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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.01 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Explore displacement, velocity, and acceleration.	18	definition of distance and length	9	collect data and calculate speed of car
				36	the precise meaning of speed	9	calculate speed of rolling marble
				36	speed is relative	10	make object move with speed of 1 m/sec
				37	calculating speed	12	finding speed of ball with one photogate
				37	how to calculate speed	14	find the speed of the ball
				38	the speed formula and calculating speed	15	find speed of the ball
				38	compare and contrast speed and velocity	17	studying acceleration
				41	speed of a ball on a ramp	17	find two speeds
				46	speed is the rate of change of position	17	learn techniques for finding acceleration
				46	definitions of position and distance	17	find the acceleration
				47	average and instantaneous speed	20	understanding equation for uniform accelerated motion
				48	determining speed from the slope of a position vs. time graph	21	calculate speed of ball
				49	distance on the speed vs. time graph	25	derive acceleration equation
				55	calculate the average speed and distance traveled	26	make ball roll at constant speed
				58	acceleration is the rate of change in the speed of an object	29	calculate the acceleration
						33	calculate the predicted speed
						39	studying position vectors

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				59	comparing speed and acceleration	39	investigating vectors
				60	formula for acceleration	42	find initial speed of ball
				61	zero acceleration vs. constant acceleration vs. acceleration with zero speed	43	calculate the velocity vector
				61	general definition of acceleration	50	calculate the speed of the ball
				62	acceleration is total change of speed divided by total change in time	66	find the speed of the ball
				64	calculate speed in accelerated motion	68	what is speed of the ball?
				64	calculating the speed of an object that is accelerating	76	calculate speeds of projectile and target balls
				64	calculate speed in accelerated motion	90	calculate the speed of the wave pulse
				67	calculate time and distance from acceleration	128	relativity and frames of reference
				74	understanding average speed and instantaneous speed	191	calculate speed of air in homemade air-speed tester
				75	calculations of speed		
				75	problem using frames of reference		
				84	direction of net force and acceleration and speed		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				118	vectors have magnitude and direction	
				119	the displacement vector and measuring displacement	
				119	displacement vectors	
				124	definition of the velocity vector	
				125	speed is the magnitude of the velocity vector	
				125	the velocity vector	
				126	components of the velocity vector	
				127	calculating velocity vectors may require knowing frames of reference	
				127	adding velocity vectors	
				128	constant velocity of horizontal component of projectile motion	
				130	analyzing changing velocity in vertical component of projectile motion	
				146	calculating linear speed of a moving wheel	
				147	the linear speed of a rolling wheel	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				150	centripetal acceleration	
				366	special relativity and time dilation	
				367	relative motion and speed of light	
				369	frequency of light depends on relative motion	
				371	simultaneity depends on the relative motion of your frame of reference	
				643	frame of reference and the equivalence principle	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.02 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Analyze vector diagrams and solve composition and resolution problems for force and momentum.	78	force is an action that can change motion	27	were any forces acting on the ball?
				81	force is related to acceleration	39	investigating vectors
						40	using polar coordinates
				83	finding the net force	41	calculate the resultant vector
				84	calculating net force	41	plotting position with cartesian coordinates
				86	zero acceleration means net zero force	43	calculate the velocity vector
				94	force calculations in different units	44	investigating force vectors
				99	balanced force problems	45	calculate force components
				100	friction is a force that resists motion	45	balancing a specified force
				103	net force includes the force of friction	49	draw a free body diagram and label forces
				106	net force must be zero in equilibrium	49	consider forces acting on the ball
				107	net force of zero and free-body diagram	73	momentum is a vector
				118	vectors have magnitude and direction	80	angular momentum behaves like a vector
				119	displacement vectors		
				119	adding vectors		
				120	adding vectors		
				120	representing vectors in Cartesian and polar coordinates		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				121	adding and subtracting vectors	
				122	calculating vector components	
				123	finding magnitude and angle of a vector	
				124	definition of the velocity vector	
				125	the velocity vector	
				125	the velocity vector	
				125	representing the velocity vector in polar and Cartesian coordinates	
				126	representing the velocity vector in polar and Cartesian coordinates	
				126	components of the velocity vector	
				126	components of the velocity vector	
				127	adding velocity vectors	
				127	adding velocity vectors	
				128	independence of horizontal and vertical motion in a velocity vector	
				130	calculating velocity components of initial velocity	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				132	representing the force vector in Cartesian and polar coordinates	
				132	interpreting the x-y components of force	
				132	the force vector describes the strength and direction of a force	
				133	balancing forces in two dimensions	
				133	calculating components of a force vector	
				134	choosing coordinates for an inclined plane	
				136	calculate the acceleration of a skier on a slope	
				141	calculate the net force	
				141	explain vectors in Cartesian and polar coordinates	
				148	centripetal force causes circular motion	
				186	work done by a force at an angle to the distance	
				222	comparison of kinetic energy and momentum	
				223	momentum is a vector	
				237	why is momentum a vector	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
				254 definition of periodic force	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.1.03 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Explore characteristics of rectilinear motion and create displacement-time graphs (velocity), velocity-time graphs (acceleration and distance).	47 position vs. time graph 48 determining speed from the slope of a position vs. time graph 48 graphs showing changes in speed 49 speed vs. time graph for constant speed 50 graphs for motion of increasing speed and decreasing speed 50 speed vs. time graph for downhill motion 54 graphing speed vs. time 55 analyzing distance vs. time graph 61 constant speed and constant acceleration 62 speed vs. time graph for accelerated motion 63 calculating acceleration from a speed vs. time graph 63 complex speed vs. time graphs 65 calculating distance from speed vs. time graph 74 describing motion with speed vs. time graph	13 graph speed versus position 16 create a speed vs. time graph 16 create a position vs. time graph 19 make a speed vs. time graph 20 speed vs. time graph for uniform acceleration 22 create a speed vs. time graph 22 create a position vs. time graph

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				74	sketching speed vs. time graphs for different changes of motion	
				76	analyzing graph for changes in motion	
				260	velocity vs. time graph of harmonic motion	
				260	position vs. time graph of harmonic motion	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.04 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Investigate the characteristics of centripetal motion and centripetal acceleration.	144	rotation and revolution and angular speed	46	contrasting linear and angular motion
				145	calculating angular speed in radians per second	46	investigating angular speed
				146	angular speed of a moving wheel	53	relationship between force and torque
				146	the relationship between linear and angular speed	53	calculating torque
				147	speedometers and odometers	54	explore rotational equilibrium and net torque
				148	acceleration can be a change in the direction of motion	58	rotational application of Newton's second law
				154	satellites and orbital motion	80	torque changes the direction of angular momentum vector
				155	satellite motion application		
				156	HEO and geostationary orbit		
				157	compare linear and angular speeds		
				160	how torque and force differ		
				160	center of rotation		
				160	translation and rotation		
				161	calculating torque using torque equation		
				161	line of action and the torque created by a force		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				162	combining torques to find the net torque	
				162	calculating torque	
				163	solve a rotational equilibrium problem	
				163	in rotational equilibrium the net torque is zero	
				164	calculate a torque from an angled force	
				164	when force and lever arm are not perpendicular	
				169	relationship between angular acceleration and linear acceleration	
				171	angular acceleration of a wheel	
				171	rotational motion and linear motion	
				174	calculating torque	
				174	compare force and torque	
				181	torque and mechanical advantage of a lever	
				183	mechanical advantage of gears	
				231	linear and angular momentum	
				234	torque resists change in angular momentum	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				238	compare linear and angular momentum	
				243	orbit is a type of cycle	
				442	torque between two magnets	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.05 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Evaluate the dynamics of systems in motion including friction, gravity, impulse and momentum, change in momentum, and conservation of momentum.	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	73	momentum is a vector
				71	air resistance and terminal speed	73	calculating momentum
				71	acceleration of gravity does not depend on mass	75	investigate collisions and conservation of momentum
				72	friction and traction and antilock brakes	77	the momentum form of Newton's second law
				75	problem understanding acceleration due to gravity	78	which ball had a greater change in momentum?
				97	strength of gravity on Earth and Jupiter	79	investigate angular momentum
				98	gravity and acceleration and weightlessness	80	explain life application of conservation of momentum
				100	the force of friction and the different types of friction	80	angular momentum behaves like a vector
				101	a model for friction		
				102	calculating the force of friction		
				103	friction and motion		
				104	reducing friction force		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				105	friction applications	
				115	friction of a pulled sled	
				124	projectiles and trajectories	
				124	effects of friction on 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	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				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	
				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	
				222	comparison of kinetic energy and momentum	
				223	momentum is a vector	
				223	momentum formula and calculating momentum	
				224	law of conservation of momentum	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				225	conservation of momentum in collisions	
				226	solving elastic and inelastic collision problems	
				226	applying conservation of momentum	
				227	momentum conservation for collisions in two and three dimensions	
				229	force on a rocket from change in momentum	
				230	calculate change in momentum for elastic vs. inelastic collisions	
				230	impulse formula	
				231	what is angular momentum	
				231	conservation of angular momentum examples	
				232	angular momentum depends on speed and mass and shape	
				232	conservation of angular momentum	
				233	formula for angular momentum	
				235	jet engines work because of conservation of momentum	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				236	momentum conservation of turbofan engine	
				237	why is momentum a vector	
				238	difference between impact and impulse	
				238	momentum in billiards	
				239	calculate momentum	
				245	friction causes damping in oscillators	
				256	friction and steady state	
				276	natural frequency and harmonics	
				370	Einstein's thinking about momentum of particles moving near the speed of light	
				629	conservation of momentum in nuclear reactions	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.06 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Investigate projectile 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		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	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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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.07 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Apply mathematics to solve motion problems.	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
				312	light intensity follows an inverse square law	43	create algebraic model
						49	write a formula
						94	give an equation that describes your observations
						189	Bernoulli's equation

