Correlation to Colorado Model Content Standards: Science

Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.1.a 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		asking questions and stating hypotheses, using prior scientific knowledge to help guide their development;	3 3 8	using life experiences and common sense inquiry starts with questions formulating a hypothesis	11 33 48 65 79 89	formulate a testable hypothesis formulate a testable hypothesis formulate a hypothesis form a hypothesis write a hypothesis what is it that moves in the case of a wave?
INQ.1.b 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		creating and defending a written plan of action for a scientific investigation;	432	making a simple capacitor	82 201	design an experiment design a procedure to separate a mixture

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
INQ.1.c 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		selecting and using appropriate technologies to gather, process, and analyze data and to report information related to an investigation;	data tables and graphs can be created on computer or graphing calculator 20 understanding metric rulers 23 reading a digital timer 91 the force platform 383 using a multimeter to measure voltage 385 measuring current with an ammeter or multimeter 387 using a multimeter to measure resistance 504 Celsius and Fahrenheit thermometers 505 how thermometers work	2 measuring a pencil 4 using a timer 5 using photogates 7 using devices to measure mass 9 using timer and photogates 11 using timer and photogates 14 using a timer and photogates 17 using a timer and photogates 18 use a timer and photogates 18 use a ruler 21 plan the experiment 21 use a timer and photogates 21 conduct the experiment 23 use a timer and photogates 26 use a timer and photogates 29 use a meter stick 29 use a spring scale 29 find mass

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
					34 use a spring scale 36 use a meter stick 42 use a timer and photogates 43 measure the distance 44 use a spring scale 47 use a timer and photogate 50 use a timer and photogate 58 use a timer and photogate 60 use a spring scale 65 use a timer and photogate 67 use a timer and photogate 75 use a timer and photogates 78 use meter stick to measure height 82 use a timer and photogate 85 select appropriate technology to make measurements 87 use photogate and timer to measure the period 89 use a spring scale to measure tension of string 90 use a timer and photogates

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
					93 use the timer to measure frequency 112 use a laser and mirror to study law of reflection 117 use a laser to locate images formed by a lens 129 choose circuit parts to light a bulb 131 use a multimeter to measure current 132 use a multimeter to measure voltage 135 use a multimeter to measure current and voltage 139 use a multimeter 140 use the multimeter 163 use a multimeter 164 use a multimeter to measure voltage 165 use a multimeter 166 use a photogate and timer 169 use a multimeter 171 use a multimeter 176 use a thermometer 178 measure the temperature 180 measure the temperature

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
						192	use a digital balance
INQ.1.d 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		identifying major sources of error or uncertainty within an investigation (for example, particular measuring devices and experimental procedures);	25 42	why accuracy and precision are important controlling variables in experiments	43 45 202	discuss sources of error discuss sources of errors identify two sources of experimental error

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.1.e 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		constructing and revising scientific explanations and models, using evidence, logic, and experiments that include identifying and controlling variables;	7	revising explanations through observation	11	recognizing and controlling variables
				8	refining theories based on observations	13	compare prediction to measurement
				11	Ptolemy model vs. Copernicus model of the solar system	13	create a graph
						16	create a graph
				40	making a good model	16	describe the graph
				40	defining variables	16	what do the results tell you?
				42	control and experimental variables	18	are the accelerations different?
				43	dependent and independent variables in graphs	19	does the ball accelerate?
						22	how do you measured positions compare to model?
				43	constructing a graph	22	create graphs
				44	graphical models	22	compare calculation with graph estimate
				44	using a graphical model to make a prediction and checking the model's accuracy	29	does experiment agree with prediction?
				54	importance of changing one variable at a time in an experiment	37	make a graph
						38	make a graph
				54	constructing a graph	43	what would happen if...?
				55	create a graph from a data table	43	sketch four graphs
				251	changing the natural frequency of a stretched rubber band	43	how does the measurement compare to your prediction?

