

# Correlation to New Jersey Science Standards 2009

## *CPO Science Foundations of Physics, 2nd Ed.*

### Student Text and Investigation Manual

Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
5.1.12.A.1 12	5.1 Science Practices	A. Understand Scientific Explanations	Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.	32	measuring distance	7	estimating length
				46	accuracy and precision of measurements	11	accuracy and resolution and printing
				50	constructing a graph	18	describe the graph
				51	using a graphical model to make a prediction and checking the model's accuracy	18	create a graph
						24	compare calculation with graph estimate
				51	graphical models	24	model for uniform accelerated motion
				123	a model for friction	24	how do you measured positions compare to model?
				124	a model for static friction		
				312	the process of digital sound reproduction	41	make a graph
				319	frequency spectrum	42	make a graph
				352	optics and optical instruments	50	how does the measurement compare to your prediction?
				433	the waveform of AC electricity	50	measure and record the distance
				514	the binary number system and its use in computers	50	sketch four graphs
				520	listing different types of matter in your home	65	create a graph
						70	measure input and output forces
		78	create a graph of speed vs. position				
		80	measure vertical distance				
		90	observe what happens				

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					94 make three different graphs
					94 measure the length of the string
					100 sketch a graph
					100 observe what happens to the motion
					102 observe the wave pulse
					132 are there differences between your prediction and measurement?
					157 graph voltage vs. current
					158 graph voltage vs. current
					178 make a graph of voltage vs. time
					187 create a graph
					195 make a graph of voltage vs. number of magnets
					198 make a current vs. voltage graph for the diode

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.1.12.A.2 12	5.1 Science Practices	A. Understand Scientific Explanations	Develop and use mathematical, physical, and computational tools to build evidence- based models and to pose theories.	32 measuring distance 46 accuracy and precision of measurements 50 constructing a graph 51 using a graphical model to make a prediction and checking the model's accuracy 51 graphical models 123 a model for friction 124 a model for static friction 312 the process of digital sound reproduction 319 frequency spectrum 352 optics and optical instruments 433 the waveform of AC electricity 514 the binary number system and its use in computers 520 listing different types of matter in your home	7 estimating length 11 accuracy and resolution and printing 18 describe the graph 18 create a graph 24 compare calculation with graph estimate 24 model for uniform accelerated motion 24 how do you measured positions compare to model? 41 make a graph 42 make a graph 50 how does the measurement compare to your prediction? 50 measure and record the distance 50 sketch four graphs 65 create a graph 70 measure input and output forces 78 create a graph of speed vs. position 80 measure vertical distance 90 observe what happens

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					94 make three different graphs
					94 measure the length of the string
					100 sketch a graph
					100 observe what happens to the motion
					102 observe the wave pulse
					132 are there differences between your prediction and measurement?
					157 graph voltage vs. current
					158 graph voltage vs. current
					178 make a graph of voltage vs. time
					187 create a graph
					195 make a graph of voltage vs. number of magnets
					198 make a current vs. voltage graph for the diode

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
5.1.12.A.3 12	5.1 Science Practices	A. Understand Scientific Explanations	Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence.	49	control and experimental variables	11	collecting data with precision
				49	writing procedures in a lab notebook helps make sure your results are repeatable	18	create a graph
				49	controlling variables in experiments	18	describe the graph
				50	constructing a graph	24	how do you measured positions compare to model?
				50	graphs are a way of representing data	24	compare calculation with graph estimate
				50	dependent and independent variables in graphs	24	uniform acceleration model
				51	graphical models	26	create an algebraic model
				51	using a graphical model to make a prediction and checking the model's accuracy	41	make a graph
				52	recognizing patterns using graphs	42	make a graph
				82	creating the acceleration formula from experiments	50	discuss sources of error
				88	developing the formulas for a model of motion with constant acceleration	50	create algebraic model
				268	understanding graphs of harmonic motion	50	how does the measurement compare to your prediction?
						50	sketch four graphs
						52	discuss sources of errors
		58	write a formula				
		65	create a graph				
		74	as mechanical advantage increases what happens to length of pulled string?				