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.08 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Experiment with elastic and inelastic collisions.	162	units of torque	73	calculating momentum
				223	momentum formula and calculating momentum	75	investigate collisions and conservation of momentum
				224	law of conservation of momentum	77	the momentum form of Newton's second law
				225	conservation of momentum in collisions	78	which ball had a greater change in momentum?
				226	applying conservation of momentum		
				226	solving elastic and inelastic collision problems		
				227	momentum conservation for collisions in two and three dimensions		
				229	force on a rocket from change in momentum		
				230	calculate change in momentum for elastic vs. inelastic collisions		
				231	conservation of angular momentum examples		
				232	conservation of angular momentum		
				235	jet engines work because of conservation of momentum		
				236	momentum conservation of turbofan engine		
				238	momentum in billiards		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				239	calculate momentum	
				276	natural frequency and harmonics	
				370	Einstein's thinking about momentum of particles moving near the speed of light	
				629	conservation of momentum in nuclear reactions	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.09 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Experiment with pendulums.	242	what is a cycle?	81	investigate the motion of a pendulum
				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		
				266	speed of a wave is the speed at which a cycle moves		
				452	MRI--each nucleus is a resonant oscillator		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.10 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Utilize trigonometry and vector analysis to solve force and momentum problems.	83	finding the net force	41	calculate the resultant vector
				84	calculating net force	44	investigating force vectors
				86	zero acceleration means net zero force	45	calculate force components
				103	net force includes the force of friction	45	balancing a specified force
				106	net force must be zero in equilibrium	49	draw a free body diagram and label forces
				107	net force of zero and free-body diagram	73	momentum is a vector
				119	adding vectors	80	angular momentum behaves like a vector
				120	adding vectors		
				121	adding and subtracting vectors		
				122	calculating vector components		
				123	finding magnitude and angle of a vector		
				125	the velocity vector		
				126	components of the velocity vector		
				127	adding velocity vectors		
				128	independence of horizontal and vertical motion in a velocity vector		
				130	calculating velocity components of initial velocity		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				132	interpreting the x-y components of force	
				132	the force vector describes the strength and direction of a force	
				133	calculating components of a force vector	
				136	calculate the acceleration of a skier on a slope	
				141	calculate the net force	
				186	work done by a force at an angle to the distance	
				222	comparison of kinetic energy and momentum	
				223	momentum is a vector	
				237	why is momentum a vector	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.11 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Apply elementary calculus to solve motion problems.	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
				312	light intensity follows an inverse square law	43	create algebraic model
						49	write a formula
						94	give an equation that describes your observations
						189	Bernoulli's equation

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.12 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Experiment with elastic and inelastic collisions.	162	units of torque	73	calculating momentum
				223	momentum formula and calculating momentum	75	investigate collisions and conservation of momentum
				224	law of conservation of momentum	77	the momentum form of Newton's second law
				225	conservation of momentum in collisions	78	which ball had a greater change in momentum?
				226	applying conservation of momentum		
				226	solving elastic and inelastic collision problems		
				227	momentum conservation for collisions in two and three dimensions		
				229	force on a rocket from change in momentum		
				230	calculate change in momentum for elastic vs. inelastic collisions		
				231	conservation of angular momentum examples		
				232	conservation of angular momentum		
				235	jet engines work because of conservation of momentum		
				236	momentum conservation of turbofan engine		
				238	momentum in billiards		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				239	calculate momentum	
				276	natural frequency and harmonics	
				370	Einstein's thinking about momentum of particles moving near the speed of light	
				629	conservation of momentum in nuclear reactions	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.13 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Distinguish between mass and weight using base units in the SI system.	26	calculating weight from mass	34	calculate the weight
				26	weight is a measure of the force of gravity pulling on mass	52	converting mass to weight
				27	understanding and measuring mass		
				82	English unit of force is the pound		
				92	measuring forces from a vertical jump		
				93	explain the difference between mass and weight		
				96	differences between mass and weight		
				97	calculating weight with mass and gravity		
				98	weight and acceleration		
				99	weight calculations		
				99	weight is a force but mass is not		
				115	explain weight and mass		
				116	calculate mass from weight		
				152	attractive force between mass of person and mass of object is weight		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.14 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Associate time with the independent variable in most experiments.	40	defining variables	11	recognizing and controlling variables
				42	control and experimental variables	13	create a graph
				43	constructing a graph	16	create a graph
				43	dependent and independent variables in graphs	16	describe the graph
						22	create graphs
				44	graphical models	37	make a graph
				54	constructing a graph	38	make a graph
				54	importance of changing one variable at a time in an experiment	43	sketch four graphs
						56	create a graph
				55	create a graph from a data table	66	create a graph of speed vs. position
				251	changing the natural frequency of a stretched rubber band	82	make three different graphs
						82	determine which variable has the greatest effect
				290	the process of digital sound reproduction	82	dependent and independent variables
				411	the waveform of AC electricity	87	sketch a graph
						135	graph voltage vs. current
						136	graph voltage vs. current
						151	make a graph of voltage vs. time
						160	create a graph

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					166 variables that affect the performance of the generator 167 make a graph of voltage vs. number of magnets 169 make a current vs. voltage graph for the diode

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.15 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Relate inertia, force, or action-reaction forces to Newton's three laws of motion.	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
				81	Newton's second law of motion	28	investigate Newton's second law
				83	calculation using Newton's second law	30	Newton's third law and free body diagrams
				84	Newton's second law and dynamics problems	30	investigate Newton's third law
				85	if there is acceleration there must be force	31	draw free body diagrams and identify action-reaction pairs
				85	force problems	77	relationship between force and motion and the second law
				85	finding force from acceleration		
				87	forces always occur in action-reaction pairs		
				88	Newton's third law operates on pairs of objects		
				89	identifying which force is acting on which object		
				89	solving problems with action-reaction forces		
				93	problems using Newton's first law and second law		
				94	seat belt problem		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				102	the normal force as the reaction in an action-reaction pair	
				106	Newton's second law and net force	
				107	forces on a free-body diagram	
				108	equilibrium and Newton's second law	
				108	use equilibrium to find an unknown force	
				111	understanding reaction forces in terms of springs and deformation	
				112	analysis of forces on a bridge	
				116	calculate the acceleration of a toy	
				135	normal force of an inclined plane	
				136	calculating acceleration on a ramp	
				137	the vector form of Newton's second law	
				137	calculating acceleration from 3-D forces	
				148	direction of force determines linear or rotational motion	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				149	calculating centripetal force	
				150	formula for centripetal acceleration	
				168	Newton's first law and rotational inertia	
				169	Newton's second law applies to rotational motion	
				171	Newton's second law for rotational motion variables	
				222	Newton's first law and momentum	
				224	momentum and Newton's third law	
				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	
				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	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.16 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Compare, contrast, and apply characteristic properties of scalar and vector quantities.	118	vectors have magnitude and direction	39	investigating vectors
				119	displacement vectors	43	calculate the velocity vector
				124	definition of the velocity vector	44	investigating force vectors
				125	the velocity vector	49	draw a free body diagram and label forces
				126	components of the velocity vector		
				127	adding velocity vectors		
				132	the force vector describes the strength and direction of a force		
				136	calculate the acceleration of a skier on a slope		
				186	work done by a force at an angle to the distance		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.17 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Investigate the definitions of force, work, power, kinetic energy, and potential energy.	78	force is an action that can change motion	27	were any forces acting on the ball?
				81	force is related to acceleration	49	consider forces acting on the ball
				99	balanced force problems	63	studying the concept of work
				100	friction is a force that resists motion	64	relationship between work and energy
				133	balancing forces in two dimensions	68	calculate potential and kinetic energy
				148	centripetal force causes circular motion	70	calculate work
				185	how to calculate work	70	calculate person's power
				185	work and energy	71	calculate work done
				185	physics definition of work	71	calculate power output for each climber
				186	the work done by a force		
				187	calculating work done against gravity		
				187	work done against gravity		
				189	relationship between work and energy		
				191	the formula for potential energy		
				191	the symmetry between work and energy		
				191	calculate the potential energy of a cart		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				192	calculating kinetic energy depends on speed and mass	
				192	the formula for kinetic energy	
				193	deriving the formula for kinetic energy	
				193	deriving the formula for kinetic energy	
				193	calculate the kinetic energy of a moving car	
				197	calculating energy supplied by Hoover Dam	
				199	concept of work	
				200	calculate work done	
				207	calculate power in climbing stairs	
				207	power is the rate of doing work or using energy	
				208	units of power	
				208	power formulas	
				209	calculating power for common devices	
				210	estimating the power in wind	
				211	estimate average input power of a person	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				211	power in biological systems	
				216	estimating the energy in tides	
				220	calculate energy and power for humans	
				220	calculate power rating	
				253	harmonic motion involves both potential and kinetic energy	
				254	definition of periodic force	
				409	power and efficiency of electric cars	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.18 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Analyze the characteristics of energy, conservation of energy including friction, and gravitational potential energy.	185	work and energy	64	compare output and input work
				188	for all machines work out cannot exceed work in	64	relationship between work and energy
				189	energy appears in different forms	66	law of conservation of energy
				189	relationship between work and energy	67	friction as a source of energy dissipation
				190	conversions of energy	68	calculate potential and kinetic energy
				190	different forms of energy	68	find the total energy at each position
				191	the symmetry between work and energy	72	draw an energy flow diagram
				191	the formula for potential energy	74	investigating collisions and conservation of energy
				192	the formula for kinetic energy		
				193	deriving the formula for kinetic energy		
				194	conservation of energy explained		
				194	energy transformations		
				194	the law of conservation of energy		
				195	applying conservation of energy for a marble rolling on a hilly track		
				195	friction can divert some energy		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				195	conservation of energy in a closed system	
				196	energy transformation hydroelectric plant	
				197	conservation of energy for Hoover Dam	
				202	efficiency and energy conversions	
				203	efficiency and conservation of energy	
				203	how friction affects machines	
				205	efficiency in biological systems	
				206	friction and the arrow of time	
				206	connection between efficiency and time	
				212	energy conversion	
				212	understand basic forms of energy	
				213	the conversion process of energy flow	
				215	energy flows in biological systems	
				216	tidal energy represents frictional energy from the Earth-moon system	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				219	energy flow of a model solar car	
				227	kinetic energy conservation for elastic collisions	
				245	friction causes damping in oscillators	
				253	harmonic motion involves both potential and kinetic energy	
				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	
				324	light from chemical reactions	
				356	electromagnetic waves exchange energy between electricity and magnetic parts	
				370	relationship and conservation of mass and energy	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				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	
				469	energy conservation and Faraday's law	
				515	thermodynamics and conservation of energy	
				552	explanation of pressure and energy	
				552	conservation of energy in fluids	
				553	energy conservation and Bernoulli's equation	
				619	radiation as a flow of energy	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				622	energy of x-rays	
				629	conservation of energy in nuclear reactions	
				647	energy from antimatter	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.19 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Relate work and power to various simple machines, mechanical advantage of different machines, and recognize simple machines that are combined to form compound machines.	13	physics and bicycles	59	investigate block and tackle machine
				13	biomechanics	60	operate and study a block and tackle machine
				105	friction is the force that keeps nails and screws in place	61	find the mechanical advantage
				134	forces on an inclined plane	62	investigate block and tackle machine
				160	using torque in household devices	69	calculate efficiency for each ball
				161	force on a wrench		
				172	force and torque transformations in bicycles		
				173	changing gears in a bicycle		
				173	force and torque transformations in bicycles		
				178	how simple machines manipulate forces		
				178	input and output for simple machines		
				179	how to calculate mechanical advantage		
				179	types of simple machines		
				180	mechanical advantage of human arm		
				180	the mechanical advantage of a lever		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				181	crowbar as an example of a lever	
				181	how a lever works	
				181	how a lever works	
				182	mechanical advantage of ropes and pulleys	
				183	how wheels and gears work	
				183	small drills use gears	
				184	screw turns rotating motion into linear motion	
				184	ramps and screws	
				200	calculate fulcrum point of a lever	
				202	definition of efficiency	
				203	efficiency explained	
				209	estimating power requirements based on force	
				213	efficiency of an energy flow process	
				219	ideal vs. real machine	
				220	calculate efficiency of model solar car	
				228	car crash safety	
				236	fuel efficiency of turbofan engines	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				249	harmonic motion in machines	
				311	efficiency of electric vs. fluorescent light bulbs	
				393	efficiency of hybrid cars	
				440	the difference between magnetic poles and electric charge	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.20 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Describe rotational equilibrium and relate this factor to torque.	146	the relationship between linear and angular speed	46	contrasting linear and angular motion
				147	speedometers and odometers	53	relationship between force and torque
				157	compare linear and angular speeds	53	calculating torque
				160	center of rotation	54	explore rotational equilibrium and net torque
				160	how torque and force differ	80	torque changes the direction of angular momentum vector
				161	calculating torque using torque equation		
				161	line of action and the torque created by a force		
				162	calculating torque		
				162	combining torques to find the net torque		
				163	solve a rotational equilibrium problem		
				163	in rotational equilibrium the net torque is zero		
				164	calculate a torque from an angled force		
				164	when force and lever arm are not perpendicular		
				171	rotational motion and linear motion		
				174	compare force and torque		
				174	calculating torque		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				181	torque and mechanical advantage of a lever	
				183	mechanical advantage of gears	
				231	linear and angular momentum	
				234	torque resists change in angular momentum	
				238	compare linear and angular momentum	
				442	torque between two magnets	
3231.1.21 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Determine the magnitude of the buoyant force exerted on a floating object or a submerged object.	547	buoyancy explained	
				556	buoyancy of gases	
				561	buoyancy of Alvin	
3231.1.22 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Investigate the apparent weight of an object submerged in a fluid.	547	buoyancy explained	
				556	buoyancy of gases	
				561	buoyancy of Alvin	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.1.23 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Explain, in terms of force and/or density, why some objects float and some objects sink.	540	definition of density and density formula	175	find the density
				547	density of ice vs. liquid water	177	the density of ice vs. water
				547	buoyancy explained		
				556	density of gases can change		
				556	buoyancy of gases		
				561	buoyancy of Alvin		
3231.1.24 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Calculate the pressure exerted by a fluid according to Pascal's Principle.	549	formula for pressure in a liquid caused by gravity		
				550	pressure and force formula		
				560	pressure force on Alvin		
3231.1.25 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Calculate how pressure varies with water depth.	548	forces applied to fluids create pressure	193	compare gauge and absolute pressure
				549	formula for pressure in a liquid caused by gravity		
				550	pressure and force formula		
				551	fluids flow because of pressure differences		
				552	potential energy of pressure		
				560	pressure force on Alvin		
				563	stress vs. pressure		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.1.26 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Examine the motion of a fluid using the continuity equation.	553 Bernoulli's equation 554 applying Bernoulli's equation 555 fluids and friction 564 Bernoulli's equation calculation	189 explore Bernoulli's equation
3231.1.27 Physics	Mechanics	Laws of mechanics are the foundations of classical physics.	Recognize the effects of Bernoulli's principle on fluid motion and its applications.	553 Bernoulli's equation 554 applying Bernoulli's equation 564 Bernoulli's equation calculation	189 explore Bernoulli's equation