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
				290 the process of digital sound reproduction 297 frequency spectrum 306 explain why hearing can be damaged by loud sounds 411 the waveform of AC electricity	56 create a graph 58 explain why the angular acceleration is different 66 create a graph of speed vs. position 76 compare predicted mass to actual mass 80 explain your observations 82 make three different graphs 82 dependent and independent variables 82 determine which variable has the greatest effect 87 sketch a graph 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 114 are there differences between your prediction and measurement? 132 what conclusions can you draw?

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
					133 analyze data and explain a rule 135 graph voltage vs. current 136 graph voltage vs. current 151 make a graph of voltage vs. time 160 create a graph 166 variables that affect the performance of the generator 167 make a graph of voltage vs. number of magnets 169 make a current vs. voltage graph for the diode

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.1.f 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		communicating and evaluating scientific thinking that leads to particular conclusions;	8	testing hypotheses with experiments	10	calculate percent difference
				43	graphs are a way of representing data	12	do your results agree with hypothesis?
				45	recognizing patterns using graphs	13	find percent error
				54	understanding patterns in relationships between variables	16	what do the results tell you?
				56	indicate relationships between variables in graphs	18	are the accelerations different?
				136	determining formula for acceleration on a ramp	19	does the ball accelerate?
				188	perpetual motion machines	33	does your experiment confirm your hypothesis?
				246	understanding graphs of harmonic motion	37	calculate percent difference
				304	comparison of wave forms from guitar sounds	38	calculate percent difference
				306	explain why hearing can be damaged by loud sounds	43	what would happen if...?
				307	decibel level vs. frequency graph for human hearing	43	calculate percent difference
				367	speed of light did not behave as expected for Michelson and Morley	50	does your experiment provide confirmation?
				369	proof of time dilation	58	explain why the angular acceleration is different
						66	does this agree with your hypothesis?
						80	explain your observations
						83	calculate percent error

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
				375	explain Thomas Young's demonstration of the wave nature of light	87	explain how force applied causes the response
				427	diagramming electric fields using field lines	90	explain why higher tension makes waves move faster
				443	diagramming magnetic fields using magnetic field lines	92	explain how wind might cause big waves in water
				479	current vs.voltage graph for a transistor	109	explain how the colored filters work
						111	how does what you observed support the quantum theory?
						132	what conclusions can you draw?
						133	analyze data and explain a rule
						202	find percent composition
						208	calculating percent yield

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.1.g 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		recognizing and analyzing alternative explanations and models; and	7 8 11 44 103	revising explanations through observation refining theories based on observations acceptance of the Copernican model of the solar system on the basis of scientific evidence checking a graphical model's accuracy evaluating perpetual motion claims	12 97 97	was this experiment better or worse than the first? reliability of a double-blind test did the method give an accurate result?
INQ.1.h 9 - 12	Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.		explaining the difference between a scientific theory and a scientific hypothesis.	8 8 136 367 369 375	Comparing a theory and a natural law testing hypotheses with experiments determining formula for acceleration on a ramp speed of light did not behave as expected for Michelson and Morley proof of time dilation explain Thomas Young's demonstration of the wave nature of light	111	how does what you observed support the quantum theory?

