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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
EM.11.P.01 Physics	Electricity and Magnetism	Students shall understand the relationship between electric forces and electric fields.	Calculate electric force using Coulomb's law:	424 Coulomb's law 425 calculate force using Coulomb's law 437 Coulomb's law is an inverse square law 438 calculating charge using Coulomb's law	148 investigate Coulomb's law
EM.11.P.02 Physics	Electricity and Magnetism	Students shall understand the relationship between electric forces and electric fields.	Calculate electric field strength:	426 fields and forces 427 an electric field exists around a charge 437 strength of an electric field 443 magnets create a magnetic field around them 649 every field has an associated particle	154 how are magnetic field lines similar to electric field lines?

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
EM.11.P.03 Physics	Electricity and Magnetism	Students shall understand the relationship between electric forces and electric fields.	Draw and interpret electric field lines	419	differences between electric force and gravity	154	how are magnetic field lines similar to electric field lines?
				424	the strength of electric forces		
				426	gravity is far weaker than electric forces		
				426	fields and forces		
				427	an electric field exists around a charge		
				428	comparison between electric fields and gravitational fields		
				437	strength of an electric field		
				441	comparing magnetic and electric forces		
				442	force between two magnetics is not an inverse square law		
				443	magnets create a magnetic field around them		
				649	every field has an associated particle		
EM.12.P.01 Physics	Electricity and Magnetism	Students shall understand the relationship between electric energy and capacitance.	Calculate electrical potential energy	383	voltage is a measure of electric potential energy		

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
EM.12.P.02 Physics	Electricity and Magnetism	Students shall understand the relationship between electric energy and capacitance.	Compute the electric potential for various charge distributions:	383	voltage is a measure of electric potential energy		
EM.12.P.03 Physics	Electricity and Magnetism	Students shall understand the relationship between electric energy and capacitance.	Calculate the capacitance of various devices:	430 431 432 433 438	capacitor is a storage device for electric charge simple capacitor circuit how a capacitor works and making a simple capacitor calculating capacitance calculating capacitance	150 151	investigate how capacitors work what is the difference between a capacitor and a battery?

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
EM.12.P.04 Physics	Electricity and Magnetism	Students shall understand the relationship between electric energy and capacitance.	Construct a circuit to produce a pre-determined value of an Ohm's law variable	379 concept of a circuit 380 understanding simple circuit and its diagram 384 battery uses chemical energy to produce electrical charge 386 simple bulb and battery circuits to illustrate electrical resistance 386 relationship between current and resistance 388 calculate the current flowing in a circuit 388 Ohm's law 396 calculation of voltage from resistance and current 398 series circuit defined 398 parallel circuit defined 399 calculating current in a series circuit using Ohm's law 399 current and resistance in a series circuit 400 voltage in a series circuit 401 parallel circuits 402 voltage and current in a parallel circuit	129 construct simple electric circuits 131 construct a simple circuit 134 Ohm's law 135 derive Ohm's law from experiment 136 use Ohm's law to calculate the resistance 137 parallel circuit and Ohm's law 137 investigate series circuits 138 build a parallel circuit 138 apply Ohm's law to series circuits 139 analyze parallel circuits 171 use Ohm's law to calculate the resistance of the transistor

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				403	using Ohm's law in parallel circuits	
				403	resistance in parallel circuits	
				404	using Ohm's law for circuit analysis	
				405	voltage dividers	
				407	calculate currents and voltages in a network circuit	
				407	solving network circuits	
				407	solving network circuits	
				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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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
EM.13.P.01 Physics	Electricity and Magnetism	Students shall understand how magnetism relates to induced and alternating currents.	Determine the strength of a magnetic field	440 magnets and magnetic materials 441 effect of magnetic force on magnetic and nonmagnetic materials 444 magnetic properties of materials 445 ferromagnetism 446 properties of ferromagnetic materials 449 Earth's magnetic core 453 comparing different magnetic materials 459 why only some materials are magnetic	
EM.13.P.02 Physics	Electricity and Magnetism	Students shall understand how magnetism relates to induced and alternating currents.	Use the first right-hand rule to find the direction of the force on the charge moving through a magnetic field	457 right-hand rule 462 finding the poles of an electromagnet using right-hand rule 475 using right-hand rule	160 study the right-hand rule
EM.13.P.03 Physics	Electricity and Magnetism	Students shall understand how magnetism relates to induced and alternating currents.	Determine the magnitude and direction of the force on a current-carrying wire in a magnetic field	356 electricity and magnetism oscillations 457 right-hand rule 462 finding the poles of an electromagnet using right-hand rule 475 using right-hand rule	160 study the right-hand rule

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
EM.13.P.04 Physics	Electricity and Magnetism	Students shall understand how magnetism relates to induced and alternating currents.	Describe how the change in the number of magnetic field lines through a circuit loop affects the magnitude and direction of the induced current	468 magnetic flux 469 Faraday's law of induction 473 Eddy currents	165 investigate Faraday's law of induction
EM.13.P.05 Physics	Electricity and Magnetism	Students shall understand how magnetism relates to induced and alternating currents.	Calculate the induced electromagnetic field (emf) and current using Faraday's law of induction:	468 magnetic flux 469 Faraday's law of induction 473 Eddy currents	165 investigate Faraday's law of induction
HT.07.P.01 Physics	Heat and Thermodynamics	Students shall understand the effects of thermal energy on particles and systems.	Perform specific heat capacity calculations:	513 definition of calorie 514 the heat equation 517 air conditioners	
HT.07.P.02 Physics	Heat and Thermodynamics	Students shall understand the effects of thermal energy on particles and systems.	Perform calculations involving latent heat:	513 definition of calorie 514 the heat equation 517 air conditioners	
HT.07.P.03 Physics	Heat and Thermodynamics	Students shall understand the effects of thermal energy on particles and systems.	Interpret the various sections of a heating curve diagram	509 temp vs. time graph for phase change of ice to water 519 temp vs. time graphs for various materials	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
HT.07.P.04 Physics	Heat and Thermodynamics	Students shall understand the effects of thermal energy on particles and systems.	Calculate heat energy of the different phase changes of a substance:	513 definition of calorie 514 the heat equation 517 air conditioners	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
HT.08.P.01 Physics	Heat and Thermodynamics	Students shall apply the two laws of thermodynamics.	Describe how the first law of thermodynamics is a statement of energy conversion	189 energy appears in different forms 190 conversions of energy 190 different forms of energy 194 energy transformations 196 energy transformation hydroelectric plant 202 efficiency and energy conversions 205 efficiency in biological systems 212 understand basic forms of energy 212 energy conversion 213 the conversion process of energy flow 219 energy flow of a model solar car 256 resonant systems accumulate energy 277 waves propagate by exchanging energy between two forms 310 light is a form of energy 320 photosynthesis converts light energy to chemical energy 322 photons are bundles of light energy	72 draw an energy flow diagram