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.2.01 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Investigate temperature in relationship to kinetic energy.	195 frictional energy converted to heat 203 friction converts input work to heat 506 temperature measures average kinetic energy 509 temperature change and thermal energy 512 temperature and thermal energy and heat 513 transfer of thermal energy 514 specific heat and the heat equation 520 relationship between temp and average kinetic energy	178 explore the connection between temperature and heat and energy 179 specific heat
3231.2.02 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Identify the characteristics of internal energy and temperature/heat (joules/calories).	512 temperature and thermal energy and heat	178 explore the connection between temperature and heat and energy
3231.2.03 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Experiment with change in heat content (quantity of thermal energy) and relate to kinetic energy and specific heat.	513 definition of calorie 514 the heat equation 517 air conditioners	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
3231.2.04 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Investigate phase changes of heat of fusion, heat of vaporization, and heat of sublimation.	506	temperature and addition of heat energy	
				509	heat of fusion	
				509	heat of fusion	
				509	temp vs. time graph for phase change of ice to water	
				509	temp vs. time graph for phase change of ice to water	
				510	heat of vaporization	
				510	heat of vaporization	
				511	evaporation and condensation	
				516	refrigerator application	
				519	temp vs. time graphs for various materials	
				520	temp vs. time curve question	
				535	sources of heat transfer in buildings	
				606	energy from sunlight stored through photosynthesis	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.2.05 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Explore thermal expansion and contraction.	524	thermal conductivity	180	investigate the thermal conductivity of various materials
3231.2.06 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Apply the second law of thermodynamics to the Carnot engine.	188	for all machines work out cannot exceed work in	64	compare output and input work
3231.2.07 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Apply the Laws of Thermodynamics to the atmospheric levels of the earth.	188	for all machines work out cannot exceed work in	64	compare output and input work
3231.2.08 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Recognize that absolute zero is the absence of molecular kinetic energy.	507	absolute zero and the limits of temperature		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.2.09 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Relate the First Law of Thermodynamics as an application of the Law of Conservation of Energy and heat transfer through conduction, convection, and radiation.	188	for all machines work out cannot exceed work in	64	compare output and input work
				189	energy appears in different forms	72	draw an energy flow diagram
				190	conversions of energy	182	investigate convection in a liquid
				190	different forms of energy		
				194	energy transformations		
				196	energy transformation hydroelectric plant		
				202	efficiency and energy conversions		
				205	efficiency in biological systems		
				212	energy conversion		
				212	understand basic forms of energy		
				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		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				320	photosynthesis converts light energy to chemical energy	
				322	photons are bundles of light energy	
				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	
				522	heat conduction	
				523	heat conduction	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				524	conduction in solids and liquids and gases	
				526	convection in liquids	
				527	convection depends on speed and surface area	
				528	convection and weather	
				530	radiation	
				535	sources of heat transfer in buildings	
				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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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.2.10 Physics	Thermodynamics	The principles and laws of thermodynamics are essential for understanding the concept of energy.	Investigate calorimetry, kinetic energy, and specific heat.	506 temperature measures average kinetic energy 511 evaporation cools liquids 512 temperature and thermal energy and heat 513 definition of calorie 514 the heat equation 514 specific heat and the heat equation 516 refrigerator application 517 air conditioners 520 relationship between temp and average kinetic energy	178 explore the connection between temperature and heat and energy 179 specific heat

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.3.01 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Investigate simple harmonic motion.	242 what is a cycle? 244 concepts of period and frequency explained 245 concept of amplitude explained 246 understanding graphs of harmonic motion 249 analyze the motion of the cycle of a pendulum 251 systems tends to have a preferred frequency 258 label graph of harmonic motion 258 identify period and frequency and cycle and amplitude 260 calculate speed of an oscillator 266 speed of a wave is the speed at which a cycle moves 276 concept of harmonics 302 harmonics and frequency and the color of sound 452 MRI--each nucleus is a resonant oscillator	81 investigate the motion of a pendulum 94 investigate harmonic wave patterns

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.02 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Investigate and analyze wavelength, frequency, period, and amplitude of longitudinal and transverse waves.	262	waves transmit energy	88	if frequency is increased what happens to total energy?
				263	waves are a form of traveling energy	89	making wave pulses on a string
				264	frequency and amplitude and wavelength in waves	89	study characteristics of a wave pulse on a string
				264	basic properties of frequency and wavelength and amplitude	89	study wave pulses on elastic cord
				265	wave pulse	90	study the speed of the wave pulse
				265	concept of speed of a wave	90	measure speed of a wave pulse
				266	formula for speed of a wave	91	make different types of waves in a ripple tank
				267	water waves are transverse and Slinky is longitudinal	91	making circular waves in a ripple tank
				267	transverse and longitudinal waves	91	is your water wave transverse or longitudinal?
				268	one- and two- and three-dimensional waves	91	making plane waves in a ripple tank
				268	creating plane waves and circular waves	93	investigate frequency and wavelength
				272	waves transfer energy through absorption	94	investigate the wavelength of standing waves
				275	standing waves on a string	94	investigate the frequency of standing waves
				277	energy of a wave is proportional to frequency and amplitude		
				277	energy of a wave		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				277	standing waves on a string	95	waves carry energy from one place to another
				278	modes of a wave	124	use a spectrometer to measure wavelength of different colors of light
				278	wavelength of a standing wave	125	study the polarization of a transverse spring wave
				279	modes of vibration		
				282	describe relationship between wave characteristics		
				283	type of wave represented by a spring		
				286	properties of sound waves		
				287	frequency and pitch of sound		
				288	relationship of loudness and amplitude and pressure in sound wave		
				291	pressure and amplitude of sound waves		
				292	frequency and wavelengths of sound		
				292	importance of wavelength of sound waves		
				292	sound is a longitudinal wave		
				300	pitch and frequency in music		
				303	design of a guitar		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				308	wave amplitude and harmonics of tuning fork and musical instrument	
				310	light is a form of energy	
				312	the intensity of light	
				313	light carries information	
				314	the speed of light	
				328	how is light used for communication?	
				356	light can be described in terms of waves	
				357	relationship between frequency and energy and color of light	
				357	frequency and wavelength of light	
				358	speed of light is frequency multiplied by length	
				373	wave fronts of light	
				375	relate color to frequency for visible light	
				530	energy and radiation relationships	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.03 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Describe a wave interaction as reflection, refraction, diffraction, or interference.	270	waves and diffraction	92	observing reflection in water waves
				270	waves and reflection	92	investigate reflection in a ripple tank
				270	waves and refraction	92	investigate diffraction in a ripple tank
				271	waves and reflection and boundaries	106	study refraction in a prism
				271	waves and refraction and boundaries	106	use a mirror to study how light behaves
				272	waves and diffraction and boundaries	106	study reflection in a prism
				273	sound and light waves and interference	112	investigate law of reflection
				274	resonance and reflection	113	study how refraction works
				310	how we see	113	investigate Snell's law of refraction
				315	light bends as it moves into a material	114	apply Snell's law of refraction
				315	light rays bounce off a surface	123	study light interference
				315	mirrors	123	study light diffraction patterns
				317	how the human eye sees color		
				318	how we perceive color		
				319	we see mostly reflected light		
				324	the process of how light is reflected		
				324	the process of how light is reflected		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				331	lenses bend light	
				331	mirrors reflect light	
				332	the image in a mirror	
				332	specular and diffuse reflection	
				333	the laws of reflection	
				333	finding the normal line for reflection	
				334	refraction is the bending of light rays	
				335	Snell's law of refraction	
				336	total internal reflection and the critical angle	
				339	the image formed in a mirror	
				340	lenses follow Snell's law of refraction	
				340	design of a lens	
				345	diffraction spot size image defect	
				352	law of reflection	
				354	using Snell's law	
				356	electromagnetic waves are oscillations of an energy field	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
				361 interference of light waves and Young's double-slit experiment 362 diffraction grating 373 holograms and the interference of light	
3231.3.04 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Explore Hooke's Law.	109 the force from a spring 110 Hooke's law 111 solid materials act like springs 544 Hooke's law for solids 545 thermal stress	37 investigating Hooke's law 38 investigating Hooke's law