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
INQ.5.a 9 - 12	Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.		analyzing benefits, limitations, costs, and consequences involved in using technology or resources (for example, X-rays, agricultural chemicals, natural gas reserves);	219 392 534 604 607 621 632	using energy efficient products hybrid cars combine advantages of gasoline fuel and electric power energy-efficient building application balancing chemical equation of acid rain impact of combustion reaction of gasoline sources of radiation in the environment nuclear waste	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
INQ.5.b 9 - 12	Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.		analyzing how the introduction of a new technology has affected or could affect human activity (for example, invention of the telescope, applications of modern telecommunications);	12	engineers design practical devices for solving problems	
				31	use of nanotechnology	
				72	antilock brakes application	
				112	designing a bridge	
				138	use of robots	
				155	geostationary satellites	
				196	hydroelectric power application	
				209	range of power for common devices	
				216	energy from ocean tides	
				217	research into tidal power	
				228	seat belts and air bags	
				235	jet engines application	
				257	quartz crystals application	
				280	microwave ovens application	
				293	uses of Doppler radar	
				311	invention of electric light	
				325	the printing press	
				349	the telescope	
				378	importance of electricity	
				392	hybrid gas/electric cars application	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				413	wiring application	
				434	how television works application	
				451	MRI application	
				490	why computers are useful	
				534	energy-efficient building application	
				604	balancing chemical equation of acid rain	
				623	creation of CAT scans	
				631	nuclear power application	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
INQ.5.c 9 - 12	Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.		demonstrating the interrelationships between science and technology (for example, building a bridge, designing a better running shoe); and	12	engineers design practical devices for solving problems	
				12	all technology is based on fundamental laws of physics	
				31	use of nanotechnology	
				31	use of nanotechnology	
				51	analyzing motion with video and strobe photography	
				72	antilock brakes application	
				72	antilock brakes application	
				112	designing a bridge	
				112	relationship between science and engineering and technology	
				138	use of robots	
				155	geostationary satellites	
				172	bicycle physics application	
				196	hydroelectric power application	
				196	hydroelectric power application	
				209	range of power for common devices	
				216	energy from ocean tides	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				217	research into tidal power	
				228	seat belts and air bags	
				235	jet engines application	
				235	jet engines application	
				243	oscillators are used in communications and music and clocks	
				257	quartz crystals application	
				257	quartz crystals application	
				263	waves can carry information	
				280	microwave ovens application	
				280	microwave ovens application	
				293	uses of Doppler radar	
				311	invention of electric light	
				325	the printing press	
				325	the printing press	
				349	the telescope	
				369	technological advances have allowed discovery of the expanding universe	
				372	holography application	
				378	importance of electricity	
				392	hybrid gas/electric cars application	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				392	hybrid gas/electric cars application	
				413	wiring application	
				413	wiring application	
				429	electron beam accelerators	
				434	how television works application	
				434	how television works application	
				451	MRI application	
				451	MRI application	
				472	maglev train application	
				473	how magplanes levitate	
				490	why computers are useful	
				492	computers and electronic addition of numbers application	
				516	refrigerator application	
				534	energy-efficient building application	
				534	energy-efficient building application	
				560	deep water submarine Alvin application	
				585	laser application	
				615	smoke detectors	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				623	creation of CAT scans	
				623	creation of CAT scans	
				631	nuclear power application	
				631	nuclear power application	
INQ.5.d 9 - 12	Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.		explaining the use of technology in an occupation.	13	medical and health professions use physics	
				16	the relation between physics and other fields of science	
				91	biomechanics application	
				449	Earth's magnetism	
				498	search for answers in physics and chemistry	
				592	connections between biology and chemistry and physics	
INQ.6.a 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		evaluating print and visual media for scientific evidence, bias, or opinion;	62	acceleration of cars	
				188	perpetual motion machines	
				292	sound in space	
				372	holograms and science fiction special effects	
				576	ôtransporter beamsö	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.6.b 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		explaining that the scientific way of knowing uses a critique and consensus process (for example, peer review, openness to criticism, logical arguments, skepticism);	8 42 641	Comparing a theory and a natural law writing procedures in a lab notebook helps make sure your results are repeatable research on future of the universe	122	communicate your findings

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.6.c 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		using graphs, equations, or other models to analyze systems involving change and constancy (for example, comparing the geologic time scale to shorter time frames);	43 43 44 45 54 54 55 56 60 66 246 282 290 304	graphs are a way of representing data constructing a graph graphical models recognizing patterns using graphs constructing a graph understanding patterns in relationships between variables create a graph from a data table indicate relationships between variables in graphs creating the acceleration formula from experiments developing the formulas for a model of motion with constant acceleration understanding graphs of harmonic motion write a formula relating velocity of wave to period and wavelength the process of digital sound reproduction comparison of wave forms from guitar sounds	13 16 16 22 22 25 28 32 37 38 43 43 49 56 66 82 87 94 135	create a graph create a graph describe the graph uniform acceleration model create graphs create an algebraic model solve second law equation for string tension develop a model that predicts acceleration make a graph make a graph create algebraic model sketch four graphs write a formula create a graph create a graph of speed vs. position make three different graphs sketch a graph give an equation that describes your observations graph voltage vs. current