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
				273	changing the natural frequency of a stretched rubber band	78	what does the graph tell you?
				304	write a formula relating velocity of wave to period and wavelength	78	create a graph of speed vs. position
				312	the process of digital sound reproduction	94	analyze data
				319	frequency spectrum	94	dependent and independent variables
				326	comparison of wave forms from guitar sounds	94	determine which variable has the greatest effect
				329	decibel level vs. frequency graph for human hearing	94	make three different graphs
				334	light intensity follows an inverse square law	100	sketch a graph
				433	the waveform of AC electricity	107	give an equation that describes your observations
				449	diagramming electric fields using field lines	132	are there differences between your prediction and measurement?
				465	diagramming magnetic fields using magnetic field lines	142	communicate your findings
				501	current vs. voltage graph for a transistor	142	present your findings
						154	did battery voltage change?
						157	graph voltage vs. current
						158	graph voltage vs. current
						178	make a graph of voltage vs. time
						187	create a graph

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					194 variables that affect the performance of the generator 195 make a graph of voltage vs. number of magnets 198 make a current vs. voltage graph for the diode 205 display information you found for your element 223 Bernoulli's equation

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
5.1.12.B.1 12	5.1 Science Practices	B. Generate Scientific Evidence Through Active Investigations	Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data.	46	why accuracy and precision are important	11	collecting data with precision
				49	controlling variables in experiments	18	find the slope of the line
				49	writing lab procedures	18	what do the results tell you?
				50	graphs are a way of representing data	24	how do you measured positions compare to model?
				51	using a graphical model to make a prediction and checking the model's accuracy	24	uniform acceleration model
				52	recognizing patterns using graphs	24	compare calculation with graph estimate
				65	slope of a position vs. time graph	26	create an algebraic model
				65	slope of a position vs. time graph	26	find the average time
				82	creating the acceleration formula from experiments	28	record position and time data
				85	acceleration and slope of a speed vs. time graph	41	use your graph to make a prediction
				88	developing the formulas for a model of motion with constant acceleration	41	calculate percent difference
				164	finding x and y components of velocity for model rocket	42	calculate percent difference
				268	understanding graphs of harmonic motion	42	use your graph to make a prediction
				268	understanding graphs of harmonic motion	47	predict exact landing location
282	analyze graph of an oscillator	50	create algebraic model				
				50	write a procedure		



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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
				304	write a formula relating velocity of wave to period and wavelength	50	what would happen if...?
				319	frequency spectrum	50	discuss sources of error
				326	comparison of wave forms from guitar sounds	50	how does the measurement compare to your prediction?
				328	explain why hearing can be damaged by loud sounds	50	calculate percent difference
				329	decibel level vs. frequency graph for human hearing	52	discuss sources of errors
				334	light intensity follows an inverse square law	58	write a formula
				434	average voltage and current of AC power	74	as mechanical advantage increases what happens to length of pulled string?
				449	diagramming electric fields using field lines	77	predict where the car moves fastest
				465	diagramming magnetic fields using magnetic field lines	78	what does the graph tell you?
				501	current vs.voltage graph for a transistor	78	record data in table
				520	since wood is created from other matter it must not be a fundamental substance	80	calculate average of three times
						83	record data in table
						84	calculate average work and power
						92	explain your observations
						94	create data table for self-designed experiment
						94	record your data in table
						94	analyze data

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					95 calculate percent error
					100 explain how force applied causes the response
					103 explain why higher tension makes waves move faster
					105 explain how wind might cause big waves in water
					107 give an equation that describes your observations
					124 explain how the colored filters work
					132 are there differences between your prediction and measurement?
					153 what conclusions can you draw?
					153 predict what the current will be
					154 did battery voltage change?
					154 analyze data and explain a rule
					223 Bernoulli's equation