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.05 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Investigate reflection, refraction, diffraction, and interference of sound waves.	247	the phase of an oscillator	83	investigate oscillators in-phase and out-of-phase
				270	waves and refraction	92	observing reflection in water waves
				270	waves and diffraction	92	investigate reflection in a ripple tank
				270	waves and reflection	92	investigate diffraction in a ripple tank
				271	waves and reflection and boundaries	101	investigate interference with sound waves
				271	waves and refraction and boundaries		
				272	waves and diffraction and boundaries		
				273	constructive and destructive interference		
				273	sound and light waves and interference		
				274	resonance and reflection		
				278	nodes and antinodes		
				295	standing wave patterns of sound		
				296	interference of sound waves		
				301	consonance and dissonance and beats		
				306	beats in a musical sound		
				356	electromagnetic waves are oscillations of an energy field		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.06 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Compare mechanical and electromagnetic waves.	262	waves transmit energy	89	making wave pulses on a string
				262	waves are all around us	89	study wave pulses on elastic cord
				263	waves are a form of traveling energy	91	is your water wave transverse or longitudinal?
				265	speed of a wave vs. speed of its medium	91	making circular waves in a ripple tank
				265	wave pulse	91	make different types of waves in a ripple tank
				267	water waves are transverse and Slinky is longitudinal	91	making plane waves in a ripple tank
				267	transverse and longitudinal waves	95	waves carry energy from one place to another
				268	one- and two- and three-dimensional waves	122	study properties of the electromagnetic spectrum
				269	propogation of waves through continuous materials		
				272	waves transfer energy through absorption		
				275	standing waves on a string		
				277	energy of a wave		
				277	standing waves on a string		
				277	standing waves are used to store energy		
				278	modes of a wave		
				279	modes of vibration		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				281	use of microwaves in microwave ovens	
				283	type of wave represented by a spring	
				284	which direction does a cork move on a water wave?	
				286	sound waves require matter to traverse	
				292	sound is a longitudinal wave	
				294	speed of sound in different materials	
				320	visible light has just the right energy for life	
				359	descriptions of radio waves and microwaves and infrared rays	
				360	x-rays and gamma rays	
				360	visible light waves	
				452	MRI uses radio waves	
				530	electromagnetic radiation	
				530	energy and radiation relationships	

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CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
3231.3.07 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Explain the Doppler Effect.	293 294 307 638	definition of the Doppler effect Doppler effect and supersonic and subsonic motion understanding of Doppler effect Doppler effect and red shift	

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CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.08 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Determine the speed of sound experimentally and describe the effects various materials and temperatures on sound transmission.	287	frequency and pitch of sound	96	investigate range of frequencies the ear can detect
				287	how we hear sound waves		
				288	relationship of loudness and amplitude and pressure in sound wave		
				288	loudness and decibels and the sensitivity of the ear		
				291	pressure and amplitude of sound waves		
				291	sound vibrates the eardrum		
				292	frequency and wavelengths of sound		
				298	constructing meaning from sound		
				299	how the ear works		
				300	pitch and frequency in music		
				300	music and sound		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.09 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Measure spring constants.	109	the force from a spring	37	investigating Hooke's law
				110	Hooke's law	38	investigating Hooke's law
				111	solid materials act like springs		
				544	Hooke's law for solids		
				545	thermal stress		

Correlation to Tennessee Science Learning Expectations

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.3.10 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Solve problems related to wave length, frequency, period, and speed.	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 speed of a wave is the speed at which a cycle moves 266 formula for speed of a wave 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

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				282	describe relationship between wave characteristics	
				287	frequency and pitch of sound	
				288	relationship of loudness and amplitude and pressure in sound wave	
				291	pressure and amplitude of sound waves	
				292	frequency and wavelengths of sound	
				292	importance of wavelength of sound waves	
				300	pitch and frequency in music	
				452	MRI--each nucleus is a resonant oscillator	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
3231.3.11 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Determine the speed of sound experimentally using various materials and temperatures.	287	frequency and pitch of sound	
				288	relationship of loudness and amplitude and pressure in sound wave	
				291	pressure and amplitude of sound waves	
				292	frequency and wavelengths of sound	
				300	pitch and frequency in music	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.12 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Describe simple harmonic motion.	242	what is a cycle?	81	investigate the motion of a pendulum
				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		
				266	speed of a wave is the speed at which a cycle moves		
				452	MRI--each nucleus is a resonant oscillator		

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CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.3.13 Physics	Waves and Sound	Understanding sound and light is accomplished by investigating wave behavior.	Compare the wave characteristics of natural auditory phenomena.	279	vibration of a drum	96	investigate range of frequencies the ear can detect
				286	sound is a wave of pressure	96	investigate human perception of sound
				287	how we hear sound waves		
				288	loudness and decibels and the sensitivity of the ear		
				288	the decibel scale		
				289	acoustics		
				289	vibrations create sound		
				291	sound vibrates the eardrum		
				291	how we know sound is a wave		
				294	effect of medium and temperature on speed of sound wave		
				295	designing a musical instrument		
				296	design of a good concert hall		
				298	sonograms		
				298	constructing meaning from sound		
				299	how the ear works		
				300	music and sound		
				301	echolocation and beats		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
				302 musical instruments 303 sound from a guitar 306 list evidence that sound is a wave	
3231.4.01 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Explore properties of electromagnetic radiation.	281 microwaves 316 white light is the combination of all the colors 320 visible light has just the right energy for life 331 prisms separate white light into its colors 337 prisms and dispersion and rainbows 357 relationship between frequency and energy and color of light 359 waves of the electromagnetic spectrum 360 visible light waves 375 relate color to frequency for visible light	109 examining the spectrum of a light source 122 study properties of the electromagnetic spectrum 124 use a spectrometer to measure wavelength of different colors of light

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CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.4.02 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Examine properties of light waves.	310	how we see	106	use a mirror to study how light behaves
				315	light rays bounce off a surface	106	study reflection in a prism
				315	mirrors	112	investigate law of reflection
				317	how the human eye sees color	124	use a spectrometer to measure wavelength of different colors of light
				318	how we perceive color		
				319	we see mostly reflected light		
				324	the process of how light is reflected		
				324	the process of how light is reflected		
				331	mirrors reflect light		
				331	lenses bend light		
				332	the image in a mirror		
				332	specular and diffuse reflection		
				333	the laws of reflection		
				333	finding the normal line for reflection		
				336	total internal reflection and the critical angle		
				339	the image formed in a mirror		
				352	law of reflection		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
				357 relationship between frequency and energy and color of light 375 relate color to frequency for visible light	
3231.4.03 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Investigate the polarization of light.	363 polarization 364 polarizers 365 applications of polarization	125 polarization of water waves 125 polarization of a spring wave 126 study the polarization of light 126 polarization of light
3231.4.04 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Investigate the optical properties of plane and curved mirrors.	315 mirrors 331 mirrors reflect light 332 the image in a mirror	106 use a mirror to study how light behaves
3231.4.05 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Investigate the optical properties of plane and curved mirrors. (note: this is an acutal repeat in document).	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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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.4.06 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Solve problems related to Snell's law	315 334 335 340 340 354	light bends as it moves into a material refraction is the bending of light rays Snell's law of refraction design of a lens lenses follow Snell's law of refraction using Snell's law	106 113 113 114	study refraction in a prism study how refraction works investigate Snell's law of refraction apply Snell's law of refraction
3231.4.07 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Explore the formation of color (both additive and subtractive properties).	318 319 321 325 326 434	the additive color process the subtractive color process the RGB and CMYK color processes are complementary color separations in high quality printing the CMYK four-color printing process RGB process and how a television picture is made	108	investigate RGB and CMYK models of color

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.4.08 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Draw, explain, and solve problems for the optics of mirrors and lenses.	315	mirrors	106	study refraction in a prism
				315	light bends as it moves into a material	106	use a mirror to study how light behaves
				331	lenses bend light	112	investigate law of reflection
				331	mirrors reflect light	113	study how refraction works
				332	the image in a mirror	114	study the critical angle of refraction in a prism
				333	the laws of reflection	114	study index of refraction
				334	refraction is the bending of light rays	115	studying optical systems
				334	the index of refraction	115	investigating the difference between an object and an image
				335	refraction depends on index of refraction in both materials	116	investigate how focal length is related to focal point
				338	optics in terms of objects and images	116	trace ray diagrams through a double convex lens
				339	mirrors form virtual images	117	sketch the image formed by a lens
				339	finding an image in a ray diagram	117	compare the image of the arrow to the original arrow
				340	focal point and focal length	119	analyze optical systems
				340	design of a lens		
				341	the image formed by a lens		
				341	focus and focal plane of a lens		
				342	drawing ray diagrams of lenses		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				342	finding the image in a ray diagram	
				343	ray diagram for a converging lens	
				343	the images formed by a lens	
				344	the brightness of an image formed by a lens	
				344	the functions of an optical system	
				346	calculating image and object distances for optical systems	
				347	using multiple images allows an optical system to change the size of an image	
				347	using image relay to analyze optical systems	
				349	telescope as an optical system	
				352	law of reflection	
				353	explain index of refraction	
				353	identifying rays from a ray diagram	
				358	index of refraction is ratio of speed of light in material to speed of light in vacuum	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.4.09 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Investigate optical phenomena (i.e., mirage, optical illusions, and dichromatic lens effect).	344 the functions of an optical system 346 calculating image and object distances for optical systems 347 using image relay to analyze optical systems 349 telescope as an optical system	115 studying optical systems 119 analyze optical systems

