

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.I.1.a Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Describe the motion of an object in terms of position, time, and velocity.	Calculate the average velocity of a moving object using data obtained from measurements of position of the object at two or more times.	36	the precise meaning of speed	9	collect data and calculate speed of car
				37	how to calculate speed	9	calculate speed of rolling marble
				37	calculating speed	10	make object move with speed of 1 m/sec
				38	the speed formula and calculating speed	12	finding speed of ball with one photogate
				41	speed of a ball on a ramp	14	find the speed of the ball
				46	speed is the rate of change of position	15	find speed of the ball
				47	average and instantaneous speed	17	find two speeds
				48	determining speed from the slope of a position vs. time graph	21	calculate speed of ball
				55	calculate the average speed and distance traveled	26	make ball roll at constant speed
				64	calculate speed in accelerated motion	33	calculate the predicted speed
				74	understanding average speed and instantaneous speed	42	find initial speed of ball
				75	calculations of speed	50	calculate the speed of the ball
				146	calculating linear speed of a moving wheel	66	find the speed of the ball
				147	the linear speed of a rolling wheel	68	what is speed of the ball?
						76	calculate speeds of projectile and target balls
		90	calculate the speed of the wave pulse				

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					191 calculate speed of air in homemade air-speed tester
phys.I.1.b Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Describe the motion of an object in terms of position, time, and velocity.	Distinguish between distance and displacement.	18 definition of distance and length 46 definitions of position and distance 49 distance on the speed vs. time graph 119 the displacement vector and measuring displacement	39 studying position vectors

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.I.1.c Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Describe the motion of an object in terms of position, time, and velocity.	Distinguish between speed and velocity.	37	how to calculate speed	9	collect data and calculate speed of car
				38	compare and contrast speed and velocity	10	make object move with speed of 1 m/sec
				48	determining speed from the slope of a position vs. time graph	12	finding speed of ball with one photogate
				49	speed vs. time graph for constant speed	14	find the speed of the ball
				50	speed vs. time graph for downhill motion	15	find speed of the ball
				54	graphing speed vs. time	16	create a speed vs. time graph
				55	calculate the average speed and distance traveled	17	find two speeds
				62	speed vs. time graph for accelerated motion	19	make a speed vs. time graph
				63	complex speed vs. time graphs	20	speed vs. time graph for uniform acceleration
				64	calculate speed in accelerated motion	21	calculate speed of ball
				65	calculating distance from speed vs. time graph	22	create a speed vs. time graph
				74	describing motion with speed vs. time graph	26	make ball roll at constant speed
				75	calculations of speed	33	calculate the predicted speed
				118	vectors have magnitude and direction	39	investigating vectors
				119	displacement vectors	42	find initial speed of ball
				43	calculate the velocity vector		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
				124	definition of the velocity vector	50	calculate the speed of the ball
				125	the velocity vector	66	find the speed of the ball
				125	speed is the magnitude of the velocity vector	68	what is speed of the ball?
				126	components of the velocity vector	76	calculate speeds of projectile and target balls
				127	adding velocity vectors	90	calculate the speed of the wave pulse
				146	calculating linear speed of a moving wheel	191	calculate speed of air in homemade air-speed tester
				147	the linear speed of a rolling wheel		
				260	velocity vs. time graph of harmonic motion		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.I.1.d Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Describe the motion of an object in terms of position, time, and velocity.	Determine and compare the average and instantaneous velocity of an object from data showing its position at given times.	36	the precise meaning of speed	9	collect data and calculate speed of car
				37	how to calculate speed	9	calculate speed of rolling marble
				37	calculating speed	10	make object move with speed of 1 m/sec
				38	the speed formula and calculating speed	12	finding speed of ball with one photogate
				41	speed of a ball on a ramp	14	find the speed of the ball
				46	speed is the rate of change of position	15	find speed of the ball
				47	average and instantaneous speed	17	find two speeds
				48	determining speed from the slope of a position vs. time graph	21	calculate speed of ball
				55	calculate the average speed and distance traveled	26	make ball roll at constant speed
				64	calculate speed in accelerated motion	33	calculate the predicted speed
				74	understanding average speed and instantaneous speed	42	find initial speed of ball
				75	calculations of speed	50	calculate the speed of the ball
				146	calculating linear speed of a moving wheel	66	find the speed of the ball
				147	the linear speed of a rolling wheel	68	what is speed of the ball?
						76	calculate speeds of projectile and target balls
		90	calculate the speed of the wave pulse				