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				324	light from chemical reactions	
				356	electromagnetic waves exchange energy between electricity and magnetic parts	
				378	electrical energy	
				384	batteries use chemical energy	
				393	conversion of energy in regenerative braking	
				400	energy conversions in a series circuit	
				451	MRI--energy exchange by a nucleus in a magnetic field	
				464	electric motor uses electromagnets to convert electrical energy to mechanical energy	
				467	electric generators transform mechanical energy into electric energy	
				552	explanation of pressure and energy	
				619	radiation as a flow of energy	
				622	energy of x-rays	
				647	energy from antimatter	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
HT.08.P.02 Physics	Heat and Thermodynamics	Students shall apply the two laws of thermodynamics.	Calculate heat, work, and the change in internal energy by applying the first law of thermodynamics:	188	for all machines work out cannot exceed work in	64	compare output and input work
HT.08.P.03 Physics	Heat and Thermodynamics	Students shall apply the two laws of thermodynamics.	Calculate the efficiency of a heat engine by using the second law of thermodynamics:	188 202 203 213 219 220 236 311 393	for all machines work out cannot exceed work in definition of efficiency efficiency explained efficiency of an energy flow process ideal vs. real machine calculate efficiency of model solar car fuel efficiency of turbofan engines efficiency of electric vs. fluorescent light bulbs efficiency of hybrid cars	64 69	compare output and input work calculate efficiency for each ball
HT.08.P.04 Physics	Heat and Thermodynamics	Students shall apply the two laws of thermodynamics.	Distinguish between entropy changes within systems and the entropy change for the universe as a whole	188	for all machines work out cannot exceed work in	64	compare output and input work

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.01 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Compare and contrast scalar and vector quantities	118 119 124 125 126 127 136 186	vectors have magnitude and direction displacement vectors definition of the velocity vector the velocity vector components of the velocity vector adding velocity vectors calculate the acceleration of a skier on a slope work done by a force at an angle to the distance	39 43 44 49	investigating vectors calculate the velocity vector investigating force vectors draw a free body diagram and label forces

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.02 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Solve problems involving constant and average velocity:	37	how to calculate speed	9	collect data and calculate speed of car
				38	compare and contrast speed and velocity	10	make object move with speed of 1 m/sec
				48	determining speed from the slope of a position vs. time graph	12	finding speed of ball with one photogate
				55	calculate the average speed and distance traveled	14	find the speed of the ball
						15	find speed of the ball
				64	calculate speed in accelerated motion	17	find two speeds
						21	calculate speed of ball
				75	calculations of speed	26	make ball roll at constant speed
				125	speed is the magnitude of the velocity vector	33	calculate the predicted speed
				146	calculating linear speed of a moving wheel	42	find initial speed of ball
				147	the linear speed of a rolling wheel	50	calculate the speed of the ball
						66	find the speed of the ball
						68	what is speed of the ball?
						76	calculate speeds of projectile and target balls
						90	calculate the speed of the wave pulse
						191	calculate speed of air in homemade air-speed tester

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.03 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Apply kinematic equations to calculate distance, time, or velocity under conditions of constant acceleration:	60	formula for acceleration	17	learn techniques for finding acceleration
				61	general definition of acceleration	17	find the acceleration
				64	calculate speed in accelerated motion	20	understanding equation for uniform accelerated motion
				67	calculate time and distance from acceleration	25	derive acceleration equation
				150	centripetal acceleration	29	calculate the acceleration

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.04 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Compare graphic representations of motion:	47	position vs. time graph	16	create a speed vs. time graph
				48	determining speed from the slope of a position vs. time graph	16	create a position vs. time graph
				49	speed vs. time graph for constant speed	19	make a speed vs. time graph
				50	speed vs. time graph for downhill motion	20	speed vs. time graph for uniform acceleration
				54	graphing speed vs. time	22	create a speed vs. time graph
				55	analyzing distance vs. time graph	22	create a position vs. time graph
				62	speed vs. time graph for accelerated motion		
				63	complex speed vs. time graphs		
				65	calculating distance from speed vs. time graph		
				74	describing motion with speed vs. time graph		
				260	velocity vs. time graph of harmonic motion		
				260	position vs. time graph of harmonic motion		

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.05 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Calculate the components of a free falling object at various points in motion:	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall		
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				124	projectiles and trajectories		
				128	gravity only accelerates vertical motion		
				129	vertical motion of a projectile		
				130	projectiles launched at an angle		
				131	range of projectiles		
				134	resolving force of gravity in ramp coordinates		
				135	acceleration down an inclined plane		
				141	effects of gravity on motion of a projectile		

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				152	law of universal gravitation and orbital motion	
				154	orbits and gravitational force	
				155	centripetal force and the law of universal gravitation combine to form the orbit equation	
				158	compare projectile motion to orbital motion	
				165	the motion of a tossed object	
				166	centers of mass and gravity may differ	
				187	work done against gravity	
				191	potential energy comes from gravity	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.06 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Compare and contrast contact force (e.g., friction) and field forces (e.g., gravitational force)	41	effect of friction on motion of a ball on a ramp	23	investigate the effect of gravity
				68	free fall and acceleration due to gravity	34	investigate static and sliding friction
				69	motion formulas for free fall	61	what effect does friction have on mechanical advantage?
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				71	air resistance and terminal speed		
				72	friction and traction and antilock brakes		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				100	the force of friction and the different types of friction		
				101	a model for friction		
				102	calculating the force of friction		
				103	friction and motion		
				104	reducing friction force		
				105	friction applications		

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				115	friction of a pulled sled	
				124	effects of friction on trajectories	
				124	projectiles and trajectories	
				128	gravity only accelerates vertical motion	
				129	vertical motion of a projectile	
				130	projectiles launched at an angle	
				131	range of projectiles	
				134	resolving force of gravity in ramp coordinates	
				135	frictional force on an inclined plane	
				135	acceleration down an inclined plane	
				136	calculating acceleration on a ramp accounting for friction	
				141	effects of gravity on motion of a projectile	
				142	effects of friction on acceleration	
				152	law of universal gravitation and orbital motion	
				154	orbits and gravitational force	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				155	centripetal force and the law of universal gravitation combine to form the orbit equation	
				158	compare projectile motion to orbital motion	
				165	the motion of a tossed object	
				166	centers of mass and gravity may differ	
				183	friction and mechanical advantage of wheel and axle	
				184	friction and mechanical advantage of ramps and screws	
				187	work done against gravity	
				191	potential energy comes from gravity	
				245	friction causes damping in oscillators	
				256	friction and steady state	

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.07 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Draw free body diagrams of all forces acting upon an object	107	drawing free-body diagrams	40	using polar coordinates
				116	draw a free-body diagram	41	plotting position with cartesian coordinates
				120	representing vectors in Cartesian and polar coordinates		
				125	drawing the velocity vector		
				125	representing the velocity vector in polar and Cartesian coordinates		
				126	representing the velocity vector in polar and Cartesian coordinates		
				132	representing the force vector in Cartesian and polar coordinates		
				134	choosing coordinates for an inclined plane		
				141	explain vectors in Cartesian and polar coordinates		
				212	making an energy flow diagram		
				333	drawing a ray diagram		
				342	drawing ray diagrams of lenses		
				380	circuit diagrams and electrical symbols		