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.4.10 Physics	Light and Optics	Understanding optics is accomplished by investigating the behavior and laws of light.	Differentiate among transmission, reflection, refraction, diffraction, and interference of light waves.	315 light rays bounce off a surface 315 light bends as it moves into a material 324 the process of how light is reflected 332 specular and diffuse reflection 333 finding the normal line for reflection 334 refraction is the bending of light rays 336 total internal reflection and the critical angle 339 the image formed in a mirror 340 design of a lens 345 diffraction spot size image defect 361 interference of light waves and Young's double-slit experiment 362 diffraction grating 364 transmission of light through two polarizers 373 holograms and the interference of light	106 study reflection in a prism 106 study refraction in a prism 113 study how refraction works 123 study light diffraction patterns 123 study light interference

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.5.01 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Create a simple electromagnet.	435 steering the electron beam on television screen 456 magnetic field of a wire 457 force on a current in a magnetic field 462 electromagnets 463 building an electromagnet 464 electric motor uses electromagnets to convert electrical energy to mechanical energy 465 how electromagnets are used in electric motors 467 concept of electromagnetic induction 471 transformers operate on electromagnetic induction 472 electromagnet-based maglev 475 diagram of electromagnet	159 build an electromagnet 160 find out what happens to strength of electromagnet when current is increased 160 what happens to the strength of an electromagnet when you increase the current? 165 investigate electromagnetic induction

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.5.02 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Draw an electric field, given a scenario of charged particles.	426	fields and forces	154	how are magnetic field lines similar to electric field lines?
				427	an electric field exists around a charge		
				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		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.5.03 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Solve problems of resistance using Ohm's law.	386 concept of electrical resistance 386 relationship between current and resistance 387 measuring resistance 388 Ohm's law 389 the resistance of electrical devices 390 resistance of conductors and insulators 391 resistors 395 knowing difference between types of resistors 396 calculation of voltage from resistance and current 399 adding resistance in a series circuit 399 calculating current in a series circuit using Ohm's law 403 using Ohm's law in parallel circuits 404 using Ohm's law for circuit analysis 407 calculate currents and voltages in a network circuit 408 resistance definition	134 study the relationship between resistance and current 134 apply the concept of electrical resistance 134 Ohm’s law 135 derive Ohm’s law from experiment 136 use Ohm’s law to calculate the resistance 138 determining total resistance in a series circuit 138 apply Ohm’s law to series circuits 171 use Ohm’s law to calculate the resistance of the transistor

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				416	using Ohm's law to calculate current	
				416	calculating resistance in a circuit	
				479	resistance of a transistor	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.5.04 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Draw and explain series and parallel circuits.	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 388 calculate the current flowing in a circuit 398 series circuit defined 398 parallel circuit defined 399 current and resistance in a series circuit 400 voltage in a series circuit 401 parallel circuits 402 advantages of parallel circuits over series circuits 402 voltage and current in a parallel circuit 403 resistance in parallel circuits 405 voltage dividers 406 comparing series and parallel circuits 407 solving network circuits	129 construct simple electric circuits 131 construct a simple circuit 137 parallel circuit and Ohm's law 137 investigate series circuits 138 build a parallel circuit 139 compare series and parallel circuits 139 analyze parallel circuits 140 build and analyze network circuits

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				407	solving network circuits		
				414	why parallel circuits are used in homes and buildings		
				414	why series circuits are not used in homes and buildings		
				415	compare current in a series and parallel circuit		
3231.5.05 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Solve problems related to voltage, current, and resistance.	386	relationship between current and resistance	134	Ohm’s law
				388	Ohm's law	135	derive Ohm’s law from experiment
				396	calculation of voltage from resistance and current	136	use Ohm’s law to calculate the resistance
				399	calculating current in a series circuit using Ohm's law	138	apply Ohm’s law to series circuits
				403	using Ohm's law in parallel circuits	171	use Ohm’s law to calculate the resistance of the transistor
				404	using Ohm's law for circuit analysis		
				407	calculate currents and voltages in a network circuit		
				416	using Ohm's law to calculate current		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.5.06 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Build series and parallel circuits to demonstrate how they function.	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 388 calculate the current flowing in a circuit 398 series circuit defined 398 parallel circuit defined 399 current and resistance in a series circuit 400 voltage in a series circuit 401 parallel circuits 402 advantages of parallel circuits over series circuits 402 voltage and current in a parallel circuit 403 resistance in parallel circuits 405 voltage dividers 406 comparing series and parallel circuits 407 solving network circuits	129 construct simple electric circuits 131 construct a simple circuit 137 parallel circuit and Ohm's law 137 investigate series circuits 138 build a parallel circuit 139 compare series and parallel circuits 139 analyze parallel circuits 140 build and analyze network circuits

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
				407 solving network circuits 414 why parallel circuits are used in homes and buildings 414 why series circuits are not used in homes and buildings 415 compare current in a series and parallel circuit	
3231.5.07 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Demonstrate a generated current by electromagnetic induction.	467 concept of electromagnetic induction 468 magnetic flux 469 Faraday's law of induction 470 generating electricity by induction 471 transformers operate on electromagnetic induction 473 Eddy currents	165 investigate Faraday's law of induction 165 investigate electromagnetic induction 166 build a generator

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.5.08 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Design a lab to demonstrate the flow of charged particles and an electric current.	421 negative charges move in a conductor 422 atomic structures of conductors and insulators and semiconductors 429 using a conductor as shielding from electric fields 430 capacitor is a storage device for electric charge 431 simple capacitor circuit 432 how a capacitor works and making a simple capacitor 433 calculating capacitance 438 calculating capacitance 480 conductivity and semiconductors	150 investigate how capacitors work 151 what is the difference between a capacitor and a battery?

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.5.09 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Analyze a given group of charges for repulsion and attraction.	418	electric charge is a fundamental property of matter	146	build a simple electroscope
				419	electric forces are created between electric charges	147	investigate the concept of electric charge
				420	explanation of coulomb	148	investigate Coulomb's law
				421	current is the flow of charge	149	investigate charged balloons
				422	negative charge of electrons and current flow		
				423	static electricity and charge polarization and induction		
				424	relationship of electric force and charge		
				424	Coulomb's law		
				425	calculate force using Coulomb's law		
				425	the force between charges		
				426	charge creates an electric field		
				428	source charges and test charges		
				430	a capacitor stores charge		
				433	ability of a capacitor to store charge is capacitance		
				437	Coulomb's law is an inverse square law		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				438	calculating charge using Coulomb's law		
3231.5.10 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Distinguish between charged particles related to repulsion and attraction.	418	electric charge is a fundamental property of matter	146	build a simple electroscope
				419	electric forces are created between electric charges	147	investigate the concept of electric charge
				420	explanation of coulomb	149	investigate charged balloons
				421	current is the flow of charge		
				422	negative charge of electrons and current flow		
				423	static electricity and charge polarization and induction		
				424	relationship of electric force and charge		
				425	the force between charges		
				426	charge creates an electric field		
				428	source charges and test charges		
				430	a capacitor stores charge		
				433	ability of a capacitor to store charge is capacitance		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.5.11 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Describe the electric field that fills the space around a charged particle or group of charges	383	voltage is a measure of electric potential energy	154	how are magnetic field lines similar to electric field lines?
				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		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.5.12 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Identify components of series and parallel circuits and solve problems related to voltage, current, and resistance.	386 relationship between current and resistance 388 Ohm's law 396 calculation of voltage from resistance and current 399 calculating current in a series circuit using Ohm's law 402 advantages of parallel circuits over series circuits 403 using Ohm's law in parallel circuits 404 using Ohm's law for circuit analysis 406 comparing series and parallel circuits 407 calculate currents and voltages in a network circuit 415 compare current in a series and parallel circuit 416 using Ohm's law to calculate current	134 Ohm's law 135 derive Ohm's law from experiment 136 use Ohm's law to calculate the resistance 138 apply Ohm's law to series circuits 139 compare series and parallel circuits 140 build and analyze network circuits 171 use Ohm's law to calculate the resistance of the transistor

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.5.13 Physics	Electricity and Magnetism	Electric change is the fundamental quantity that underlies electricity and magnetism.	Describe how current is generated by electromagnetic induction.	470	generating electricity by induction	166	build a generator
3231.6.01 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Write and balance equations for the three forms of radioactive decay.	502	elements past #92 are radioactive and decay	210	simulate radioactive decay
				570	radioactive isotopes	211	types of radiation
				573	fusion	213	fusion and fission
				573	nuclear reactions		
				614	three kinds of radioactivity		
				614	radioactive decay		
				615	alpha and beta and gamma radiation		
				616	energy and radioactivity		
				620	danger of gamma rays and alpha particles		
				625	nuclear reactions		
				627	fusion reactions		
				628	fission reactions		
				634	three kinds of radioactive decay		
				635	differences between fission and fusion		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.02 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Solve half-life problems.	502 elements past #92 are radioactive and decay 570 radioactive isotopes 573 fusion 573 nuclear reactions 614 radioactive decay 616 energy and radioactivity 625 nuclear reactions 627 fusion reactions 628 fission reactions 635 differences between fission and fusion	213 fusion and fission
3231.6.03 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Explain dating methods using carbon-14 or uranium.	570 use of radioactive isotopes in medicine 618 carbon dating 622 x-ray machines 623 CAT scans 632 nuclear energy	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.04 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Investigate the concept of half-life.	502 elements past #92 are radioactive and decay 570 radioactive isotopes 614 radioactive decay 616 energy and radioactivity 617 half-life 618 half-life calculation 636 half-life of nitrogen-13	209 radioactive decay and half life

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.05 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Explain how particles behave like waves.	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 629 conservation of particles in nuclear reactions 630 antimatter and neutrinos and other particles 646 standard model of particle physics 647 matter and antimatter 648 standard model of particles	197 quantum physics 200 explore how a vibrating string has similar properties to a quantum system
3231.6.06 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Distinguish between coherent and incoherent light.	362 the diffraction pattern of laser light 585 laser application 586 how lasers make light	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.6.07 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Recognize how the quantum theory explains the photoelectric effect.	580 580 581 581 582 583 589 589	comparing classical and quantum physics the photoelectric effect classical vs. quantum theory of light Einstein explains the photoelectric effect classical vs. quantum concept of electron how the uncertainty principle differs from classical theory electrons in classical vs. quantum physics photoelectric effect	197 200	quantum physics explore how a vibrating string has similar properties to a quantum system
3231.6.08 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Investigate the history and current events associated with nuclear and radioactive science.	570 614 615 618 622 623 632	use of radioactive isotopes in medicine Marie Curie Henri Bequerel and beta rays carbon dating x-ray machines CAT scans nuclear energy		