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
					191 calculate speed of air in homemade air-speed tester
phys.I.1.e Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Describe the motion of an object in terms of position, time, and velocity.	Collect, graph, and interpret data for position vs. time to describe the motion of an object and compare this motion to the motion of another object.	47 position vs. time graph 48 determining speed from the slope of a position vs. time graph 55 analyzing distance vs. time graph 260 position vs. time graph of harmonic motion	16 create a position vs. time graph 22 create a position vs. time graph

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.1.2.a Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Analyze the motion of an object in terms of velocity, time, and acceleration.	Determine the average acceleration of an object from data showing velocity at given times.	58	acceleration is the rate of change in the speed of an object	17	learn techniques for finding acceleration
				59	comparing speed and acceleration	17	find the acceleration
				60	formula for acceleration	17	studying acceleration
				60	calculating acceleration from experiments	20	understanding equation for uniform accelerated motion
				61	general definition of acceleration	25	derive acceleration equation
				62	acceleration is total change of speed divided by total change in time	29	calculate the acceleration
				64	calculating the speed of an object that is accelerating		
				64	calculate speed in accelerated motion		
				67	calculate time and distance from acceleration		
				70	calculating height and time of flight in free fall problems		
				84	direction of net force and acceleration and speed		
				103	calculate the acceleration of a car including friction		
				129	analyze a horizontally launched projectile		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				142 calculating acceleration for sled on slope	
				150 centripetal acceleration	
				150 calculate the centripetal acceleration of a motorcycle	
phys.I.2.b Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Analyze the motion of an object in terms of velocity, time, and acceleration.	Describe the velocity of an object when its acceleration is zero.	61 zero acceleration vs. constant acceleration vs. acceleration with zero speed 128 constant velocity of horizontal component of projectile motion 130 analyzing changing velocity in vertical component of projectile motion	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.1.2.c Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Analyze the motion of an object in terms of velocity, time, and acceleration.	Collect, graph, and interpret data for velocity vs. time to describe the motion of an object.	49	speed vs. time graph for constant speed	16	create a speed vs. time graph
				50	speed vs. time graph for downhill motion	19	make a speed vs. time graph
				54	graphing speed vs. time	20	speed vs. time graph for uniform acceleration
				62	speed vs. time graph for accelerated motion	22	create 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		
				260	velocity vs. time graph of harmonic motion		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.I.2.d Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Analyze the motion of an object in terms of velocity, time, and acceleration.	Describe the acceleration of an object moving in a circular path at constant speed (i.e., constant speed, but changing direction).	144	rotation and revolution and angular speed	46	investigating angular speed
				145	calculating angular speed in radians per second	49	investigating centripetal force
				146	angular speed of a moving wheel		
				148	acceleration can be a change in the direction of motion		
				149	calculating centripetal force		
				155	centripetal force and the law of universal gravitation combine to form the orbit equation		
				158	calculating centripetal force		
				160	translation and rotation		
460	orbital motion of a charge						

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.1.2.e Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Analyze the motion of an object in terms of velocity, time, and acceleration.	Analyze the velocity and acceleration of an object over time.	60	calculating acceleration from experiments	17	learn techniques for finding acceleration
				60	formula for acceleration	17	find the acceleration
				61	zero acceleration vs. constant acceleration vs. acceleration with zero speed	20	understanding equation for uniform accelerated motion
				61	general definition of acceleration	25	derive acceleration equation
				64	calculate speed in accelerated motion	29	calculate the acceleration
				67	calculate time and distance from acceleration		
				70	calculating height and time of flight in free fall problems		
				103	calculate the acceleration of a car including friction		
				128	constant velocity of horizontal component of projectile motion		
				129	analyze a horizontally launched projectile		
				130	analyzing changing velocity in vertical component of projectile motion		
				142	calculating acceleration for sled on slope		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				150 calculate the centripetal acceleration of a motorcycle 150 centripetal acceleration	
phys.I.3.a Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Relate the motion of objects to a frame of reference.	Compare the motion of an object relative to two frames of reference.	36 speed is relative 75 problem using frames of reference 127 calculating velocity vectors may require knowing frames of reference 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	128 relativity and frames of reference