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
				307 decibel level vs. frequency graph for human hearing 312 light intensity follows an inverse square law 411 the waveform of AC electricity 427 diagramming electric fields using field lines 443 diagramming magnetic fields using magnetic field lines 479 current vs.voltage graph for a transistor	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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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.6.d 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		analyzing and comparing models of cyclic change as used within and among scientific disciplines (for example, water cycle, circular motion, sound waves, weather cycles);	144 145 146 149 154 155 155 156 158 160 243 286 289 291	rotation and revolution and angular speed calculating angular speed in radians per second angular speed of a moving wheel calculating centripetal force satellites and orbital motion satellite motion application centripetal force and the law of universal gravitation combine to form the orbit equation HEO and geostationary orbit calculating centripetal force translation and rotation orbit is a type of cycle sound is a wave of pressure vibrations create sound how we know sound is a wave	46 49	investigating angular speed investigating centripetal force

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
				294	effect of medium and temperature on speed of sound wave		
				306	list evidence that sound is a wave		
				460	orbital motion of a charge		
INQ.6.e 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		identifying and predicting cause-effect relationships within a system (for example, the effect of temperature on gas volume, effect of carbon dioxide level on the greenhouse effect, effects of changing nutrients at the base of a food pyramid);	2	understanding natural laws	12	cause and effect relationships
				3	connecting cause and effect through observation	90	what effect does changing the tension have?
				9	connecting cause and effect through analysis		
				45	recognizing patterns and cause and effect relationships		

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.6.f 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		identifying and describing the dynamics of natural systems (for example, weather systems, ecological systems, body systems, systems at dynamic equilibrium);	86	zero net force in equilibrium	28	system of Atwood's machine
				99	weight in equilibrium problems	44	forces in equilibrium
				106	definition of equilibrium		
				108	applications of equilibrium		
				111	equilibrium and reaction or normal forces		
				115	understanding of equilibrium		
				133	equilibrium of forces and balancing forces		
				163	rotational equilibrium		
				175	explain rotational equilibrium		
				202	processes		
				204	natural systems and efficiency		
				205	efficiency of plants		
				206	reversible and irreversible processes		
				210	power in natural systems		
				212	energy flow in systems		
				213	breaking down an energy flow system into processes		
				214	steady state energy balance of Earth		

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				214	natural systems work in cycles	
				215	food webs and ecosystems	
				248	harmonic motion and equilibrium	
				250	stable and unstable equilibrium	
				251	restoring forces and inertia affect natural frequency	
				264	equilibrium level of waves	
				447	the magnetic field of Earth	
				449	shifting and reversal of Earth's magnetic poles	
				522	thermal equilibrium	
				528	convection in the ocean	
				566	knowing structure of atom	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.6.g 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		identifying and testing a model to analyze systems involving change and constancy (for example, a mathematical expression for gas behavior; constructing a closed ecosystem such as an aquarium);	7	developing models to explain observations	13	create a graph
				40	creating useful models	16	describe the graph
				43	constructing a graph	16	create a graph
				44	graphical models	22	model for uniform accelerated motion
				54	constructing a graph	22	create graphs
				55	create a graph from a data table	22	uniform acceleration model
				60	creating the acceleration formula from experiments	25	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	32	develop a model that predicts acceleration
				102	a model for static friction	37	make a graph
				282	write a formula relating velocity of wave to period and wavelength	38	make a graph
				290	the process of digital sound reproduction	43	create algebraic model
				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
						82	make three different graphs
						87	sketch a graph
						94	give an equation that describes your observations