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.6.09 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Identify the parts of an atom.	420	electric charge is a property of the particles that make up the atom	174	record atomic number
				420	electric charge is a property of the particles that make up the atom	194	basic properties of subatomic particles
				422	movement of electrons in current	194	subatomic particles
				437	draw a model of an atom	203	electrons and energy levels
				444	electrons and magnetism	203	review subatomic particles
				444	magnetism is a property of particles that make up the atom		
				459	atomic currents		
				480	electrons in a semiconductor		
				500	smallest piece of matter is the atom		
				566	three particles make up the atom		
				566	charge and mass of electrons and protons and neutrons		
				567	structure of the atom		
				567	mass and the nucleus		
				569	elements and atoms and atomic number		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				570	chemical properties of isotopes due to atomic structure	
				572	stability of nucleus and balance of protons and neutrons	
				574	Neils Bohr's theory	
				576	Neils Bohr	
				577	energy levels explain spectral lines	
				588	properties of subatomic particles	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.6.10 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Describe the properties and location of subatomic particles.	420	electric charge is a property of the particles that make up the atom	194	basic properties of subatomic particles
				422	movement of electrons in current		
				444	magnetism is a property of particles that make up the atom		
				459	atomic currents		
				480	electrons in a semiconductor		
				500	smallest piece of matter is the atom		
				566	charge and mass of electrons and protons and neutrons		
				567	mass and the nucleus		
				588	properties of subatomic particles		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.11 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Describe three forms of radioactivity.	502 elements past #92 are radioactive and decay 570 radioactive isotopes 573 fusion 573 nuclear reactions 614 radioactive decay 616 energy and radioactivity 625 nuclear reactions 627 fusion reactions 628 fission reactions 635 differences between fission and fusion	213 fusion and fission
3231.6.12 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Distinguish between nuclear fission and nuclear fusion.	573 fusion 627 fusion reactions 628 fission reactions 635 differences between fission and fusion	213 fusion and fission

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.13 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Investigate and describe quantum mechanics and the properties of quantum theory.	576 quantum states 577 energy levels and quantum states 578 quantum state holds one electron 579 quantum states are called orbitals in chemistry 580 comparing classical and quantum physics 581 classical vs. quantum theory of light 582 quantum theory 582 classical vs. quantum concept of electron 583 how the uncertainty principle differs from classical theory 584 quantum theory and probability 588 quantum states and energy levels 589 electrons in classical vs. quantum physics	197 quantum theory and electrons 197 quantum physics 200 explore how a vibrating string has similar properties to a quantum system

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.14 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Explain the changes in atomic number or mass number for each form of radioactivity.	573 nuclear reactions 625 nuclear reactions	
3231.6.15 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Discuss transmutation and transuranium.	502 elements past #92 are radioactive and decay 570 radioactive isotopes 573 fusion 573 nuclear reactions 614 radioactive decay 616 energy and radioactivity 620 ionizing and nonionizing radiation 624 measuring radiation with Geiger counter 624 danger of ionizing radiation 625 nuclear reactions 627 fusion reactions 628 fission reactions 635 differences between fission and fusion	213 fusion and fission

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.6.16 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Explain how particles behave like waves.	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
3231.6.17 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Describe how a laser is produced.	362 the diffraction pattern of laser light 585 laser application 586 how lasers make light	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.6.18 Physics	Nuclear Physics	Nuclear physics can be better understood with a deeper understanding of particle physics.	Recognize how the quantum theory explains the photoelectric effect.	580	comparing classical and quantum physics	197	quantum physics
				580	the photoelectric effect	200	explore how a vibrating string has similar properties to a quantum system
				581	classical vs. quantum theory of light		
				581	Einstein explains the photoelectric effect		
				582	classical vs. quantum concept of electron		
				583	how the uncertainty principle differs from classical theory		
				589	electrons in classical vs. quantum physics		
				589	photoelectric effect		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.01 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Trace the historical development of a scientific principle or theory.	52	Dr. Harold Edgerton and strobe photography	75	the discovery of atom's nucleus
				155	first artificial human-made Earth satellite was Sputnik	122	research types of electromagnetic waves
				178	Great Pyramid of Giza and simple machines		
				257	Pierre and Jacques Curie and the piezoelectric effect		
				269	wave motion and equilibrium		
				290	technological breakthrough of sound recording		
				310	past theories of light		
				325	history of printing		
				348	the usefulness of recorded images		
				349	the telescope		
				361	Young's double-slit experiment		
				368	Einstein's thinking revolutionized physics		
				447	discovering and using magnetism		
				499	development of atomic theory		
				501	search for elements and alchemy		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				561	the Alvin research submarine	
				575	discovery of helium	
				614	Marie Curie	
				615	Henri Bequerel and beta rays	
				625	turning lead into gold	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.02 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Conduct scientific investigations that include testable questions, verifiable hypotheses, and appropriate variables to explore new phenomena or verify the experimental results of others.	3	using life experiences and common sense	11	recognizing and controlling variables
				4	inquiry through observation	11	formulate a testable hypothesis
				7	creating explanations through observation	33	formulate a testable hypothesis
				8	formulating a hypothesis	43	write a procedure
				8	forming hypotheses and testing with experiments	43	test your prediction
				9	testing ideas against scientific evidence	43	follow the scientific method
				10	putting forth ideas and then testing them	43	perform experiment
				40	defining variables	48	formulate a hypothesis
				42	control and experimental variables	65	investigate motion on a roller coaster
				42	writing lab procedures	65	form a hypothesis
				43	dependent and independent variables in graphs	65	where does the marble move the fastest?
				54	importance of changing one variable at a time in an experiment	67	investigate motion on a roller coaster
				242	finding a basic cycle of harmonic motion	79	write a hypothesis
				251	changing the natural frequency of a stretched rubber band	82	design an experiment
						82	determine which variable has the greatest effect
						82	plan three experiments to determine which variable affects the period of a pendulum

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				323	using glow-in-the-dark plastic to demonstrate photon energy levels	82	dependent and independent variables
				423	charge by friction	111	do your observations support this hypothesis?
				432	making a simple capacitor	147	how did A and B tapes acquire different charge?
				456	an experiment with a wire and compass	166	variables that affect the performance of the generator
				463	building an electromagnet with wire and a nail	201	design a procedure to separate a mixture
				467	experiment demonstrating electromagnetic induction	201	develop a procedure
3231.Inq.03 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Select appropriate independent, dependent, or controlled variables for an experiment.	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		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.04 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Analyze the components of a properly designed scientific investigation.	42 432	writing lab procedures making a simple capacitor	21 43 43 82 201 201 201	plan the experiment follow the scientific method write a procedure design an experiment develop a procedure determine the equipment you will need design a procedure to separate a mixture

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.Inq.05 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Perform an experiment to test a prediction.	7 creating theories based on observations 42 writing lab procedures 242 finding a basic cycle of harmonic motion 293 demonstrating the Doppler effect 456 an experiment with a wire and compass 463 building an electromagnet with wire and a nail 467 experiment demonstrating electromagnetic induction 498 since wood is created from other matter it must not be a fundamental substance	13 predict speed of ball 18 how would acceleration be different? 21 conduct the experiment 28 set up the ultimate pulley 33 calculate the predicted speed 37 use your graph to make a prediction 38 use your graph to make a prediction 42 predict exact landing location 43 perform experiment 43 write a procedure 43 follow the scientific method 65 predict where the ball moves fastest 65 studying motion of ball on loop track 65 investigate motion on a roller coaster 67 set up the straight track 67 investigate motion on a roller coaster

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					85 design and test a way to increase natural frequency 85 select appropriate technology to make measurements 129 choose circuit parts to light a bulb 132 predict what the current will be 201 develop a procedure 202 conduct your experiment

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.06 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Select appropriate tools and technology to collect precise and accurate quantitative and qualitative data.		data tables and graphs can be created on computer or graphing calculator	1	estimating length
				18	measuring distance	2	measuring a pencil
				20	understanding metric rulers	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	6	collecting data with precision
				383	using a multimeter to measure voltage	7	using devices to measure mass
				385	measuring current with an ammeter or multimeter	9	using timer and photogates
				387	using a multimeter to measure resistance	11	using timer and photogates
				504	Celsius and Fahrenheit thermometers	14	using a timer and photogates
				505	how thermometers work	15	collect time data with precision
						15	collect time data
						17	using a timer and photogates
						18	collect time data with precision
						18	use a timer and photogates
						18	use a ruler

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					21 use a timer and photogates 23 use a timer and photogates 26 use a timer and photogates 28 set up the ultimate pulley 29 use a spring scale 29 use a meter stick 29 find mass 34 use a spring scale 36 use a meter stick 39 using a compass 42 use a timer and photogates 43 measure and record the distance 43 measure the distance 44 use a spring scale 47 use a timer and photogate 50 use a timer and photogate 58 use a timer and photogate 60 use a spring scale 60 measure input and output forces 65 use a timer and photogate

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					67 set up the straight track 67 use a timer and photogate 67 measure vertical distance 75 use a timer and photogates 78 use meter stick to measure height 82 use a timer and photogate 82 measure the length of the string 85 design and test a way to increase natural frequency 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 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

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					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 176 use a thermometer 178 measure the temperature 180 measure the temperature 192 check the pressure with your gauge 192 use a digital balance 202 conduct your experiment

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.07 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Determine if data supports or contradicts a hypothesis or conclusion.	7	revising explanations through observation	10	calculate percent difference
				7	creating theories based on observations	12	was this experiment better or worse than the first?
				8	refining theories based on observations	13	predict speed of ball
				10	the usefulness of phlogiston theory despite being incorrect	13	compare prediction to measurement
				11	acceptance of the Copernican model of the solar system on the basis of scientific evidence	13	find percent error
						16	what do the results tell you?
				11	Ptolemy model vs. Copernicus model of the solar system	18	are the accelerations different?
						18	how would acceleration be different?
				40	making a good model	19	does the ball accelerate?
				44	checking a graphical model's accuracy	22	how do you measured positions compare to model?
				44	using a graphical model to make a prediction and checking the model's accuracy	22	compare calculation with graph estimate
						29	does experiment agree with prediction?
				71	parachutes and air resistance	33	calculate the predicted speed
				103	evaluating perpetual motion claims	37	use your graph to make a prediction
				297	frequency spectrum	37	calculate percent difference

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				306	explain why hearing can be damaged by loud sounds	38	use your graph to make a prediction
				498	since wood is created from other matter it must not be a fundamental substance	38	calculate percent difference
						42	predict exact landing location
						43	how does the measurement compare to your prediction?
						43	what would happen if...?
						43	calculate percent difference
						58	explain why the angular acceleration is different
						65	predict where the ball moves fastest
						76	compare predicted mass to actual mass
						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
						97	did the method give an accurate result?