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.I.3.b Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Relate the motion of objects to a frame of reference.	Predict the motion of an object relative to a different frame of reference (e.g., an object dropped from a moving vehicle observed from the vehicle and by a person standing on the sidewalk).	36 speed is relative 75 problem using frames of reference 127 calculating velocity vectors may require knowing frames of reference 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	128 relativity and frames of reference

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.I.3.c Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Relate the motion of objects to a frame of reference.	Describe how selecting a specific frame of reference can simplify the description of the motion of an object.	36 speed is relative 75 problem using frames of reference 127 calculating velocity vectors may require knowing frames of reference 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	128 relativity and frames of reference
phys.I.4.a Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Use Newton's first law to explain the motion of an object.	Describe the motion of a moving object on which balanced forces are acting.	99 balanced force problems 133 balancing forces in two dimensions	49 consider forces acting on the ball

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.I.4.b Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Use Newton's first law to explain the motion of an object.	Describe the motion of a stationary object on which balanced forces are acting.	99 133	balanced force problems balancing forces in two dimensions	49	consider forces acting on the ball
phys.I.4.c Physics	Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	Use Newton's first law to explain the motion of an object.	Describe the balanced forces acting on a moving object commonly encountered (e.g., forces acting on an automobile moving at constant velocity, forces that maintain a body in an upright position while walking).	99 133	balanced force problems balancing forces in two dimensions	49	consider forces acting on the ball

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.II.1.a Physics	Students will understand the relation between force, mass, and acceleration.	Analyze forces acting on an object.	Observe and describe forces encountered in everyday life (e.g., braking of an automobile - friction, falling rain drops - gravity, directional compass - magnetic, bathroom scale - elastic or spring).	13	physics applies to the internal working of the body	27	were any forces acting on the ball?
				78	force is an action that can change motion	45	balancing a specified force
				81	force is related to acceleration		
				83	finding the net force		
				84	calculating net force		
				86	zero acceleration means net zero force		
				90	the natural jet engine in a squid		
				91	force platform used to analyze forces from running and walking		
				92	force from a vertical jump		
				98	effects of g forces and zero gravity on the human body		
				100	friction is a force that resists motion		
				103	net force includes the force of friction		
				106	net force must be zero in equilibrium		
				107	net force of zero and free-body diagram		
				141	calculate the net force		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				148 centripetal force causes circular motion 254 definition of periodic force 448 biological compasses of animals	
phys.II.1.b Physics	Students will understand the relation between force, mass, and acceleration.	Analyze forces acting on an object.	Use vector diagrams to represent the forces acting on an object.	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	44 investigating force vectors 49 draw a free body diagram and label forces
phys.II.1.c Physics	Students will understand the relation between force, mass, and acceleration.	Analyze forces acting on an object.	Measure the forces on an object using appropriate tools.	82 units of force are pounds and newtons 83 understanding units for using Newton's second law 91 the force platform 94 force calculations in different units	29 use a spring scale 29 measure the force 34 use a spring scale 34 measure the force 44 use a spring scale 60 use a spring scale 89 use a spring scale to measure tension of string

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.II.1.d Physics	Students will understand the relation between force, mass, and acceleration.	Analyze forces acting on an object.	Calculate the net force acting on an object.	83 finding the net force 84 calculating net force 86 zero acceleration means net zero force 103 net force includes the force of friction 106 net force must be zero in equilibrium 107 net force of zero and free-body diagram 141 calculate the net force	45 balancing a specified force

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.II.2.a Physics	Students will understand the relation between force, mass, and acceleration.	Using Newton's second law, relate the force, mass, and acceleration of an object.	Determine the relationship between the net force on an object and the object's acceleration.	81	Newton's second law of motion	28	investigate Newton's second law
				83	calculation using Newton's second law	77	relationship between force and motion and the second law
				84	Newton's second law and dynamics problems		
				85	force problems		
				85	finding force from acceleration		
				93	problems using Newton's first law and second law		
				106	Newton's second law and net force		
				108	equilibrium and Newton's second law		
				108	use equilibrium to find an unknown force		
				116	calculate the acceleration of a toy		
				136	calculating acceleration on a ramp		
				137	the vector form of Newton's second law		
				137	calculating acceleration from 3-D forces		
				149	calculating centripetal force		
150	formula for centripetal acceleration						