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page	Volume Two Investigation Manual Page
					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
INQ.6.h 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		explaining an exponential model (for example, pH scale, population growth, Richter scale); and	600 the pH scale	

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
INQ.6.i 9 - 12	Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.		refining a hypothesis based on an accumulation of data over time (for example, Alvarez's theory on dinosaur extinction).	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		
				499	development of atomic theory		
				580	Newton and classical physics		
				614	Marie Curie		
				615	Henri Bequerel and beta rays		

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
PS.2.2.a 9 - 12	Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).	identifying, measuring, calculating, and analyzing quantitative relationships involved with energy forms (for example, heat transfer in a system involving mass, specific heat, and change in temperature of matter); and	513 513 514 514 517 529 533 534 538 538	definition of calorie joules and calories and Btus the heat equation specific heat and the heat equation air conditioners heat transfer coefficient and the convection equation Stefan-Boltzmann formula R-value convection equation problem using heat conduction equation to calculate R-value	179 184	specific heat explore properties of thermal radiation

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
PS.2.2.b 9 - 12	Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).	identifying, measuring, calculating, and analyzing relationships associated with energy transfer (changes in temperature, velocity, potential energy, kinetic energy, conduction, convection, radiation, voltage, current).	36	the precise meaning of speed	9	calculate speed of rolling marble
				37	calculating speed	66	law of conservation of energy
				38	the speed formula and calculating speed	68	find the total energy at each position
				41	speed of a ball on a ramp	68	calculate potential and kinetic energy
				46	speed is the rate of change of position	72	potential to kinetic energy conversion in a pendulum
				47	average and instantaneous speed	74	investigating collisions and conservation of energy
				61	zero acceleration vs. constant acceleration vs. acceleration with zero speed	88	potential to kinetic energy conversions of a pendulum
				74	understanding average speed and instantaneous speed	129	construct simple electric circuits
				128	constant velocity of horizontal component of projectile motion	131	construct a simple circuit
				130	analyzing changing velocity in vertical component of projectile motion	131	explore the concept of electric current
				191	the formula for potential energy	132	explore the concept of voltage
				192	the formula for kinetic energy	134	Ohm’s law
				193	deriving the formula for kinetic energy	135	derive Ohm’s law from experiment
						135	study the relationship between current and voltage

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
				194	energy transformations	136	use Ohm's law to calculate the resistance
				195	frictional energy converted to heat	137	investigate series circuits
				195	applying conservation of energy for a marble rolling on a hilly track	137	parallel circuit and Ohm's law
				196	energy transformation hydroelectric plant	138	build a parallel circuit
				197	conservation of energy for Hoover Dam	138	apply Ohm's law to series circuits
				199	kinetic and potential energy conversions while bouncing in a trampoline	139	analyze parallel circuits
				203	friction converts input work to heat	171	use Ohm's law to calculate the resistance of the transistor
				212	energy flow in a pendulum	176	investigate temperature and its effect on materials
				245	kinetic to potential energy changes in motion of an oscillator	182	investigate convection in a liquid
				253	oscillators exchange energy back and forth between potential and kinetic		
				253	harmonic motion involves both potential and kinetic energy		
				378	concept of electric current		
				379	concept of a circuit		
				380	understanding simple circuit and its diagram		

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Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				382	current flows through wires and carries energy	
				382	voltage measures differences in energy	
				382	electrical current explained	
				383	voltage is a measure of electric potential energy	
				383	voltage and potential energy	
				384	battery uses chemical energy to produce electrical charge	
				386	relationship between current and resistance	
				386	simple bulb and battery circuits to illustrate electrical resistance	
				388	Ohm's law	
				388	calculate the current flowing in a circuit	
				396	calculation of voltage from resistance and current	
				398	parallel circuit defined	
				398	series circuit defined	
				399	current and resistance in a series circuit	