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Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
	427 drawing the electric field using field lines 443 diagramming magnetic fields using magnetic field lines	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.08 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Calculate the applied forces represented in a free body diagram	119	adding vectors	40	using polar coordinates
				120	representing vectors in Cartesian and polar coordinates	41	plotting position with cartesian coordinates
				120	adding vectors	41	calculate the resultant vector
				121	adding and subtracting vectors	45	calculate force components
				122	calculating vector components		
				123	finding magnitude and angle of a vector		
				125	the velocity vector		
				125	representing the velocity vector in polar and Cartesian coordinates		
				126	components of the velocity vector		
				126	representing the velocity vector in polar and Cartesian coordinates		
				127	adding velocity vectors		
				128	independence of horizontal and vertical motion in a velocity vector		
				130	calculating velocity components of initial velocity		
				132	representing the force vector in Cartesian and polar coordinates		

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
				132	interpreting the x-y components of force		
				133	calculating components of a force vector		
				134	choosing coordinates for an inclined plane		
				141	explain vectors in Cartesian and polar coordinates		
MF.01.P.09 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Apply Newton's first law of motion to show balanced and unbalanced forces	61	any acceleration must come from a force	26	collect data on Newton's first law
				78	changes in motion only occur through force	26	study Newton's first law
				79	all objects tend to resist changes in motion	27	explain how Newton's first law applies
				85	if there is acceleration there must be force	49	consider forces acting on the ball
				94	seat belt problem		
				99	balanced force problems		
				133	balancing forces in two dimensions		
				148	direction of force determines linear or rotational motion		
				168	Newton's first law and rotational inertia		
				222	Newton's first law and momentum		

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.10 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Apply Newton's second law of motion to solve motion problems that involve constant forces:	81	Newton's second law of motion	28	investigate Newton's second law
				83	calculation using Newton's second law	77	relationship between force and motion and the second law
				84	Newton's second law and dynamics problems		
				85	force problems		
				85	finding force from acceleration		
				93	problems using Newton's first law and second law		
				106	Newton's second law and net force		
				108	equilibrium and Newton's second law		
				108	use equilibrium to find an unknown force		
				116	calculate the acceleration of a toy		
				136	calculating acceleration on a ramp		
				137	the vector form of Newton's second law		
				137	calculating acceleration from 3-D forces		
				149	calculating centripetal force		
				150	formula for centripetal acceleration		

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				169	Newton's second law applies to rotational motion	
				171	Newton's second law for rotational motion variables	
				228	Newton's second law relating force and momentum	
				229	momentum form of Newton's second law	
				252	Newton's second law and natural frequency	

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.01.P.11 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Apply Newton's third law of motion to explain action-reaction pairs	87	forces always occur in action-reaction pairs	30	Newton's third law and free body diagrams
				88	Newton's third law operates on pairs of objects	30	investigate Newton's third law
				89	solving problems with action-reaction forces	31	draw free body diagrams and identify action-reaction pairs
				89	identifying which force is acting on which object		
				102	the normal force as the reaction in an action-reaction pair		
				107	forces on a free-body diagram		
				111	understanding reaction forces in terms of springs and deformation		
				112	analysis of forces on a bridge		
				135	normal force of an inclined plane		
				224	momentum and Newton's third law		
				425	electric forces always occur in pairs according to Newton's third law		
				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 #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
MF.01.P.12 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Calculate frictional forces (i.e., kinetic and static):	41 effect of friction on motion of a ball on a ramp 71 air resistance and terminal speed 72 friction and traction and antilock brakes 100 the force of friction and the different types of friction 101 a model for friction 102 calculating the force of friction 103 friction and motion 104 reducing friction force 105 friction applications 115 friction of a pulled sled 124 effects of friction on trajectories 135 frictional force on an inclined plane 136 calculating acceleration on a ramp accounting for friction 142 effects of friction on acceleration 183 friction and mechanical advantage of wheel and axle	34 investigate static and sliding friction 61 what effect does friction have on mechanical advantage?

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Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
	184 friction and mechanical advantage of ramps and screws 245 friction causes damping in oscillators 256 friction and steady state	

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
MF.01.P.13 Physics	Motion and Forces	Students shall understand one-dimensional motion.	Calculate the magnitude of the force of friction:	41 effect of friction on motion of a ball on a ramp 71 air resistance and terminal speed 72 friction and traction and antilock brakes 100 the force of friction and the different types of friction 101 a model for friction 102 calculating the force of friction 103 friction and motion 104 reducing friction force 105 friction applications 115 friction of a pulled sled 124 effects of friction on trajectories 135 frictional force on an inclined plane 136 calculating acceleration on a ramp accounting for friction 142 effects of friction on acceleration 183 friction and mechanical advantage of wheel and axle	34 investigate static and sliding friction 61 what effect does friction have on mechanical advantage?

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
				184 friction and mechanical advantage of ramps and screws 245 friction causes damping in oscillators 256 friction and steady state	
MF.02.P.01 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Calculate the resultant vector of a moving object	119 adding vectors 120 adding vectors 121 adding and subtracting vectors 127 adding velocity vectors	41 calculate the resultant vector
MF.02.P.02 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Resolve two-dimensional vectors into their components:	122 calculating vector components 123 finding magnitude and angle of a vector 125 the velocity vector 126 components of the velocity vector 128 independence of horizontal and vertical motion in a velocity vector 130 calculating velocity components of initial velocity 132 interpreting the x-y components of force 133 calculating components of a force vector	45 calculate force components

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.03 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Calculate the magnitude and direction of a vector from its components:	120	representing vectors in Cartesian and polar coordinates	40	using polar coordinates
				125	representing the velocity vector in polar and Cartesian coordinates	41	plotting position with cartesian coordinates
				126	representing the velocity vector in polar and Cartesian coordinates		
				132	representing the force vector in Cartesian and polar coordinates		
				134	choosing coordinates for an inclined plane		
				141	explain vectors in Cartesian and polar coordinates		

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.04 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Solve two-dimensional problems using balanced forces:	26	calculating weight from mass	34	calculate the weight
				97	calculating weight with mass and gravity	40	using polar coordinates
				99	weight calculations	41	plotting position with cartesian coordinates
				120	representing vectors in Cartesian and polar coordinates		
				125	representing the velocity vector in polar and Cartesian coordinates		
				126	representing the velocity vector in polar and Cartesian coordinates		
				132	representing the force vector in Cartesian and polar coordinates		
				134	choosing coordinates for an inclined plane		
				141	explain vectors in Cartesian and polar coordinates		

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Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.05 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Solve two-dimensional problems using the Pythagorean Theorem or the quadratic formula:	60	creating the acceleration formula from experiments	22	uniform acceleration model
				66	developing the formulas for a model of motion with constant acceleration	25	create an algebraic model
						28	solve second law equation for string tension
				282	write a formula relating velocity of wave to period and wavelength	32	develop a model that predicts acceleration
						43	create algebraic model
				312	light intensity follows an inverse square law	49	write a formula
						94	give an equation that describes your observations
						189	Bernoulli's equation