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					97 reliability of a double-blind test 109 explain how the colored filters work 114 are there differences between your prediction and measurement? 132 what conclusions can you draw? 132 predict what the current will be 133 analyze data and explain a rule 202 find percent composition 204 build models of Na and Cl and use them to explain bonding 208 calculating percent yield

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.08 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Recognize, analyze, and evaluate alternative explanations for the same set of observations.	7	revising explanations through observation	16	what do the results tell you?
				8	refining theories based on observations	18	are the accelerations different?
				306	explain why hearing can be damaged by loud sounds	19	does the ball accelerate?
						43	what would happen if...?
						58	explain why the angular acceleration is different
						80	explain your observations
						87	explain how force applied causes the response
						90	explain why higher tension makes waves move faster
						92	explain how wind might cause big waves in water
						109	explain how the colored filters work
						132	what conclusions can you draw?
						133	analyze data and explain a rule

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.09 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Evaluate the accuracy and precision of data.	11	Ptolemy model vs. Copernicus model of the solar system	2	significant digit practice
				40	making a good model	6	precision in measurement
				42	controlling variables in experiments	6	collecting data with precision
				44	using a graphical model to make a prediction and checking the model's accuracy	13	compare prediction to measurement
				297	frequency spectrum	15	collect time data with precision
						18	collect time data with precision
						22	compare calculation with graph estimate
						22	how do you measured positions compare to model?
						29	does experiment agree with prediction?
						43	how does the measurement compare to your prediction?
						43	discuss sources of error
						45	discuss sources of errors
						76	compare predicted mass to actual mass
						114	are there differences between your prediction and measurement?
						153	make measurement with precision

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					153 making measurements with precision 202 find the mass to the nearest tenth of a gram

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.10 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	State a conclusion in terms of the relationship between two or more variables.	60	creating the acceleration formula from experiments	16	what do the results tell you?
				66	developing the formulas for a model of motion with constant acceleration	18	are the accelerations different?
						19	does the ball accelerate?
				282	write a formula relating velocity of wave to period and wavelength	22	uniform acceleration model
				306	explain why hearing can be damaged by loud sounds	25	create an algebraic model
						28	solve second law equation for string tension
				312	light intensity follows an inverse square law	32	develop a model that predicts acceleration
						43	what would happen if...?
						43	create algebraic model
						49	write a formula
						58	explain why the angular acceleration is different
						80	explain your observations
						87	explain how force applied causes the response
						90	explain why higher tension makes waves move faster
						92	explain how wind might cause big waves in water
						94	give an equation that describes your observations

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					109 explain how the colored filters work 132 what conclusions can you draw? 133 analyze data and explain a rule 189 Bernoulli's equation

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.Inq.11 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Defend a conclusion based on scientific evidence.	11 acceptance of the Copernican model of the solar system on the basis of scientific evidence 44 checking a graphical model's accuracy 103 evaluating perpetual motion claims 306 explain why hearing can be damaged by loud sounds	10 calculate percent difference 12 was this experiment better or worse than the first? 13 find percent error 16 what do the results tell you? 18 are the accelerations different? 19 does the ball accelerate? 37 calculate percent difference 38 calculate percent difference 43 calculate percent difference 43 what would happen if...? 58 explain why the angular acceleration is different 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

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					92 explain how wind might cause big waves in water 97 did the method give an accurate result? 97 reliability of a double-blind test 109 explain how the colored filters work 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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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.12 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Analyze experimental results and identify possible sources of bias or experimental error.	11	Ptolemy model vs. Copernicus model of the solar system	13	compare prediction to measurement
				25	why accuracy and precision are important	22	how do you measured positions compare to model?
				40	making a good model	22	compare calculation with graph estimate
				42	controlling variables in experiments	29	does experiment agree with prediction?
				43	graphs are a way of representing data	43	discuss sources of error
				44	using a graphical model to make a prediction and checking the model's accuracy	43	how does the measurement compare to your prediction?
				45	recognizing patterns using graphs	45	discuss sources of errors
				54	understanding patterns in relationships between variables	76	compare predicted mass to actual mass
				56	indicate relationships between variables in graphs	114	are there differences between your prediction and measurement?
				246	understanding graphs of harmonic motion	202	identify two sources of experimental error
				297	frequency spectrum		
				304	comparison of wave forms from guitar sounds		
				307	decibel level vs. frequency graph for human hearing		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				427	diagramming electric fields using field lines	
				443	diagramming magnetic fields using magnetic field lines	
				479	current vs.voltage graph for a transistor	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.13 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Compare the results of an experiment with what is already known about the topic under investigation.	7	revising explanations through observation	22	model for uniform accelerated motion
				7	developing models to explain observations		
				8	refining theories based on observations		
				40	creating useful models		
				41	Galileo and Newton conducted experiments with balls on ramps		
				78	Newton's laws of motion		
				81	Newton's discovery of the connection between force and mass and acceleration		
				101	a model for friction		
				102	a model for static friction		
				152	Sir Isaac Newton and law of universal gravitation		
				330	optics and optical instruments		
				349	Galileo and telescopes		
				350	Newtonian reflecting telescope		
				382	Ben Franklin and current		
				420	Charles-Augustin de Coulomb		
				440	magnetism		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				447	history of magnetism	
				492	the binary number system and its use in computers	
				501	ancient Greeks' ideas of elements	
				580	Newton and classical physics	
				614	Marie Curie	
				615	Henri Bequerel and beta rays	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.14 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Suggest alternative explanations for the same set of observations.	7	revising explanations through observation	16	what do the results tell you?
				8	refining theories based on observations	18	are the accelerations different?
				306	explain why hearing can be damaged by loud sounds	19	does the ball accelerate?
						43	what would happen if...?
						58	explain why the angular acceleration is different
						80	explain your observations
						87	explain how force applied causes the response
						90	explain why higher tension makes waves move faster
						92	explain how wind might cause big waves in water
						109	explain how the colored filters work
						132	what conclusions can you draw?
						133	analyze data and explain a rule

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.15 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Formulate and revise scientific explanations and models using logic and evidence.	7	revising explanations through observation	12	was this experiment better or worse than the first?
				8	refining theories based on observations	13	create a graph
				11	Ptolemy model vs. Copernicus model of the solar system	13	compare prediction to measurement
				11	acceptance of the Copernican model of the solar system on the basis of scientific evidence	16	create a graph
						16	describe the graph
				40	making a good model	22	create graphs
				42	controlling variables in experiments	22	how do you measured positions compare to model?
				43	constructing a graph	22	compare calculation with graph estimate
				44	using a graphical model to make a prediction and checking the model's accuracy	29	does experiment agree with prediction?
						37	make a graph
				44	checking a graphical model's accuracy	38	make a graph
				44	graphical models	43	how does the measurement compare to your prediction?
				54	constructing a graph	43	discuss sources of error
				55	create a graph from a data table	43	sketch four graphs
				103	evaluating perpetual motion claims	45	discuss sources of errors
						56	create a graph
				290	the process of digital sound reproduction	66	create a graph of speed vs. position

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				297	frequency spectrum	76	compare predicted mass to actual mass
				411	the waveform of AC electricity	82	make three different graphs
						87	sketch a graph
						97	reliability of a double-blind test
						97	did the method give an accurate result?
						114	are there differences between your prediction and measurement?
						135	graph voltage vs. current
						136	graph voltage vs. current
						151	make a graph of voltage vs. time
						160	create a graph
						167	make a graph of voltage vs. number of magnets
						169	make a current vs. voltage graph for the diode

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Inq.16 Physics	Embedded Inquiry	Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.	Compare conclusions that offer different, but acceptable explanations for the same set of experimental data.	7	revising explanations through observation	16	what do the results tell you?
				8	refining theories based on observations	18	are the accelerations different?
				25	why accuracy and precision are important	19	does the ball accelerate?
				43	graphs are a way of representing data	43	what would happen if...?
				45	recognizing patterns using graphs	58	explain why the angular acceleration is different
				54	understanding patterns in relationships between variables	80	explain your observations
				56	indicate relationships between variables in graphs	87	explain how force applied causes the response
				246	understanding graphs of harmonic motion	90	explain why higher tension makes waves move faster
				304	comparison of wave forms from guitar sounds	92	explain how wind might cause big waves in water
				306	explain why hearing can be damaged by loud sounds	109	explain how the colored filters work
				307	decibel level vs. frequency graph for human hearing	132	what conclusions can you draw?
				427	diagramming electric fields using field lines	133	analyze data and explain a rule
						202	identify two sources of experimental error

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
				443 diagramming magnetic fields using magnetic field lines 479 current vs.voltage graph for a transistor	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.01 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Plot points on the Cartesian coordinate graphing system.	43	constructing a graph	13	create a graph
				44	graphical models	16	create a graph
				54	constructing a graph	16	describe the graph
				55	create a graph from a data table	22	create graphs
						37	make a graph
				290	the process of digital sound reproduction	38	make a graph
				411	the waveform of AC electricity	43	sketch four graphs
						56	create a graph
						66	create a graph of speed vs. position
						82	make three different graphs
						87	sketch a graph
						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

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.02 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Graph basic relations and functions.	43	constructing a graph	13	create a graph
				44	graphical models	16	describe the graph
				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	16	create a graph
				50	speed vs. time graph for downhill motion	19	make a speed vs. time graph
				54	constructing a graph	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 graphs
				55	create a graph from a data table	22	create a position vs. time graph
				62	speed vs. time graph for accelerated motion	37	make a graph
				63	complex speed vs. time graphs	38	make a graph
				65	calculating distance from speed vs. time graph	43	sketch four graphs
				74	describing motion with speed vs. time graph	56	create a graph
				260	velocity vs. time graph of harmonic motion	66	create a graph of speed vs. position
				260	position vs. time graph of harmonic motion	82	make three different graphs
						87	sketch a graph
						135	graph voltage vs. current

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
				290	the process of digital sound reproduction	136	graph voltage vs. current
				411	the waveform of AC electricity	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
3231.Math.03 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Determine the slope of a linear function.	48	slope of a position vs. time graph	16	find the slope of the line
				63	acceleration and slope of a speed vs. time graph	19	find the slope of the line
3231.Math.04 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Determine the frequency, range, mode, median, and mean from a list of data.	412	average voltage and current of AC power	25	find the average time
						58	find average of three trials
						67	calculate average of three times
						71	calculate average work and power

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.05 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Utilize a graphing calculator to enter data and find basic statistics: frequency, range, means, mode, median, and standard deviation.	25 412	why accuracy and precision are important average voltage and current of AC power	25 58 67 71 202	find the average time find average of three trials calculate average of three times calculate average work and power identify two sources of experimental error
3231.Math.06 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Solve for all variables based on a formula.	60 66 282 312	creating the acceleration formula from experiments developing the formulas for a model of motion with constant acceleration write a formula relating velocity of wave to period and wavelength light intensity follows an inverse square law	22 25 28 32 43 49 94 189	uniform acceleration model create an algebraic model solve second law equation for string tension develop a model that predicts acceleration create algebraic model write a formula give an equation that describes your observations Bernoulli's equation