Correlation to Colorado Model Content Standards: Science

Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				399	calculating current in a series circuit using Ohm's law	
				400	voltage in a series circuit	
				401	parallel circuits	
				402	voltage and current in a parallel circuit	
				403	resistance in parallel circuits	
				403	using Ohm's law in parallel circuits	
				404	using Ohm's law for circuit analysis	
				405	voltage dividers	
				407	solving network circuits	
				407	solving network circuits	
				407	calculate currents and voltages in a network circuit	
				408	current definition	
				408	voltage definition	
				414	why series circuits are not used in homes and buildings	
				414	why parallel circuits are used in homes and buildings	
				416	using Ohm's law to calculate current	

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				421	current is the flow of charge	
				422	negative charge of electrons and current flow	
				431	current into and out of capacitors	
				431	voltage of a capacitor circuit	
				504	temperature scales and Fahrenheit-Celsius conversions	
				505	measuring temperature	
				507	the Kelvin scale and converting between Kelvin and Celsius	
				509	temperature change and thermal energy	
				513	balance of thermal energy	
				513	transfer of thermal energy	
				519	understanding Fahrenheit and Celsius and Kelvin	
				522	heat conduction	
				522	thermal equilibrium	
				523	heat conduction	
				523	thermal conductors and insulators	
				524	conduction in solids and liquids and gases	

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				526	convection in liquids	
				527	convection depends on speed and surface area	
				528	convection and weather	
				530	radiation	
				533	using Kelvin for radiation calculations	
				535	sources of heat transfer in buildings	
				537	heat flow between objects of different temperature	
				558	using temperature in Kelvins for Charles' law	

Correlation to Colorado Model Content Standards: Science

Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
PS.2.3.a 9 - 12	Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.	identifying, describing, and explaining physical and chemical changes involving the conservation of matter and energy (for example, oscillating pendulum/spring, chemical reactions, nuclear reactions);	194 194 195 195 197 203 206 215 227 370 469 515 552	the law of conservation of energy conservation of energy explained conservation of energy in a closed system applying conservation of energy for a marble rolling on a hilly track conservation of energy for Hoover Dam efficiency and conservation of energy connection between efficiency and time energy flows in biological systems kinetic energy conservation for elastic collisions relationship and conservation of mass and energy energy conservation and Faraday's law thermodynamics and conservation of energy conservation of energy in fluids	66 68 74	law of conservation of energy find the total energy at each position investigating collisions and conservation of energy

Correlation to Colorado Model Content Standards: Science

Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				553	energy conservation and Bernoulli's equation	
				605	mass conservation in chemical reactions	
				612	law of mass conservation	
				629	conservation of energy in nuclear reactions	

Correlation to Colorado Model Content Standards: Science

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
PS.2.3.b 9 - 12	Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.	observing, measuring, and calculating quantities to demonstrate conservation of matter and energy in chemical changes (for example, acid-base, precipitation reactions), and physical interactions of matter (for example, force, work, power);	185 185 185 186 187 187 189 191 191 192 193 193 197 199 200 207 207	physics definition of work how to calculate work work and energy the work done by a force work done against gravity calculating work done against gravity relationship between work and energy calculate the potential energy of a cart the symmetry between work and energy calculating kinetic energy depends on speed and mass deriving the formula for kinetic energy calculate the kinetic energy of a moving car calculating energy supplied by Hoover Dam concept of work calculate work done power is the rate of doing work or using energy calculate power in climbing stairs	63 64 69 70 70 71 71	studying the concept of work relationship between work and energy calculate efficiency for each ball calculate work calculate person's power calculate work done calculate power output for each climber

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				208	units of power	
				208	power formulas	
				209	calculating power for common devices	
				210	estimating the power in wind	
				211	power in biological systems	
				211	estimate average input power of a person	
				213	efficiency of an energy flow process	
				216	estimating the energy in tides	
				219	ideal vs. real machine	
				220	calculate efficiency of model solar car	
				220	calculate power rating	
				220	calculate energy and power for humans	
				236	fuel efficiency of turbofan engines	
				311	efficiency of electric vs. fluorescent light bulbs	
				409	power and efficiency of electric cars	
				600	acids donate hydrogen ions and bases accept hydrogen ions	