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.06 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Describe the path of a projectile as a parabola	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall		
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				124	projectiles and trajectories		
				128	gravity only accelerates vertical motion		
				129	vertical motion of a projectile		
				130	projectiles launched at an angle		
				131	range of projectiles		
				134	resolving force of gravity in ramp coordinates		
				135	acceleration down an inclined plane		
				141	effects of gravity on motion of a projectile		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				152	law of universal gravitation and orbital motion	
				154	orbits and gravitational force	
				155	centripetal force and the law of universal gravitation combine to form the orbit equation	
				158	compare projectile motion to orbital motion	
				165	the motion of a tossed object	
				166	centers of mass and gravity may differ	
				187	work done against gravity	
				191	potential energy comes from gravity	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.07 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Apply kinematic equations to solve problems involving projectile motion of an object launched at an angle:	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall		
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				124	projectiles and trajectories		
				128	gravity only accelerates vertical motion		
				129	vertical motion of a projectile		
				130	projectiles launched at an angle		
				131	range of projectiles		
				134	resolving force of gravity in ramp coordinates		
				135	acceleration down an inclined plane		
				141	effects of gravity on motion of a projectile		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				152	law of universal gravitation and orbital motion	
				154	orbits and gravitational force	
				155	centripetal force and the law of universal gravitation combine to form the orbit equation	
				158	compare projectile motion to orbital motion	
				165	the motion of a tossed object	
				166	centers of mass and gravity may differ	
				187	work done against gravity	
				191	potential energy comes from gravity	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.08 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Apply kinematic equations to solve problems involving projectile motion of an object launched with initial horizontal velocity	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall		
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				124	projectiles and trajectories		
				128	gravity only accelerates vertical motion		
				129	vertical motion of a projectile		
				130	projectiles launched at an angle		
				131	range of projectiles		
				134	resolving force of gravity in ramp coordinates		
				135	acceleration down an inclined plane		
				141	effects of gravity on motion of a projectile		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
				152 law of universal gravitation and orbital motion 154 orbits and gravitational force 155 centripetal force and the law of universal gravitation combine to form the orbit equation 158 compare projectile motion to orbital motion 165 the motion of a tossed object 166 centers of mass and gravity may differ 187 work done against gravity 191 potential energy comes from gravity	
MF.02.P.09 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Calculate rotational motion with a constant force directed toward the center:	144 rotation and revolution and angular speed 145 calculating angular speed in radians per second 146 angular speed of a moving wheel 148 acceleration can be a change in the direction of motion 160 translation and rotation	46 investigating angular speed

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.02.P.10 Physics	Motion and Forces	Students shall understand two-dimensional motion.	Solve problems in circular motion by using centripetal acceleration:	149	calculating centripetal force	49	investigating centripetal force
				155	centripetal force and the law of universal gravitation combine to form the orbit equation		
				158	calculating centripetal force		
				460	orbital motion of a charge		
MF.03.P.01 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Relate radians to degrees:	169	relationship between angular acceleration and linear acceleration	58	rotational application of Newton's second law
				171	angular acceleration of a wheel		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.03.P.02 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Calculate the magnitude of torque on an object:	160	how torque and force differ	53	relationship between force and torque
				160	center of rotation	53	calculating torque
				161	calculating torque using torque equation	54	explore rotational equilibrium and net torque
				161	line of action and the torque created by a force	80	torque changes the direction of angular momentum vector
				162	combining torques to find the net torque		
				162	calculating torque		
				163	in rotational equilibrium the net torque is zero		
				163	solve a rotational equilibrium problem		
				164	when force and lever arm are not perpendicular		
				164	calculate a torque from an angled force		
				174	calculating torque		
				174	compare force and torque		
				181	torque and mechanical advantage of a lever		
				183	mechanical advantage of gears		
				234	torque resists change in angular momentum		
				442	torque between two magnets		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.03.P.03 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Calculate angular speed and angular acceleration:	169 171	relationship between angular acceleration and linear acceleration angular acceleration of a wheel	58	rotational application of Newton's second law
MF.03.P.04 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Solve problems using kinematic equations for angular motion:	231 232 233	what is angular momentum angular momentum depends on speed and mass and shape formula for angular momentum	79 80	investigate angular momentum explain life application of conservation of momentum
MF.03.P.05 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Solve problems involving tangential speed:	231 232 233	what is angular momentum angular momentum depends on speed and mass and shape formula for angular momentum	79 80	investigate angular momentum explain life application of conservation of momentum
MF.03.P.06 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Solve problems involving tangential acceleration:	231 232 233	what is angular momentum angular momentum depends on speed and mass and shape formula for angular momentum	79 80	investigate angular momentum explain life application of conservation of momentum

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.03.P.07 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Calculate centripetal acceleration:	148	acceleration can be a change in the direction of motion	49	investigating centripetal force
				149	calculating centripetal force		
				155	centripetal force and the law of universal gravitation combine to form the orbit equation		
				158	calculating centripetal force		
				460	orbital motion of a charge		
MF.03.P.08 Physics	Motion and Forces	Students shall understand the dynamics of rotational equilibrium.	Apply Newton's universal law of gravitation to find the gravitational force between two masses:	152	description of law of universal gravitation	51	calculate gravitational force of attraction
				153	formula and calculations for law of universal gravitation	51	investigate law of universal gravitation
				154	orbital motion		
				158	calculate weight and acceleration due to gravity on Pluto		
				216	tides are due to force of gravity		
				642	Newton's laws and gravity		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.04.P.01 Physics	Motion and Forces	Students shall understand the relationship between work and energy.	Calculate net work done by a constant net force:	83	finding the net force	45	balancing a specified force
				84	calculating net force		
				86	zero acceleration means net zero force		
				103	net force includes the force of friction		
				106	net force must be zero in equilibrium		
				107	net force of zero and free-body diagram		
				141	calculate the net force		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.04.P.02 Physics	Motion and Forces	Students shall understand the relationship between work and energy.	Solve problems relating kinetic energy and potential energy to the work-energy theorem:	191	the formula for potential energy	68	calculate potential and kinetic energy
				192	the formula for kinetic energy	72	potential to kinetic energy conversion in a pendulum
				193	deriving the formula for kinetic energy	88	potential to kinetic energy conversions of a pendulum
				194	energy transformations		
				196	energy transformation hydroelectric plant		
				199	kinetic and potential energy conversions while bouncing in a trampoline		
				212	energy flow in a pendulum		
				245	kinetic to potential energy changes in motion of an oscillator		
				253	harmonic motion involves both potential and kinetic energy		
				253	oscillators exchange energy back and forth between potential and kinetic		
MF.04.P.03 Physics	Motion and Forces	Students shall understand the relationship between work and energy.	Solve problems through the application of conservation of mechanical energy:	195	applying conservation of energy for a marble rolling on a hilly track	66	law of conservation of energy
				197	conservation of energy for Hoover Dam	68	find the total energy at each position
						74	investigating collisions and conservation of energy

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
MF.04.P.04 Physics	Motion and Forces	Students shall understand the relationship between work and energy.	Relate the concepts of time and energy to power	207 calculate power in climbing stairs 208 power formulas 210 estimating the power in wind 211 power in biological systems 220 calculate power rating 409 power and efficiency of electric cars	70 calculate person's power 71 calculate power output for each climber
MF.04.P.05 Physics	Motion and Forces	Students shall understand the relationship between work and energy.	Prove the relationship of time, energy and power through problem solving:	207 calculate power in climbing stairs 208 power formulas 210 estimating the power in wind 211 power in biological systems 220 calculate power rating 409 power and efficiency of electric cars	70 calculate person's power 71 calculate power output for each climber
MF.05.P.01 Physics	Motion and Forces	Students shall understand the law of conservation of momentum.	Describe changes in momentum in terms of force and time	230 impulse formula 238 difference between impact and impulse	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
MF.05.P.02 Physics	Motion and Forces	Students shall understand the law of conservation of momentum.	Solve problems using the impulse-momentum theorem:	230 impulse formula 238 difference between impact and impulse	
MF.05.P.03 Physics	Motion and Forces	Students shall understand the law of conservation of momentum.	Compare total momentum of two objects before and after they interact:	224 law of conservation of momentum 225 conservation of momentum in collisions 226 applying conservation of momentum 227 momentum conservation for collisions in two and three dimensions 231 conservation of angular momentum examples 232 conservation of angular momentum 235 jet engines work because of conservation of momentum 370 Einstein's thinking about momentum of particles moving near the speed of light 629 conservation of momentum in nuclear reactions	78 which ball had a greater change in momentum?