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.07 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Solve for the t – value, p (probability), and % of confidence between two lists of data (manipulated variables and responding variables).	43	draw a smooth curve; do NOT simply connect the dots	25	find the average time
						25	find the average time
				412	average voltage and current of AC power	58	find average of three trials
						58	find average of three trials
				412	average voltage and current of AC power	67	calculate average of three times
						67	calculate average of three times
						71	calculate average work and power
						71	calculate average work and power
3231.Math.08 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Reject or accept a null hypothesis based on statistical analysis	25	why accuracy and precision are important	13	is there a trend in measurements?
						63	as mechanical advantage increases what happens to length of pulled string?
						66	what does the graph tell you?
						82	analyze data
						133	did battery voltage change?
						202	identify two sources of experimental error

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.09 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Find the regression line (equation) between data for manipulated and responding variables.	43	constructing a graph	13	create a graph
				44	graphical models	16	create a graph
				54	constructing a graph	16	describe the graph
				55	create a graph from a data table	22	create graphs
				260	analyze graph of an oscillator	25	find the average time
				290	the process of digital sound reproduction	37	make a graph
				411	the waveform of AC electricity	38	make a graph
				412	average voltage and current of AC power	43	sketch four graphs
						56	create a graph
						58	find average of three trials
						66	create a graph of speed vs. position
						67	calculate average of three times
						71	calculate average work and power
						82	make three different graphs
						87	sketch a graph
						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

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					169 make a current vs. voltage graph for the diode

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.10 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Utilize trigonometric functions (sine, cosine, and tangent) to solve simple vector problems.	83	finding the net force	41	calculate the resultant vector
				84	calculating net force	44	investigating force vectors
				86	zero acceleration means net zero force	45	calculate force components
				103	net force includes the force of friction	45	balancing a specified force
				106	net force must be zero in equilibrium	49	draw a free body diagram and label forces
				107	net force of zero and free-body diagram		
				119	adding vectors		
				120	adding vectors		
				121	adding and subtracting vectors		
				122	calculating vector components		
				123	finding magnitude and angle of a vector		
				125	the velocity vector		
				126	components of the velocity vector		
				127	adding velocity vectors		
				128	independence of horizontal and vertical motion in a velocity vector		
				130	calculating velocity components of initial velocity		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	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	
				136	calculate the acceleration of a skier on a slope	
				141	calculate the net force	
				186	work done by a force at an angle to the distance	

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.11 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Apply the laws of sine and cosine to solve vector problems.	83	finding the net force	41	calculate the resultant vector
				84	calculating net force	44	investigating force vectors
				86	zero acceleration means net zero force	45	calculate force components
				103	net force includes the force of friction	45	balancing a specified force
				106	net force must be zero in equilibrium	49	draw a free body diagram and label forces
				107	net force of zero and free-body diagram		
				119	adding vectors		
				120	adding vectors		
				121	adding and subtracting vectors		
				122	calculating vector components		
				123	finding magnitude and angle of a vector		
				125	the velocity vector		
				126	components of the velocity vector		
				127	adding velocity vectors		
				128	independence of horizontal and vertical motion in a velocity vector		
				130	calculating velocity components of initial velocity		

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	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	
				136	calculate the acceleration of a skier on a slope	
				141	calculate the net force	
				186	work done by a force at an angle to the distance	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.12 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Solve mechanics problems using the quadratic formula.	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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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	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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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.13 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Find the derivative (velocity function) of a distance (displacement) function.	60	creating the acceleration formula from experiments	17	find the acceleration
				61	zero acceleration vs. constant acceleration vs. acceleration with zero speed	22	uniform acceleration model
				64	calculate speed in accelerated motion	25	create an algebraic model
				66	developing the formulas for a model of motion with constant acceleration	25	derive acceleration equation
				67	calculate time and distance from acceleration	28	solve second law equation for string tension
				128	constant velocity of horizontal component of projectile motion	29	calculate the acceleration
				130	analyzing changing velocity in vertical component of projectile motion	32	develop a model that predicts acceleration
				282	write a formula relating velocity of wave to period and wavelength	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

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.Math.14 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Find the derivative (acceleration function) of a velocity function.	60 61 64 67 150	formula for acceleration general definition of acceleration calculate speed in accelerated motion calculate time and distance from acceleration centripetal acceleration	17 17 20 25 29	find the acceleration learn techniques for finding acceleration understanding equation for uniform accelerated motion derive acceleration equation calculate the acceleration
3231.Math.15 Physics	Embedded Mathematics	Physics applies mathematics to investigate questions, solve problems, and communicate findings.	Link various calculus procedures to solve physics problems.	60 66 282 312	creating the acceleration formula from experiments developing the formulas for a model of motion with constant acceleration write a formula relating velocity of wave to period and wavelength light intensity follows an inverse square law	22 25 28 32 43 49 94 189	uniform acceleration model create an algebraic model solve second law equation for string tension develop a model that predicts acceleration create algebraic model write a formula give an equation that describes your observations Bernoulli's equation

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Student Text and Investigation Manual

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.T/E.1 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Select appropriate tools and procedures best suited to conduct a specified scientific inquiry.		data tables and graphs can be created on computer or graphing calculator	1	estimating length
				18	measuring distance	2	measuring a pencil
				20	understanding metric rulers	4	using a timer
				23	reading a digital timer	5	using photogates
				25	accuracy and precision of measurements	6	accuracy and resolution and printing
				42	writing lab procedures	6	collecting data with precision
				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	15	collect time data
				505	how thermometers work	15	collect time data with precision
						17	using a timer and photogates
						18	use a timer and photogates
						18	collect time data with precision
						18	use a ruler

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					21 use a timer and photogates 23 use a timer and photogates 26 use a timer and photogates 28 set up the ultimate pulley 29 use a meter stick 29 find mass 29 use a spring scale 34 use a spring scale 36 use a meter stick 39 using a compass 42 use a timer and photogates 43 measure and record the distance 43 write a procedure 43 measure the distance 44 use a spring scale 47 use a timer and photogate 50 use a timer and photogate 58 use a timer and photogate 60 measure input and output forces 60 use a spring scale

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					65 use a timer and photogate 67 measure vertical distance 67 set up the straight track 67 use a timer and photogate 75 use a timer and photogates 78 use meter stick to measure height 82 use a timer and photogate 82 measure the length of the string 85 design and test a way to increase natural frequency 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 106 experiment with mirrors 112 use a laser and mirror to study law of reflection 112 study reflection with a mirror

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
					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 176 use a thermometer 178 measure the temperature 180 measure the temperature 192 check the pressure with your gauge

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
						192	use a digital balance
						201	develop a procedure
						202	conduct your experiment
3231.T/E.2 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Apply the engineering design process to construct a prototype that meets developmentally appropriate specifications.	113	the engineering design cycle	28	interpret setup diagram
				543	failure analysis in the design process	85	draw a sketch of your system
						92	sketch the wave fronts
						163	apply steps of the design cycle to building different electric motors
						173	designing and building logic circuits
3231.T/E.3 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.	113	test and evaluate the prototype structure design	83	design and construct a pendulum
				113	build and test a prototype structure out of toothpicks	85	create a system that oscillates
				389	electrical devices are designed to operate at a certain voltage	163	design and test different electric motors
						164	evaluate the performance of motor designs
				543	evaluate three designs for a bridge	167	suggest improvements you could make to the generator design
						191	build an air-speed tester

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page	Volume Two Investigation Manual Page
3231.T/E.4 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Explore how the unintended consequences of new technologies can impact human and non-human communities.	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	
3231.T/E.5 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Evaluate the overall benefit to cost ratio of a new technology.	113 test and evaluate the prototype structure design 389 electrical devices are designed to operate at a certain voltage 543 evaluate three designs for a bridge	164 evaluate the performance of motor designs 167 suggest improvements you could make to the generator design

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.T/E.6 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Present research on current engineering technologies that contribute to improvements in our daily lives.	12	all technology is based on fundamental laws of physics	168	electronic devices are part of our daily lives
				12	engineers design practical devices for solving problems		
				31	nanotechnology application		
				31	use of nanotechnology		
				51	analyzing motion with video and strobe photography		
				72	antilock brakes application		
				73	use of control computers in cars		
				112	designing a bridge		
				112	relationship between science and engineering and technology		
				138	use of robots		
				155	geostationary satellites		
				172	bicycle physics application		
				196	hydroelectric power application		
				209	range of power for common devices		
				216	energy from ocean tides		
				217	research into tidal power		

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				228	seat belts and air bags	
				235	jet engines application	
				243	oscillators are used in communications and music and clocks	
				257	quartz crystals application	
				263	waves can carry information	
				280	microwave ovens application	
				290	recording sound	
				293	uses of Doppler radar	
				297	recording complex wave forms	
				302	synthesized instruments	
				304	modifying sound electronically in electric guitars	
				311	invention of electric light	
				313	information in sound is carried by light	
				313	information in images	
				321	televisions and the RGB color process using pixels	
				325	the printing press	

Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				328	how television creates pictures using three types of pixels	
				348	recording images electronically	
				349	the telescope	
				365	LCD screen pixels	
				369	technological advances have allowed discovery of the expanding universe	
				372	holography application	
				378	importance of electricity	
				392	hybrid gas/electric cars application	
				392	hybrid gas/electric cars application	
				405	use of voltage dividers in sound electronics	
				413	wiring application	
				429	electron beam accelerators	
				434	how television works application	
				451	MRI application	
				472	maglev train application	
				473	how magplanes levitate	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page
				484	stereo uses transistor circuit	
				488	analog and digital signals	
				488	analog vs. digital signals in sound reproduction	
				489	digital representation of a number	
				489	information in digital and analog signals	
				490	why computers are useful	
				490	computers are devices for processing digital information	
				492	computers and electronic addition of numbers application	
				516	refrigerator application	
				534	energy-efficient building application	
				560	deep water submarine Alvin application	
				585	laser application	
				615	smoke detectors	
				623	creation of CAT scans	
				631	nuclear power application	

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Standard #: Course	Standard	Conceptual Strand	Checks for Understanding	Volume One Student Text Page		Volume Two Investigation Manual Page	
3231.T/E.7 Physics	Embedded Technology and Engineering	Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.	Design a series of multi-view drawings that can be used by others to construct an adaptive design and test its effectiveness.	107	drawing free-body diagrams	28	interpret setup diagram
				116	draw a free-body diagram	85	draw a sketch of your system
				125	drawing the velocity vector	92	sketch the wave fronts
				212	making an energy flow diagram		
				333	drawing a ray diagram		
				342	drawing ray diagrams of lenses		
				380	circuit diagrams and electrical symbols		
				427	drawing the electric field using field lines		
				443	diagramming magnetic fields using magnetic field lines		