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
5.1.12.B.2 12	5.1 Science Practices	B. Generate Scientific Evidence Through Active Investigations	Build, refine, and represent evidence- based models using mathematical, physical, and computational tools.	32	measurements of distance in units of length	8	significant digit practice
				33	scientists use metric units	8	measuring a pencil
				33	description of length measured in English and metric systems	8	practice length measurement
				34	understanding metric rulers	10	using the DataCollector
				36	reading a digital timer	10	using photogate
				39	measuring mass in kg and grams	11	precision in measurement
				46	accuracy and precision of measurements	12	using devices to measure mass
				82	creating the acceleration formula from experiments	12	estimating mass
				88	developing the formulas for a model of motion with constant acceleration	14	make distance measurement
				113	the force platform	14	using the DataCollector and velocity sensor
				123	a model for friction	24	model for uniform accelerated motion
				124	a model for static friction	24	uniform acceleration model
				164	finding x and y components of velocity for model rocket	25	use the DataCollector and velocity sensor
				304	write a formula relating velocity of wave to period and wavelength	25	measure the distance
						26	create an algebraic model
		27	find length in centimeters				
		27	use the DataCollector and velocity sensor				
		28	record position and time data				

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				334	light intensity follows an inverse square law	40	measure the mass
				352	optics and optical instruments	40	measure the new position
				405	using a multimeter to measure voltage	44	using a compass
				407	measuring current with an ammeter or multimeter	47	use the DataCollector and photogates
				409	using a multimeter to measure resistance	50	create algebraic model
				514	the binary number system and its use in computers	50	measure the distance
				526	Celsius and Fahrenheit thermometers	51	use a spring scale
				527	how thermometers work	58	write a formula
						59	use the DataCollector and photogate
						70	use a spring scale
						73	measure string length
						77	measure vertical distance
						77	use the DataCollector and photogate
						78	record data in table
						80	use the DataCollector and photogate
						81	convert grams to kilograms
						83	record data in table
						83	measure and mark height
						90	make the string 70 cm long
						90	measure mass of ball

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					90 use meter stick to measure height
					94 use the DataCollector and photogate
					94 record your data in table
					94 create data table for self-designed experiment
					100 use photogate and DataCollector to measure the period
					102 use a spring scale to measure tension of string
					106 use the DataCollector to measure frequency
					107 give an equation that describes your observations
					130 study reflection with a mirror
					130 use a laser and mirror to study law of reflection
					134 use mirrors and lenses to learn how images are formed
					136 use a laser to locate images formed by a lens
					152 use a multimeter to measure current

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					153 use a multimeter to measure voltage
					157 use a multimeter to measure current and voltage
					162 use a multimeter
					164 use the multimeter
					180 make measurement with precision
					180 making measurements with precision
					184 reading a compass
					191 use a multimeter
					192 use a multimeter to measure voltage
					193 use a multimeter
					194 use a photogate and DataCollector
					198 use a multimeter
					200 use a multimeter
					212 measure the temperature
					223 Bernoulli's equation
					226 use a digital balance
					226 check the pressure with your gauge
					226 find the mass of the bottle

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
5.1.12.B.3 12	5.1 Science Practices	B. Generate Scientific Evidence Through Active Investigations	Revise predictions and explanations using evidence, and connect explanations/argu- ments to established scientific knowledge, models, and theories.	18	what is a scientific theory?	18	what do the results tell you?
				18	do not confuse theory with opinion	50	test your prediction
				25	putting forth ideas and then testing them	50	what would happen if...?
				48	Galileo and Newton conducted experiments with balls on ramps	77	where does the marble move the fastest?
				100	Newton's laws of motion	92	explain your observations
				103	Newton's discovery of the connection between force and mass and acceleration	100	explain how force applied causes the response
				158	determining formula for acceleration on a ramp	103	explain why higher tension makes waves move faster
				174	Sir Isaac Newton and law of universal gravitation	105	explain how wind might cause big waves in water
				328	explain why hearing can be damaged by loud sounds	124	explain how the colored filters work
				345	using glow-in-the-dark plastic to demonstrate photon energy levels	127	how does what you observed support the quantum theory?
				371	Galileo and telescopes	127	do your observations support this hypothesis?
				372	Newtonian reflecting telescope	153	what conclusions can you draw?
				389	speed of light did not behave as expected for Michelson and Morley	154	analyze data and explain a rule