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
MF.05.P.04 Physics	Motion and Forces	Students shall understand the law of conservation of momentum.	Solve problems for perfectly inelastic and elastic collisions:	224	law of conservation of momentum	78	which ball had a greater change in momentum?
				225	conservation of momentum in collisions		
				226	applying conservation of momentum		
				227	momentum conservation for collisions in two and three dimensions		
				231	conservation of angular momentum examples		
				232	conservation of angular momentum		
				235	jet engines work because of conservation of momentum		
				370	Einstein's thinking about momentum of particles moving near the speed of light		
				629	conservation of momentum in nuclear reactions		
MF.06.P.01 Physics	Motion and Forces	Students shall understand the concepts of fluid mechanics.	Calibrate the applied buoyant force to determine if the object will sink or float:	547	buoyancy explained		
				556	buoyancy of gases		
				561	buoyancy of Alvin		

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
MF.06.P.02 Physics	Motion and Forces	Students shall understand the concepts of fluid mechanics.	Apply Pascal's principle to an enclosed fluid system:	549 formula for pressure in a liquid caused by gravity 550 pressure and force formula 560 pressure force on Alvin	
MF.06.P.03 Physics	Motion and Forces	Students shall understand the concepts of fluid mechanics.	Apply Bernoulli's equation to solve fluid-flow problems:	553 Bernoulli's equation 554 applying Bernoulli's equation 564 Bernoulli's equation calculation	189 explore Bernoulli's equation
MF.06.P.04 Physics	Motion and Forces	Students shall understand the concepts of fluid mechanics.	Use the ideal gas law to predict the properties of an ideal gas under different conditions	559 the combined gas law	
NP.14.P.01 Physics	Nuclear Physics	Students shall understand the concepts of quantum mechanics as they apply to the atomic spectrum.	Calculate energy quanta using Planck's equation:	580 comparing classical and quantum physics 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	197 quantum physics 200 explore how a vibrating string has similar properties to a quantum system

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
NP.14.P.02 Physics	Nuclear Physics	Students shall understand the concepts of quantum mechanics as they apply to the atomic spectrum.	Calculate the de Broglie wavelength of matter:	580 comparing classical and quantum physics 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	197 quantum physics 200 explore how a vibrating string has similar properties to a quantum system
NP.14.P.03 Physics	Nuclear Physics	Students shall understand the concepts of quantum mechanics as they apply to the atomic spectrum.	Distinguish between classical ideas of measurement and Heisenberg's uncertainty principle	583 the uncertainty principle 583 how the uncertainty principle differs from classical theory	

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
NP.14.P.04 Physics	Nuclear Physics	Students shall understand the concepts of quantum mechanics as they apply to the atomic spectrum.	Research emerging theories in physics, such as string theory	314 Einstein's theory of relativity 366 relationship between matter and energy and time and space 367 speed of light paradox 368 speed and time and clocks 369 consequences of time dilation 370 Einstein's mass-energy formula 371 simultaneity depends on the relative motion of your frame of reference 616 energy and radioactivity 625 nuclear reactions can convert mass into energy 629 energy is stored as mass in nuclear reactions 642 Einstein's theory and gravity and inertial mass 644 general relativity and curved space-time 645 black holes and general relativity 647 energy released in reactions between matter and antimatter	127 when does special relativity become important? 128 the equivalence of mass and energy

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
NP.15.P.01 Physics	Nuclear Physics	Students shall understand the process of nuclear decay.	Calculate the binding energy of various nuclei	573 fusion 627 fusion reactions 628 fission reactions 635 differences between fission and fusion	213 fusion and fission
NP.15.P.02 Physics	Nuclear Physics	Students shall understand the process of nuclear decay.	Predict the products of nuclear decay	573 nuclear reactions 625 nuclear reactions	
NP.15.P.03 Physics	Nuclear Physics	Students shall understand the process of nuclear decay.	Calculate the decay constant and the half-life of a radioactive substance	502 elements past #92 are radioactive and decay 570 radioactive isotopes 614 radioactive decay 616 energy and radioactivity	

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.16.P.01 Physics	Nature of Science	Students shall demonstrate an understanding that science is a way of knowing.	Describe why science is limited to natural explanations of how the world works	4	learning about natural laws through inquiry and observation	22	model for uniform accelerated motion
				7	developing models to explain observations		
				7	in science inquiry is used to uncover truth		
				40	creating useful models		
				101	a model for friction		
				102	a model for static friction		
				154	the orbits of planets and comets		
				211	output power from plants is input power for animals		
				243	examples of oscillators		
				259	wing-beat cycle of a hummingbird		
				330	optics and optical instruments		
				492	the binary number system and its use in computers		
				560	deep water submarine Alvin application		
				644	proof of Einstein's theory of general relativity		
				645	astronomers find black holes by what is around them		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
				646	a standard model for particle physics		
NS.16.P.02 Physics	Nature of Science	Students shall demonstrate an understanding that science is a way of knowing.	Compare and contrast the criteria for the formation of hypotheses, theories and laws	8 8 136 367 369 375	Comparing a theory and a natural law formulating a hypothesis 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	11 33 48 65 79 111	formulate a testable hypothesis formulate a testable hypothesis formulate a hypothesis form a hypothesis write a hypothesis how does what you observed support the quantum theory?

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.16.P.03 Physics	Nature of Science	Students shall demonstrate an understanding that science is a way of knowing.	Summarize the guidelines of science: -results are based on observations, evidence, and testing -hypotheses must be testable -understandings and/or conclusions may change -peer review and verification	4	inquiry through observation	11	formulate a testable hypothesis
				7	revising explanations through observation	33	formulate a testable hypothesis
				7	creating explanations through observation	43	follow the scientific method
				8	formulating a hypothesis	43	test your prediction
				8	refining theories based on observations	48	formulate a hypothesis
						65	form a hypothesis
				8	forming hypotheses and testing with experiments	65	where does the marble move the fastest?
				10	putting forth ideas and then testing them	79	write a hypothesis
				323	using glow-in-the-dark plastic to demonstrate photon energy levels	111	do your observations support this hypothesis?
				423	charge by friction	147	how did A and B tapes acquire different charge?
NS.17.P.01 Physics	Nature of Science	Students shall safely design and conduct a scientific inquiry to solve valid problems.	Develop the appropriate procedures using controls and variables (dependent and independent) in scientific experimentation	40	defining variables	11	recognizing and controlling variables
				42	control and experimental variables	82	determine which variable has the greatest effect
				43	dependent and independent variables in graphs	82	dependent and independent variables
				54	importance of changing one variable at a time in an experiment	166	variables that affect the performance of the generator
				251	changing the natural frequency of a stretched rubber band		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
NS.17.P.02 Physics	Nature of Science	Students shall safely design and conduct a scientific inquiry to solve valid problems.	Research and apply appropriate safety precautions (ADE Guidelines) when designing and/or conducting scientific investigations	543 safety factors	79 safety note 129 safety precautions 131 safety precautions 150 safety note 159 safety note 160 electromagnet safety 176 safety note 176 heat safety 185 safety tip 192 gas pressure safety note 206 acid safety

