and quantum physics	200	explore how a vibrating string has similar properties to a quantum system
				581	classical vs. quantum theory of light		
				582	classical vs. quantum concept of electron		
				583	how the uncertainty principle differs from classical theory		
				589	electrons in classical vs. quantum physics		
				638	spectral-line patterns and red shift		

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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.	219	using energy efficient products		
				392	hybrid cars combine advantages of gasoline fuel and electric power		
				392	environmental impact of auto pollution		
				534	energy-efficient building application		
				607	impact of combustion reaction of gasoline		
				621	human technology contributes to radiation in environment		
				628	nuclear waste		

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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.	113	test and evaluate the prototype structure design	83	design and construct a pendulum
				113	build and test a prototype structure out of toothpicks	85	create a system that oscillates
				113	conceptual design for a bridge	163	design and test different electric motors
				113	the engineering design cycle	163	propose solutions that will work for each disk
				389	electrical devices are designed to operate at a certain voltage	163	apply steps of the design cycle to building different electric motors
				543	evaluate three designs for a bridge	164	evaluate the performance of motor designs
				543	failure analysis in the design process	167	suggest improvements you could make to the generator design
						173	designing and building logic circuits
		191	build an air-speed tester				

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Standard #: Section	Grade	Topic	Indicator	student text pg	detail	investigation pg	detail
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.	113	build and test a prototype structure out of toothpicks	83	design and construct a pendulum
				113	conceptual design for a bridge	85	create a system that oscillates
				113	the engineering design cycle	163	design and test different electric motors
				113	test and evaluate the prototype structure design	163	propose solutions that will work for each disk
				389	electrical devices are designed to operate at a certain voltage	163	apply steps of the design cycle to building different electric motors
				543	failure analysis in the design process	164	evaluate the performance of motor designs
				543	evaluate three designs for a bridge	167	suggest improvements you could make to the generator design
						173	designing and building logic circuits
		191	build an air-speed tester				