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				391	
					proof of time dilation
				397	
					explain Thomas Young's demonstration of the wave nature of light
				404	
					Ben Franklin and current
				442	
					Charles-Augustin de Coulomb
				445	
					charge by friction
				521	
					development of atomic theory
				602	
					Newton and classical physics
				614	
					Marie Curie
				615	
					Henri Bequerel and beta rays



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5.1.12.B.4 12	5.1 Science Practices	B. Generate Scientific Evidence Through Active Investigations	Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations.	25	putting forth ideas and then testing them	18	what do the results tell you?
				46	why accuracy and precision are important	24	how do you measured positions compare to model?
				49	writing procedures in a lab notebook helps make sure your results are repeatable	24	compare calculation with graph estimate
				49	controlling variables in experiments	41	calculate percent difference
				50	graphs are a way of representing data	42	calculate percent difference
				51	using a graphical model to make a prediction and checking the model's accuracy	50	what would happen if...?
				51	using a graphical model to make a prediction and checking the model's accuracy	50	test your prediction
				50	recognizing patterns using graphs	50	calculate percent difference
				268	understanding graphs of harmonic motion	50	how does the measurement compare to your prediction?
				319	frequency spectrum	50	discuss sources of error
				326	comparison of wave forms from guitar sounds	52	discuss sources of errors
				328	explain why hearing can be damaged by loud sounds	77	where does the marble move the fastest?
				328	explain why hearing can be damaged by loud sounds	92	explain your observations
				329	decibel level vs. frequency graph for human hearing	95	calculate percent error
		100	explain how force applied causes the response				

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				345 using glow-in-the-dark plastic to demonstrate photon energy levels	103 explain why higher tension makes waves move faster
				445 charge by friction	105 explain how wind might cause big waves in water
				449 diagramming electric fields using field lines	124 explain how the colored filters work
				465 diagramming magnetic fields using magnetic field lines	127 do your observations support this hypothesis?
				501 current vs.voltage graph for a transistor	132 are there differences between your prediction and measurement?
					153 what conclusions can you draw?
					154 analyze data and explain a rule

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.1.12.C.1 12	5.1 Science Practices	C. Reflect on Scientific Knowledge	Reflect on and revise understandings as new evidence emerges.	328 explain why hearing can be damaged by loud sounds	18 what do the results tell you? 50 what would happen if...? 92 explain your observations 100 explain how force applied causes the response 103 explain why higher tension makes waves move faster 105 explain how wind might cause big waves in water 124 explain how the colored filters work 153 what conclusions can you draw? 154 analyze data and explain a rule

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
5.1.12.C.2 12	5.1 Science Practices	C. Reflect on Scientific Knowledge	Use data representations and new models to revise predictions and explanations.	50	constructing a graph	18	create a graph
				51	checking a graphical model's accuracy	18	describe the graph
				51	graphical models	24	uniform acceleration model
				52	recognizing patterns and cause and effect relationships	26	create an algebraic model
				82	creating the acceleration formula from experiments	41	calculate percent difference
				88	developing the formulas for a model of motion with constant acceleration	41	make a graph
						42	make a graph
						42	calculate percent difference
				125	evaluating perpetual motion claims	50	sketch four graphs
				282	analyze graph of an oscillator	50	calculate percent difference
				304	write a formula relating velocity of wave to period and wavelength	50	create algebraic model
						58	write a formula
						65	create a graph
				312	the process of digital sound reproduction	78	create a graph of speed vs. position
334	light intensity follows an inverse square law	94	make three different graphs				
433	the waveform of AC electricity	95	calculate percent error				
		100	sketch a graph				
		103	what effect does changing the tension have?				