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.17.P.03 Physics	Nature of Science	Students shall safely design and conduct a scientific inquiry to solve valid problems.	Identify sources of bias that could affect experimental outcome	2	understanding natural laws	11	recognizing and controlling variables
				3	connecting cause and effect through observation	12	cause and effect relationships
				4	inquiry through observation	43	test your prediction
				7	revising explanations through observation	65	where does the marble move the fastest?
				7	creating explanations through observation	82	determine which variable has the greatest effect
				8	forming hypotheses and testing with experiments	82	dependent and independent variables
				8	refining theories based on observations	90	what effect does changing the tension have?
				9	connecting cause and effect through analysis	109	record observations
				10	putting forth ideas and then testing them	110	examine the effects of glow-in-the-dark material
				40	defining variables	111	do your observations support this hypothesis?
				42	control and experimental variables	147	how did A and B tapes acquire different charge?
				43	dependent and independent variables in graphs	166	variables that affect the performance of the generator
				45	recognizing patterns and cause and effect relationships		
				54	importance of changing one variable at a time in an experiment		

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Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
	251 changing the natural frequency of a stretched rubber band 323 using glow-in-the-dark plastic to demonstrate photon energy levels 423 charge by friction	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.17.P.04 Physics	Nature of Science	Students shall safely design and conduct a scientific inquiry to solve valid problems.	Gather and analyze data using appropriate summary statistics (e.g., percent yield, percent error)	11	Ptolemy model vs. Copernicus model of the solar system	1	estimating length
				18	measuring distance	6	accuracy and resolution and printing
				25	why accuracy and precision are important	13	is there a trend in measurements?
				25	accuracy and precision of measurements	13	create a graph
				40	making a good model	13	compare prediction to measurement
				42	controlling variables in experiments	16	create a graph
				43	graphs are a way of representing data	16	describe the graph
				43	constructing a graph	22	create graphs
				44	using a graphical model to make a prediction and checking the model's accuracy	22	how do you measured positions compare to model?
				44	graphical models	22	compare calculation with graph estimate
				45	recognizing patterns using graphs	25	find the average time
				54	understanding patterns in relationships between variables	29	does experiment agree with prediction?
				54	constructing a graph	37	make a graph
				55	create a graph from a data table	38	make a graph
						43	discuss sources of error
						43	measure and record the distance
						43	sketch four graphs

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Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page		Volume Two Investigation Manual Page	
	56	indicate relationships between variables in graphs	43	how does the measurement compare to your prediction?
	246	understanding graphs of harmonic motion	45	discuss sources of errors
	290	the process of digital sound reproduction	56	create a graph
	297	frequency spectrum	58	find average of three trials
	304	comparison of wave forms from guitar sounds	60	measure input and output forces
	307	decibel level vs. frequency graph for human hearing	63	as mechanical advantage increases what happens to length of pulled string?
	411	the waveform of AC electricity	66	create a graph of speed vs. position
	412	average voltage and current of AC power	66	what does the graph tell you?
	427	diagramming electric fields using field lines	67	calculate average of three times
	443	diagramming magnetic fields using magnetic field lines	67	measure vertical distance
	479	current vs.voltage graph for a transistor	71	calculate average work and power
			76	compare predicted mass to actual mass
			82	measure the length of the string
			82	analyze data
			82	make three different graphs
			87	sketch a graph

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
		114 are there differences between your prediction and measurement? 133 did battery voltage change? 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 202 identify two sources of experimental error

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.17.P.05 Physics	Nature of Science	Students shall safely design and conduct a scientific inquiry to solve valid problems.	Formulate valid conclusions without bias	7	creating theories based on observations	10	calculate percent difference
				188	perpetual motion machines	12	do your results agree with hypothesis?
				306	explain why hearing can be damaged by loud sounds	13	predict speed of ball
						13	find percent error
				498	since wood is created from other matter it must not be a fundamental substance	16	what do the results tell you?
						18	are the accelerations different?
						18	how would acceleration be different?
						19	does the ball accelerate?
						33	calculate the predicted speed
						33	does your experiment confirm your hypothesis?
						37	use your graph to make a prediction
						37	calculate percent difference
						38	use your graph to make a prediction
						38	calculate percent difference
						42	predict exact landing location
						43	calculate percent difference

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
		43 what would happen if...? 50 does your experiment provide confirmation? 58 explain why the angular acceleration is different 65 predict where the ball moves fastest 66 does this agree with your hypothesis? 80 explain your observations 83 calculate percent error 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 predict what the current will be 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 #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
NS.18.P.01 Physics	Nature of Science	Students shall demonstrate an understanding of historical trends in physics.	Recognize that theories are scientific explanations that require empirical data, verification and peer review	7 8	revising explanations through observation refining theories based on observations	

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.18.P.02 Physics	Nature of Science	Students shall demonstrate an understanding of historical trends in physics.	Research historical and current events in physics	52	Dr. Harold Edgerton and strobe photography	122	research types of electromagnetic waves
				208	James Watt	147	Gilbert built the first electroscope
				257	Pierre and Jacques Curie and the piezoelectric effect		
				311	Thomas Edison and the electric light		
				314	Einstein and the speed of light		
				316	Albert Einstein		
				361	Thomas Young		
				366	Albert Einstein's theory of special relativity		
				367	Albert A. Michelson and Edward R. Morley		
				400	Gustav Robert Kirchhoff		
				440	magnetism		
				447	history of magnetism		
				501	ancient Greeks' ideas of elements		
				574	Niels Bohr		
				575	Johann Balmer		
				578	Wolfgang Pauli		
				580	Max Planck and Albert Einstein		
				630	Wolfgang Pauli		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
	644 proof of Einstein's theory of general relativity 647 Paul Dirac	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.19.P.01 Physics	Nature of Science	Students shall use mathematics, science equipment, and technology as tools to communicate and solve physics problems.	Use appropriate equipment and technology as tools for solving problems (e.g., balances, scales, calculators, probes, glassware, burners, computer software and hardware)		data tables and graphs can be created on computer or graphing calculator	1	estimating length
				18	measuring distance	4	using a timer
				23	reading a digital timer	5	using photogates
				25	accuracy and precision of measurements	6	accuracy and resolution and printing
				91	the force platform	7	using devices to measure mass
				383	using a multimeter to measure voltage	9	using timer and photogates
				385	measuring current with an ammeter or multimeter	11	using timer and photogates
				387	using a multimeter to measure resistance	14	using a timer and photogates
				504	Celsius and Fahrenheit thermometers	17	using a timer and photogates
				505	how thermometers work	18	use a timer and photogates
						21	use a timer and photogates
						23	use a timer and photogates
						26	use a timer and photogates
						29	find mass
						29	use a spring scale
						34	use a spring scale
						39	using a compass