Correlation to Colorado Model Content Standards: Science

Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				600	the pH scale	
				600	acids and bases	
				603	chemical reactions and energy	
				610	energy in reaction of dynamite	

Correlation to Colorado Model Content Standards: Science

Foundations of Physics

Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
PS.2.3.c 9 - 12	Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.	describing and predicting chemical changes (for example, combustion, simple chemical reactions), and physical interactions of matter (for example, velocity, force, work, power),	36 37 38 41 47 48 48 49 50 54 55 55 61 62 63	speed is relative how to calculate speed compare and contrast speed and velocity effect of friction on motion of a ball on a ramp position vs. time graph determining speed from the slope of a position vs. time graph determining speed from the slope of a position vs. time graph speed vs. time graph for constant speed speed vs. time graph for downhill motion graphing speed vs. time calculate the average speed and distance traveled analyzing distance vs. time graph any acceleration must come from a force speed vs. time graph for accelerated motion complex speed vs. time graphs	9 10 12 14 15 16 16 17 19 20 21 22 22 26 26 27	collect data and calculate speed of car make object move with speed of 1 m/sec finding speed of ball with one photogate find the speed of the ball find speed of the ball create a speed vs. time graph create a position vs. time graph find two speeds make a speed vs. time graph speed vs. time graph for uniform acceleration calculate speed of ball create a position vs. time graph create a speed vs. time graph study Newton’s first law make ball roll at constant speed explain how Newton’s first law applies

Correlation to Colorado Model Content Standards: Science

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
				64	calculate speed in accelerated motion	28	investigate Newton's second law
				65	calculating distance from speed vs. time graph	30	investigate Newton's third law
				71	air resistance and terminal speed	33	calculate the predicted speed
				72	friction and traction and antilock brakes	34	investigate static and sliding friction
				74	describing motion with speed vs. time graph	42	find initial speed of ball
				75	problem using frames of reference	50	calculate the speed of the ball
				75	calculations of speed	61	what effect does friction have on mechanical advantage?
				78	changes in motion only occur through force	66	find the speed of the ball
				79	all objects tend to resist changes in motion	68	what is speed of the ball?
				81	Newton's second law of motion	76	calculate speeds of projectile and target balls
				84	Newton's second law and dynamics problems	90	calculate the speed of the wave pulse
				85	if there is acceleration there must be force	128	relativity and frames of reference
				85	finding force from acceleration	191	calculate speed of air in homemade air-speed tester
				87	forces always occur in action-reaction pairs		