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					<p>107 give an equation that describes your observations</p> <p>110 did the method give an accurate result?</p> <p>110 reliability of a double-blind test</p> <p>157 graph voltage vs. current</p> <p>158 graph voltage vs. current</p> <p>178 make a graph of voltage vs. time</p> <p>187 create a graph</p> <p>195 make a graph of voltage vs. number of magnets</p> <p>198 make a current vs. voltage graph for the diode</p> <p>223 Bernoulli's equation</p>

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.1.12.C.3 12	5.1 Science Practices	C. Reflect on Scientific Knowledge	Consider alternative theories to interpret and evaluate evidence-based arguments.	18 what is a scientific theory? 18 do not confuse theory with opinion 158 determining formula for acceleration on a ramp 389 speed of light did not behave as expected for Michelson and Morley 391 proof of time dilation 397 explain Thomas Young's demonstration of the wave nature of light 614 Marie Curie 615 Henri Bequerel and beta rays	127 how does what you observed support the quantum theory?
5.1.12.D.1 12	5.1 Science Practices	D. Participate Productively in Science	Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and experiences.	49 writing procedures in a lab notebook helps make sure your results are repeatable	142 communicate your findings 142 present your findings 205 display information you found for your element

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
5.1.12.D.2 12	5.1 Science Practices	D. Participate Productively in Science	Represent ideas using literal representations, such as graphs, tables, journals, concept maps, and diagrams.	49	writing procedures in a lab notebook helps make sure your results are repeatable	18	create a graph
						18	describe the graph
						28	record position and time data
						29	interpret setup diagram
						41	make a graph
						42	make a graph
						50	sketch four graphs
						65	create a graph
						78	create a graph of speed vs. position
						78	record data in table
						83	record data in table
						94	make three different graphs
						94	record your data in table
						94	create data table for self- designed experiment
						97	draw a sketch of your system
						100	sketch a graph
		105	sketch the wave fronts				
		157	graph voltage vs. current				
		158	graph voltage vs. current				
		178	make a graph of voltage vs. time				

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				402 circuit diagrams and electrical symbols	187 create a graph
				433 the waveform of AC electricity	195 make a graph of voltage vs. number of magnets
				449 drawing the electric field using field lines	198 make a current vs. voltage graph for the diode
				465 diagramming magnetic fields using magnetic field lines	



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5.1.12.D.3 12	5.1 Science Practices	D. Participate Productively in Science	Demonstrate how to use scientific tools and instruments and knowledge of how to handle animals with respect for their safety and welfare.	<p>Lab safety symbols and instructions are found in the investigation manual on the page before TOC</p> <p>34 understanding metric rulers</p> <p>36 reading a digital timer</p> <p>113 the force platform</p> <p>405 using a multimeter to measure voltage</p> <p>407 measuring current with an ammeter or multimeter</p> <p>409 using a multimeter to measure resistance</p> <p>526 Celsius and Fahrenheit thermometers</p> <p>527 how thermometers work</p>	<p>8 measuring a pencil</p> <p>10 using the DataCollector</p> <p>10 using photogate</p> <p>12 using devices to measure mass</p> <p>14 using the DataCollector and velocity sensor</p> <p>25 use the DataCollector and velocity sensor</p> <p>27 use the DataCollector and velocity sensor</p> <p>44 using a compass</p> <p>47 use the DataCollector and photogates</p> <p>50 measure the distance</p> <p>51 use a spring scale</p> <p>59 use the DataCollector and photogate</p> <p>70 use a spring scale</p> <p>77 use the DataCollector and photogate</p> <p>80 use the DataCollector and photogate</p> <p>90 use meter stick to measure height</p> <p>91 safety note</p>