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
		42 use a timer and photogates 43 measure and record 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 measure input and output forces 60 use a spring scale 65 use a timer and photogate 67 measure vertical distance 67 use a timer and photogate 75 use a timer and photogates 82 measure the length of the string 82 use a timer and photogate 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 93 use the timer to measure frequency

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
					106 experiment with mirrors 112 use a laser and mirror to study law of reflection 112 study reflection with a mirror 115 use mirrors and lenses to learn how images are formed 117 use a laser to locate images formed by a lens 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 157 reading a compass 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

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
					176 use a thermometer 178 measure the temperature 180 measure the temperature 192 check the pressure with your gauge 192 use a digital balance

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.19.P.02 Physics	Nature of Science	Students shall use mathematics, science equipment, and technology as tools to communicate and solve physics problems.	Manipulate scientific data using appropriate mathematical calculations, charts, tables, and graphs	7	creating theories based on observations	1	estimating length
				18	measuring distance	6	collecting data with precision
				25	accuracy and precision of measurements	6	accuracy and resolution and printing
				43	constructing a graph	10	calculate percent difference
				44	graphical models	13	find percent error
				54	constructing a graph	13	create a graph
				55	create a graph from a data table	13	predict speed of ball
				60	creating the acceleration formula from experiments	15	record data in a table
				66	developing the formulas for a model of motion with constant acceleration	15	collect time data with precision
				142	finding x and y components of velocity for model rocket	16	create a graph
				282	write a formula relating velocity of wave to period and wavelength	16	describe the graph
				290	the process of digital sound reproduction	17	use a data table
				312	light intensity follows an inverse square law	18	how would acceleration be different?
				411	the waveform of AC electricity	18	record data
				412	average voltage and current of AC power	18	collect time data with precision
						21	record results in table
						22	uniform acceleration model
						22	create graphs
						25	create an algebraic model

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
				498	since wood is created from other matter it must not be a fundamental substance	25	find the average time
						27	record position and time data
						28	solve second law equation for string tension
						29	record mass and force
						32	develop a model that predicts acceleration
						33	calculate the predicted speed
						37	calculate percent difference
						37	make a graph
						37	use your graph to make a prediction
						38	calculate percent difference
						38	use your graph to make a prediction
						38	make a graph
						42	predict exact landing location
						43	sketch four graphs
						43	measure and record the distance
						43	calculate percent difference
						43	create algebraic model

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
					49 write a formula 56 create a graph 58 find average of three trials 60 measure input and output forces 65 predict where the ball moves fastest 66 create a graph of speed vs. position 66 record data in table 67 measure vertical distance 67 calculate average of three times 70 record data in table 71 calculate average work and power 82 measure the length of the string 82 record your data in table 82 make three different graphs 82 create data table for self-designed experiment 83 calculate percent error 87 sketch a graph

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
					94 give an equation that describes your observations 132 predict what the current will be 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 202 find percent composition 208 calculating percent yield

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.19.P.03 Physics	Nature of Science	Students shall use mathematics, science equipment, and technology as tools to communicate and solve physics problems.	Utilize technology to communicate research findings	18	measuring distance	1	estimating length
				25	accuracy and precision of measurements	6	accuracy and resolution and printing
				42	writing procedures in a lab notebook helps make sure your results are repeatable	43	measure and record the distance
						60	measure input and output forces
						67	measure vertical distance
						82	measure the length of the string
						122	communicate your findings

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
NS.20.P.01 Physics	Nature of Science	Students shall describe the connections between pure and applied science.	Compare and contrast the connections between pure science and applied science as it relates to physics	12	all technology is based on fundamental laws of physics	
				14	using analysis and problem solving and an understanding of technology to make economic decisions	
				51	analyzing motion with video and strobe photography	
				112	relationship between science and engineering and technology	
				172	bicycle physics application	
				243	oscillators are used in communications and music and clocks	
				263	waves can carry information	
				369	technological advances have allowed discovery of the expanding universe	
				372	holography application	
				392	hybrid gas/electric cars application	
				429	electron beam accelerators	
				472	maglev train application	
				473	how magplanes levitate	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Strand Standard Learning Expectation Course Title	Volume One Student Text Page	Volume Two Investigation Manual Page
	492 computers and electronic addition of numbers application 516 refrigerator application 535 designing buildings to be energy efficient 560 deep water submarine Alvin application 585 economics of laser technology 585 laser application 615 smoke detectors	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.20.P.02 Physics	Nature of Science	Students shall describe the connections between pure and applied science.	Give examples of scientific bias that affect outcomes of experimental results	25	why accuracy and precision are important	13	is there a trend in measurements?
				306	explain why hearing can be damaged by loud sounds	16	what do the results tell you?
						18	are the accelerations different?
						19	does the ball accelerate?
						43	what would happen if...?
						58	explain why the angular acceleration is different
						63	as mechanical advantage increases what happens to length of pulled string?
						66	what does the graph tell you?
						80	explain your observations
						82	analyze data
						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?

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
					133 analyze data and explain a rule 133 did battery voltage change? 202 identify two sources of experimental error

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
NS.20.P.03 Physics	Nature of Science	Students shall describe the connections between pure and applied science.	Discuss why scientists should work within ethical parameters	52	Dr. Harold Edgerton and strobe photography	147	Gilbert built the first electroscope
				208	James Watt		
				257	Pierre and Jacques Curie and the piezoelectric effect		
				311	Thomas Edison and the electric light		
				314	Einstein and the speed of light		
				316	Albert Einstein		
				361	Thomas Young		
				366	Albert Einstein's theory of special relativity		
				367	Albert A. Michelson and Edward R. Morley		
				400	Gustav Robert Kirchhoff		
				574	Niels Bohr		
				575	Johann Balmer		
				578	Wolfgang Pauli		
				580	Max Planck and Albert Einstein		
				630	Wolfgang Pauli		
				644	proof of Einstein's theory of general relativity		
				647	Paul Dirac		

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
NS.20.P.04 Physics	Nature of Science	Students shall describe the connections between pure and applied science.	Evaluate long-range plans concerning resource use and by-product disposal for environmental, economic, and political impact.	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	
				604	balancing chemical equation of acid rain	
				607	impact of combustion reaction of gasoline	
				621	sources of radiation in the environment	
				621	human technology contributes to radiation in environment	
				628	nuclear waste	
				632	nuclear waste	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
NS.20.P.05 Physics	Nature of Science	Students shall describe the connections between pure and applied science.	Explain how the cyclical relationship between science and technology results in reciprocal advancements in science and technology	12 all technology is based on fundamental laws of physics 51 analyzing motion with video and strobe photography 112 relationship between science and engineering and technology 113 the engineering design cycle 113 test and evaluate the prototype structure design 113 conceptual design for a bridge 113 build and test a prototype structure out of toothpicks 172 bicycle physics application 243 oscillators are used in communications and music and clocks 263 waves can carry information 369 technological advances have allowed discovery of the expanding universe 372 holography application 389 electrical devices are designed to operate at a certain voltage	83 design and construct a pendulum 85 create a system that oscillates 163 design and test different electric motors 163 propose solutions that will work for each disk 163 apply steps of the design cycle to building different electric motors 164 evaluate the performance of motor designs 167 suggest improvements you could make to the generator design 173 designing and building logic circuits 191 build an air-speed tester