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				169	
				171	
				228	
				229	
				252	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.II.2.b Physics	Students will understand the relation between force, mass, and acceleration.	Using Newton's second law, relate the force, mass, and acceleration of an object.	Relate the effect of an object's mass to its acceleration when an unbalanced force is applied.	81	Newton's second law of motion	28	investigate Newton's second law
				83	calculation using Newton's second law	77	relationship between force and motion and the second law
				84	Newton's second law and dynamics problems		
				85	force problems		
				85	finding force from acceleration		
				93	problems using Newton's first law and second law		
				106	Newton's second law and net force		
				108	equilibrium and Newton's second law		
				108	use equilibrium to find an unknown force		
				116	calculate the acceleration of a toy		
				136	calculating acceleration on a ramp		
				137	the vector form of Newton's second law		
				137	calculating acceleration from 3-D forces		
				149	calculating centripetal force		
150	formula for centripetal acceleration						

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

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

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.II.2.c Physics	Students will understand the relation between force, mass, and acceleration.	Using Newton's second law, relate the force, mass, and acceleration of an object.	Determine the relationship between force, mass, and acceleration from experimental data and compare the results to Newton's second law.	81	Newton's second law of motion	28	investigate Newton's second law
				83	calculation using Newton's second law	77	relationship between force and motion and the second law
				84	Newton's second law and dynamics problems		
				85	force problems		
				85	finding force from acceleration		
				93	problems using Newton's first law and second law		
				106	Newton's second law and net force		
				108	equilibrium and Newton's second law		
				108	use equilibrium to find an unknown force		
				116	calculate the acceleration of a toy		
				136	calculating acceleration on a ramp		
				137	the vector form of Newton's second law		
				137	calculating acceleration from 3-D forces		
				149	calculating centripetal force		
150	formula for centripetal acceleration						

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

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				Newton's second law applies to rotational motion	
				171	
				Newton's second law for rotational motion variables	
				228	
				Newton's second law relating force and momentum	
				229	
				momentum form of Newton's second law	
				252	
				Newton's second law and natural frequency	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

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phys.II.2.d Physics	Students will understand the relation between force, mass, and acceleration.	Using Newton's second law, relate the force, mass, and acceleration of an object.	Predict the combined effect of multiple forces (e.g., friction, gravity, and normal forces) on an object's motion.	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	40	using polar coordinates
				70	solving problems with free fall	41	plotting position with cartesian coordinates
				71	acceleration of gravity does not depend on mass	44	investigating force vectors
				71	air resistance and terminal speed	45	calculate force components
				72	friction and traction and antilock brakes	49	draw a free body diagram and label forces
				75	problem understanding acceleration due to gravity	61	what effect does friction have on mechanical advantage?
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				100	the force of friction and the different types of friction		
				101	a model for friction		
				102	calculating the force of friction		
				103	friction and motion		
				104	reducing friction force		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				105	
				friction applications	
				115	
				friction of a pulled sled	
				120	
				representing vectors in Cartesian and polar coordinates	
				122	
				calculating vector components	
				123	
				finding magnitude and angle of a vector	
				124	
				effects of friction on trajectories	
				124	
				projectiles and trajectories	
				125	
				representing the velocity vector in polar and Cartesian coordinates	
				125	
				the velocity vector	
				126	
				components of the velocity vector	
				126	
				representing the velocity vector in polar and Cartesian coordinates	
				128	
				gravity only accelerates vertical motion	
				128	
				independence of horizontal and vertical motion in a velocity vector	
				129	
				vertical motion of a projectile	

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				130	
					calculating velocity components of initial velocity
				130	
					projectiles launched at an angle
				131	
					range of projectiles
				132	
					interpreting the x-y components of force
				132	
					representing the force vector in Cartesian and polar coordinates
				133	
					calculating components of a force vector
				134	
					choosing coordinates for an inclined plane
				134	
					resolving force of gravity in ramp coordinates
				135	
					acceleration down an inclined plane
				135	
					frictional force on an inclined plane
				136	
					calculate the acceleration of a skier on a slope
				136	
					calculating acceleration on a ramp accounting for friction
				141	
					explain vectors in Cartesian and polar coordinates