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					94 use the DataCollector and photogate
					100 use photogate and DataCollector to measure the period
					102 use a spring scale to measure tension of string
					106 use the DataCollector to measure frequency
					130 study reflection with a mirror
					130 use a laser and mirror to study law of reflection
					134 use mirrors and lenses to learn how images are formed
					136 use a laser to locate images formed by a lens
					150 safety precautions
					152 use a multimeter to measure current
					152 safety precautions
					153 use a multimeter to measure voltage
					157 use a multimeter to measure current and voltage
					162 use a multimeter

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					164 use the multimeter
					176 safety note
					184 reading a compass
					186 safety note
					187 electromagnet safety
					191 use a multimeter
					192 use a multimeter to measure voltage
					193 use a multimeter
					194 use a photogate and DataCollector
					198 use a multimeter
					200 use a multimeter
					212 measure the temperature
					218 safety tip
					226 check the pressure with your gauge
					226 gas pressure safety note
					226 use a digital balance

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### Student Text and Investigation Manual

Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.2.12.D.1 12	5.2 Physical Science	D. Energy Transfer and Conservation	Model the relationship between the height of an object and its potential energy.	213 the formula for potential energy 214 the formula for kinetic energy 215 deriving the formula for kinetic energy 275 harmonic motion involves both potential and kinetic energy	81 calculate potential and kinetic energy

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5.2.12.D.3 12	5.2 Physical Science	D. Energy Transfer and Conservation	Describe the products and potential applications of fission and fusion reactions.	524 elements past #92 are radioactive and decay 592 use of radioactive isotopes in medicine 592 radioactive isotopes 595 nuclear reactions 595 fusion 614 three kinds of radioactivity 614 radioactive decay 615 alpha and beta and gamma radiation 616 energy and radioactivity 617 half-life 618 carbon dating 618 half-life calculation 620 ionizing and nonionizing radiation 620 danger of gamma rays and alpha particles 622 x-ray machines 623 CAT scans 624 measuring radiation with Geiger counter 624 danger of ionizing radiation 625 nuclear reactions	238 radioactive decay and half life 239 simulate radioactive decay 240 types of radiation

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				627 fusion reactions	
				628 fission reactions	
				632 nuclear energy	
				634 three kinds of radioactive decay	
				635 differences between fission and fusion	
				636 half-life of nitrogen-13	

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5.2.12.D.4 12	5.2 Physical Science	D. Energy Transfer and Conservation	Measure quantitatively the energy transferred between objects during a collision.	245	momentum formula and calculating momentum	87	calculating momentum
				246	law of conservation of momentum	90	which ball had a greater change in momentum?
				247	conservation of momentum in collisions		
				248	applying conservation of momentum		
				248	solving elastic and inelastic collision problems		
				249	momentum conservation for collisions in two and three dimensions		
				251	force on a rocket from change in momentum		
				252	calculate change in momentum for elastic vs. inelastic collisions		
				253	conservation of angular momentum examples		
				254	conservation of angular momentum		
				257	jet engines work because of conservation of momentum		
				258	momentum conservation of turbofan engine		
				260	momentum in billiards		
				261	calculate momentum		

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				298 natural frequency and harmonics	
				392 Einstein's thinking about momentum of particles moving near the speed of light	
				629 conservation of momentum in nuclear reactions	



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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.2.12.E.1 12	5.2 Physical Science	E. Force and Motion	Compare the calculated and measured speed, average speed, and acceleration of an object in motion, and account for differences that may exist between calculated and measured values.	48 speed of a ball on a ramp 58 speed is the rate of change of position 61 the precise meaning of speed 62 calculating speed 62 how to calculate speed 64 average and instantaneous speed 65 determining speed from the slope of a position vs. time graph 68 the speed formula and calculating speed 80 acceleration is the rate of change in the speed of an object 81 comparing speed and acceleration 82 formula for acceleration 83 zero acceleration vs. constant acceleration vs. acceleration with zero speed 83 general definition of acceleration 84 acceleration is total change of speed divided by total change in time	14 collect data and calculate speed of car 14 calculate speed of rolling marble 26 derive acceleration equation 47 find initial speed of car 59 calculate the speed of the car 78 find the speed of the ball 81 what is speed of the car? 103 calculate the speed of the wave pulse 225 calculate speed of air in homemade air-speed tester