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				392	hybrid gas/electric cars application	
				429	electron beam accelerators	
				472	maglev train application	
				473	how magplanes levitate	
				492	computers and electronic addition of numbers application	
				516	refrigerator application	
				543	failure analysis in the design process	
				543	evaluate three designs for a bridge	
				560	deep water submarine Alvin application	
				585	laser application	
				615	smoke detectors	
NS.21.P.01 Physics	Nature of Science	Students shall describe various physics careers and the training required for the selected career.	Research and evaluate careers in physics using the following criteria: •educational requirements •salary •availability of jobs •working conditions	12	engineers design practical devices for solving problems	
				13	medical and health professions use physics	
				91	careers in biomechanics	
				227	police forensic scientists	
				289	careers in acoustics	
				404	electrical engineers	

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
WO.09.P.01 Physics	Waves and Optics	Students shall distinguish between simple harmonic motion and waves.	Explain how force, velocity, and acceleration change as an object vibrates with simple harmonic motion	242 what is a cycle? 244 concepts of period and frequency explained 245 concept of amplitude explained 249 analyze the motion of the cycle of a pendulum 251 systems tends to have a preferred frequency 258 identify period and frequency and cycle and amplitude 260 calculate speed of an oscillator 264 frequency and amplitude and wavelength in waves 265 concept of speed of a wave 266 formula for speed of a wave 266 speed of a wave is the speed at which a cycle moves 277 energy of a wave is proportional to frequency and amplitude 278 wavelength of a standing wave	81 investigate the motion of a pendulum 88 if frequency is increased what happens to total energy? 90 study the speed of the wave pulse 94 investigate the wavelength of standing waves 94 investigate the frequency of standing waves

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
				282	describe relationship between wave characteristics		
				292	importance of wavelength of sound waves		
				452	MRI--each nucleus is a resonant oscillator		
WO.09.P.02 Physics	Waves and Optics	Students shall distinguish between simple harmonic motion and waves.	Calculate the spring force using Hooke's law:	544	Hooke's law for solids	37	investigating Hooke's law
				545	thermal stress	38	investigating Hooke's law

Correlation to Arkansas Science Curriculum Framework 2005

Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
WO.09.P.03 Physics	Waves and Optics	Students shall distinguish between simple harmonic motion and waves.	Calculate the period and frequency of an object vibrating with a simple harmonic motion	242 what is a cycle? 244 concepts of period and frequency explained 245 concept of amplitude explained 249 analyze the motion of the cycle of a pendulum 251 systems tends to have a preferred frequency 258 identify period and frequency and cycle and amplitude 260 calculate speed of an oscillator 264 frequency and amplitude and wavelength in waves 265 concept of speed of a wave 266 formula for speed of a wave 266 speed of a wave is the speed at which a cycle moves 277 energy of a wave is proportional to frequency and amplitude 278 wavelength of a standing wave	81 investigate the motion of a pendulum 88 if frequency is increased what happens to total energy? 90 study the speed of the wave pulse 94 investigate the wavelength of standing waves 94 investigate the frequency of standing waves

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page
				282	describe relationship between wave characteristics	
				292	importance of wavelength of sound waves	
				452	MRI--each nucleus is a resonant oscillator	

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
WO.09.P.04 Physics	Waves and Optics	Students shall distinguish between simple harmonic motion and waves.	Differentiate between pulse and periodic waves	242 what is a cycle? 244 concepts of period and frequency explained 245 concept of amplitude explained 249 analyze the motion of the cycle of a pendulum 251 systems tends to have a preferred frequency 258 identify period and frequency and cycle and amplitude 260 calculate speed of an oscillator 265 wave pulse 266 speed of a wave is the speed at which a cycle moves 267 water waves are transverse and Slinky is longitudinal 268 one- and two- and three-dimensional waves 275 standing waves on a string 277 standing waves on a string 452 MRI--each nucleus is a resonant oscillator	81 investigate the motion of a pendulum 89 making wave pulses on a string 89 study wave pulses on elastic cord 91 making circular waves in a ripple tank 91 make different types of waves in a ripple tank 91 making plane waves in a ripple tank

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
WO.09.P.05 Physics	Waves and Optics	Students shall distinguish between simple harmonic motion and waves.	Relate energy and amplitude	242 244 245 249 251 258 260 266 452	what is a cycle? concepts of period and frequency explained concept of amplitude explained analyze the motion of the cycle of a pendulum systems tends to have a preferred frequency identify period and frequency and cycle and amplitude calculate speed of an oscillator speed of a wave is the speed at which a cycle moves MRI--each nucleus is a resonant oscillator	81	investigate the motion of a pendulum

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
WO.10.P.01 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Calculate the frequency and wavelength of electromagnetic radiation	262 waves are all around us 277 standing waves are used to store energy 281 microwaves 281 use of microwaves in microwave ovens 359 waves of the electromagnetic spectrum 359 descriptions of radio waves and microwaves and infrared rays 360 x-rays and gamma rays 452 MRI uses radio waves	
WO.10.P.02 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Apply the law of reflection for flat mirrors:	315 mirrors 331 mirrors reflect light 332 the image in a mirror 333 the laws of reflection 352 law of reflection	106 use a mirror to study how light behaves 112 investigate law of reflection
WO.10.P.03 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Describe the images formed by flat mirrors	315 mirrors 331 mirrors reflect light 332 the image in a mirror	106 use a mirror to study how light behaves
WO.10.P.04 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Calculate distances and focal lengths for curved mirrors:	315 mirrors 331 mirrors reflect light 332 the image in a mirror	106 use a mirror to study how light behaves

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Foundations of Physics

Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page		Volume Two Investigation Manual Page	
WO.10.P.05 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Draw ray diagrams to find the image distance and magnification for curved mirrors	315 331 332	mirrors mirrors reflect light the image in a mirror	106	use a mirror to study how light behaves
WO.10.P.06 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Solve problems using Snell's law:	335 340 354	Snell's law of refraction lenses follow Snell's law of refraction using Snell's law	113 114	investigate Snell's law of refraction apply Snell's law of refraction
WO.10.P.07 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Calculate the index of refraction through various media using the following equation:	334 335 353 358	the index of refraction refraction depends on index of refraction in both materials explain index of refraction index of refraction is ratio of speed of light in material to speed of light in vacuum	114 114	study the critical angle of refraction in a prism study index of refraction

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Student Text and Investigation Manual

Standard #: Course Title	Strand	Standard	Learning Expectation	Volume One Student Text Page	Volume Two Investigation Manual Page
WO.10.P.08 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Use a ray diagram to find the position of an image produced by a lens	331 lenses bend light 339 finding an image in a ray diagram 340 focal point and focal length 341 focus and focal plane of a lens 342 drawing ray diagrams of lenses 343 ray diagram for a converging lens 353 identifying rays from a ray diagram	116 investigate how focal length is related to focal point 116 trace ray diagrams through a double convex lens 117 sketch the image formed by a lens
WO.10.P.09 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Solve problems using the thin-lens equation:	331 lenses bend light 340 converging and diverging lenses	116 investigate how a converging lens bends light
WO.10.P.10 Physics	Waves and Optics	Students shall compare and contrast the law of reflection and the law of refraction.	Calculate the magnification of lenses:	331 lenses bend light 338 how the human eye sees images 372 three-dimensional images and the human eye	