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				88	Newton's third law operates on pairs of objects	
				89	identifying which force is acting on which object	
				93	problems using Newton's first law and second law	
				94	force calculations in different units	
				100	the force of friction and the different types of friction	
				101	a model for friction	
				102	calculating the force of friction	
				102	the normal force as the reaction in an action-reaction pair	
				103	friction and motion	
				104	reducing friction force	
				105	friction applications	
				106	Newton's second law and net force	
				108	equilibrium and Newton's second law	
				111	understanding reaction forces in terms of springs and deformation	
				115	friction of a pulled sled	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				124	effects of friction on trajectories	
				125	speed is the magnitude of the velocity vector	
				127	calculating velocity vectors may require knowing frames of reference	
				135	frictional force on an inclined plane	
				136	calculating acceleration on a ramp accounting for friction	
				137	the vector form of Newton's second law	
				142	effects of friction on acceleration	
				146	calculating linear speed of a moving wheel	
				147	the linear speed of a rolling wheel	
				148	direction of force determines linear or rotational motion	
				168	Newton's first law and rotational inertia	
				183	friction and mechanical advantage of wheel and axle	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				184	friction and mechanical advantage of ramps and screws	
				222	Newton's first law and momentum	
				224	momentum and Newton's third law	
				228	Newton's second law relating force and momentum	
				245	friction causes damping in oscillators	
				256	friction and steady state	
				260	position vs. time graph of harmonic motion	
				260	velocity vs. time graph of harmonic motion	
				366	special relativity and time dilation	
				367	relative motion and speed of light	
				369	frequency of light depends on relative motion	
				371	simultaneity depends on the relative motion of your frame of reference	
				425	electric forces always occur in pairs according to Newton's third law	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				548	Newton's third law and pressure in a fluid	
				550	pressure and the third law	
				557	pressure of gases	
				575	spectral analysis of the sun	
				579	structure of water molecule	
				593	chemical change example of burning	
				601	chemistry of carbon is organic chemistry	
				601	elements forming the human body	
				602	chemical reaction of making water	
				602	formation of rust is a chemical reaction	
				607	reactions of burning gasoline	
				610	basis for carbon's importance to life	
				643	frame of reference and the equivalence principle	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page	
PS.2.3.d 9 - 12	Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)	Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.	describing and explaining physical interactions of matter using conceptual models (for example, conservation laws of matter and energy, particle model for gaseous behavior).	30 30 33 190 194 194 194 195 195 196 197 202 203 205	relationship between states of matter and arrangement and motion of atoms and molecules physical differences between solids and liquids and gases describe movement of atoms in solids and gases conversions of energy the law of conservation of energy conservation of energy explained energy transformations applying conservation of energy for a marble rolling on a hilly track conservation of energy in a closed system energy transformation hydroelectric plant conservation of energy for Hoover Dam efficiency and energy conversions efficiency and conservation of energy efficiency in biological systems	66 68 72 74 108	law of conservation of energy find the total energy at each position draw an energy flow diagram investigating collisions and conservation of energy investigate RGB and CMYK models of color

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				206	connection between efficiency and time	
				212	energy conversion	
				213	the conversion process of energy flow	
				215	energy flows in biological systems	
				219	energy flow of a model solar car	
				227	kinetic energy conservation for elastic collisions	
				256	resonant systems accumulate energy	
				262	waves are all around us	
				277	waves propagate by exchanging energy between two forms	
				277	standing waves are used to store energy	
				281	use of microwaves in microwave ovens	
				286	sound is a wave of pressure	
				289	vibrations create sound	
				291	how we know sound is a wave	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				294	effect of medium and temperature on speed of sound wave	
				306	list evidence that sound is a wave	
				318	the additive color process	
				319	the subtractive color process	
				320	photosynthesis converts light energy to chemical energy	
				321	the RGB and CMYK color processes are complementary	
				324	light from chemical reactions	
				325	color separations in high quality printing	
				326	the CMYK four-color printing process	
				356	electromagnetic waves exchange energy between electricity and magnetic parts	
				359	descriptions of radio waves and microwaves and infrared rays	
				360	x-rays and gamma rays	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				370	relationship and conservation of mass and energy	
				393	conversion of energy in regenerative braking	
				400	energy conversions in a series circuit	
				434	RGB process and how a television picture is made	
				451	MRI--energy exchange by a nucleus in a magnetic field	
				452	MRI uses radio waves	
				464	electric motor uses electromagnets to convert electrical energy to mechanical energy	
				467	electric generators transform mechanical energy into electric energy	
				469	energy conservation and Faraday's law	
				506	temperature and addition of heat energy	
				508	characteristics of matter related to its phase	
				508	phases of matter and arrangement of molecules	
				515	thermodynamics and conservation of energy	

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Student Text and Investigation Manual

Standard #: Grade	Standard	Objective	Benchmark	Volume One Student Text Page		Volume Two Investigation Manual Page
				519	phases of matter	
				552	conservation of energy in fluids	
				553	energy conservation and Bernoulli's equation	
				595	chemical bonds determine properties of materials	
				612	law of mass conservation	
				629	conservation of energy in nuclear reactions	