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				86	
				86	
				86	
				89	
				106	
				150	
				152	
				168	
				169	
				172	

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.2.12.E.2 12	5.2 Physical Science	E. Force and Motion	Compare the translational and rotational motions of a thrown object and potential applications of this understanding.	90 free fall and acceleration due to gravity 91 motion formulas for free fall 92 solving problems with free fall 93 acceleration of gravity does not depend on mass 119 strength of gravity on Earth and Jupiter 120 gravity and acceleration and weightlessness 142 representing vectors in Cartesian and polar coordinates 146 projectiles and trajectories 147 representing the velocity vector in polar and Cartesian coordinates 148 representing the velocity vector in polar and Cartesian coordinates 150 gravity only accelerates vertical motion 151 vertical motion of a projectile 152 projectiles launched at an angle 153 range of projectiles	25 investigate the effect of gravity 45 using polar coordinates 46 plotting position with cartesian coordinates 47 analyze the motion of a marble in 2 dimensions 49 investigate the range of a projectile 50 create and test a model to predict the landing spot of a projectile 53 contrasting linear and angular motion 58 investigating centripetal force 63 explore rotational equilibrium and net torque

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				154	
				representing the force vector in Cartesian and polar coordinates	
				156	
				choosing coordinates for an inclined plane	
				156	
				resolving force of gravity in ramp coordinates	
				157	
				acceleration down an inclined plane	
				163	
				effects of gravity on motion of a projectile	
				163	
				explain vectors in Cartesian and polar coordinates	
				168	
				the relationship between linear and angular speed	
				169	
				speedometers and odometers	
				171	
				calculating centripetal force	
				174	
				law of universal gravitation and orbital motion	
				176	
				orbits and gravitational force	
				177	
				centripetal force and the law of universal gravitation combine to form the orbit equation	

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				177	
				179	
				180	
				180	
				184	
				185	
				187	
				188	
				193	
				209	
				213	
				253	
				260	
				482	

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.2.12.E.3 12	5.2 Physical Science	E. Force and Motion	Create simple models to demonstrate the benefits of seatbelts using Newton's first law of motion.	83 any acceleration must come from a force 100 changes in motion only occur through force 101 all objects tend to resist changes in motion 102 Newton's laws and cup holders 107 if there is acceleration there must be force 116 seat belt problem 170 direction of force determines linear or rotational motion 177 satellite motion application 190 Newton's first law and rotational inertia 244 Newton's first law and momentum 262 forces in a car stopping	27 collect data on Newton's first law 27 study Newton's first law 28 explain how Newton's first law applies

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
5.2.12.E.4 12	5.2 Physical Science	E. Force and Motion	Measure and describe the relationship between the force acting on an object and the resulting acceleration.	103 Newton's second law of motion 105 calculation using Newton's second law 106 Newton's second law and dynamics problems 107 force problems 107 finding force from acceleration 115 problems using Newton's first law and second law 121 balanced force problems 128 Newton's second law and net force 130 use equilibrium to find an unknown force 130 equilibrium and Newton's second law 138 calculate the acceleration of a toy 155 balancing forces in two dimensions 158 calculating acceleration on a ramp 159 calculating acceleration from 3-D forces 159 the vector form of Newton's second law	29 investigate Newton's second law 58 consider forces acting on the car

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Standard #: By the end of	Standard	Strand	Cumulative Progress Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				171	
				calculating centripetal force	
				172	
				formula for centripetal acceleration	
				191	
				Newton's second law applies to rotational motion	
				193	
				Newton's second law for rotational motion variables	
				250	
				Newton's second law relating force and momentum	
				251	
				momentum form of Newton's second law	
				274	
				Newton's second law and natural frequency	