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				141	
					effects of gravity on motion of a projectile
				142	
					effects of friction on acceleration
				152	
					law of universal gravitation and orbital motion
				154	
					orbits and gravitational force
				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
				186	
					work done by a force at an angle to the distance
				187	
					work done against gravity
				191	
					potential energy comes from gravity

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				245	friction causes damping in oscillators
				256	friction and steady state

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.II.3.a Physics	Students will understand the relation between force, mass, and acceleration.	Explain that forces act in pairs as described by Newton's third law.	Identify pairs of forces (e.g., action-reaction, equal and opposite) acting between two objects (e.g., two electric charges, a book and the table it rests upon, a person and a rope being pulled).	87	forces always occur in action-reaction pairs	30	Newton's third law and free body diagrams
				88	Newton's third law operates on pairs of objects	30	investigate Newton's third law
				89	solving problems with action-reaction forces	31	draw free body diagrams and identify action-reaction pairs
				89	identifying which force is acting on which object		
				102	the normal force as the reaction in an action-reaction pair		
				107	forces on a free-body diagram		
				111	understanding reaction forces in terms of springs and deformation		
				112	analysis of forces on a bridge		
				135	normal force of an inclined plane		
				224	momentum and Newton's third law		
				425	electric forces always occur in pairs according to Newton's third law		
				548	Newton's third law and pressure in a fluid		
				550	pressure and the third law		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				557 pressure of gases	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.II.3.b Physics	Students will understand the relation between force, mass, and acceleration.	Explain that forces act in pairs as described by Newton's third law.	Determine the magnitude and direction of the acting force when magnitude and direction of the reacting force is known.	87	forces always occur in action-reaction pairs	30	Newton's third law and free body diagrams
				88	Newton's third law operates on pairs of objects	30	investigate Newton's third law
				89	solving problems with action-reaction forces	31	draw free body diagrams and identify action-reaction pairs
				89	identifying which force is acting on which object		
				102	the normal force as the reaction in an action-reaction pair		
				107	forces on a free-body diagram		
				111	understanding reaction forces in terms of springs and deformation		
				112	analysis of forces on a bridge		
				135	normal force of an inclined plane		
				224	momentum and Newton's third law		
				425	electric forces always occur in pairs according to Newton's third law		
				548	Newton's third law and pressure in a fluid		
				550	pressure and the third law		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				557 pressure of gases	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.II.3.c Physics	Students will understand the relation between force, mass, and acceleration.	Explain that forces act in pairs as described by Newton's third law.	Provide examples of practical applications of Newton's third law (e.g., forces on a retaining wall, rockets, walking).	87	forces always occur in action-reaction pairs	30	Newton's third law and free body diagrams
				88	Newton's third law operates on pairs of objects	30	investigate Newton's third law
				89	solving problems with action-reaction forces	31	draw free body diagrams and identify action-reaction pairs
				89	identifying which force is acting on which object		
				102	the normal force as the reaction in an action-reaction pair		
				107	forces on a free-body diagram		
				111	understanding reaction forces in terms of springs and deformation		
				112	analysis of forces on a bridge		
				135	normal force of an inclined plane		
				224	momentum and Newton's third law		
				425	electric forces always occur in pairs according to Newton's third law		
				548	Newton's third law and pressure in a fluid		
				550	pressure and the third law		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				557 pressure of gases	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page
phys.II.3.d Physics	Students will understand the relation between force, mass, and acceleration.	Explain that forces act in pairs as described by Newton's third law.	Relate the historical development of Newton's laws of motion to our current understanding of the nature of science (e.g., based upon previous knowledge, empirical evidence, replicable observations, development of scientific law).	41	Galileo and Newton conducted experiments with balls on ramps	147 Gilbert built the first electroscope
				52	Dr. Harold Edgerton and strobe photography	
				78	Newton's laws of motion	
				81	Newton's discovery of the connection between force and mass and acceleration	
				152	Sir Isaac Newton and law of universal gravitation	
				208	James Watt	
				257	Pierre and Jacques Curie and the piezoelectric effect	
				311	Thomas Edison and the electric light	
				314	Einstein and the speed of light	
				316	Albert Einstein	
				349	Galileo and telescopes	
				350	Newtonian reflecting telescope	
				361	Thomas Young	
				366	Albert Einstein's theory of special relativity	
				367	Albert A. Michelson and Edward R. Morley	

Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				382	
					Ben Franklin and current
				400	
					Gustav Robert Kirchhoff
				420	
					Charles-Augustin de Coulomb
				574	
					Niels Bohr
				575	
					Johann Balmer
				578	
					Wolfgang Pauli
				580	
					Newton and classical physics
				580	
					Max Planck and Albert Einstein
				630	
					Wolfgang Pauli
				644	
					proof of Einstein's theory of general relativity
				647	
					Paul Dirac

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.III.1.a Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (i.e., Newton's law of universal gravitation).	Investigate how mass affects the gravitational force (e.g., spring scale, balance, or other method of finding a relationship between mass and the gravitational force).	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall		
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				124	projectiles and trajectories		
				128	gravity only accelerates vertical motion		
				129	vertical motion of a projectile		
				130	projectiles launched at an angle		
				131	range of projectiles		
				134	resolving force of gravity in ramp coordinates		
				135	acceleration down an inclined plane		
141	effects of gravity on motion of a projectile						

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

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

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.III.1.b Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (i.e., Newton's law of universal gravitation).	Distinguish between mass and weight.	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		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.III.1.c Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (i.e., Newton's law of universal gravitation).	Describe how distance between objects affects the gravitational force (e.g., effect of gravitational forces of the moon and sun on objects on Earth).	152	description of law of universal gravitation	51	calculate gravitational force of attraction
				153	formula and calculations for law of universal gravitation	51	investigate law of universal gravitation
				154	orbital motion		
				158	calculate weight and acceleration due to gravity on Pluto		
				216	tides are due to force of gravity		
				642	Newton's laws and gravity		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.III.1.d Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (i.e., Newton's law of universal gravitation).	Explain how evidence and inference are used to describe fundamental forces in nature, such as the gravitational force.	68	free fall and acceleration due to gravity	23	investigate the effect of gravity
				69	motion formulas for free fall		
				70	solving problems with free fall		
				71	acceleration of gravity does not depend on mass		
				75	problem understanding acceleration due to gravity		
				97	strength of gravity on Earth and Jupiter		
				98	gravity and acceleration and weightlessness		
				124	projectiles and trajectories		
				128	gravity only accelerates vertical motion		
				129	vertical motion of a projectile		
				130	projectiles launched at an angle		
				131	range of projectiles		
				134	resolving force of gravity in ramp coordinates		
				135	acceleration down an inclined plane		
141	effects of gravity on motion of a projectile						

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	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	
phys.III.1.e Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (i.e., Newton's law of universal gravitation).	Research the importance of gravitational forces in the space program.	234 gyroscopes and the space shuttle 236 rocket engines 259 measuring mass in space	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.III.2.a Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Describe the factors that affect the electric force (i.e., Coulomb's law).	Relate the types of charge to their effect on electric force (i.e., like charges repel, unlike charges attract).	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		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.III.2.b Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Describe the factors that affect the electric force (i.e., Coulomb's law).	Describe how the amount of charge affects the electric force.	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		
				441	comparing magnetic and electric forces		
				442	force between two magnetics is not an inverse square law		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.III.2.c Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Describe the factors that affect the electric force (i.e., Coulomb's law).	Investigate the relationship of distance between charged objects and the strength of the electric force.	424 Coulomb's law 425 calculate force using Coulomb's law 437 Coulomb's law is an inverse square law 438 calculating charge using Coulomb's law	148 investigate Coulomb's law

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.III.2.d Physics	Students will understand the factors determining the strength of gravitational and electric forces.	Describe the factors that affect the electric force (i.e., Coulomb's law).	Research and report on electric forces in everyday applications found in both nature and technology (e.g., lightning, living organisms, batteries, copy machine, electrostatic precipitators).	418	electric charge is a fundamental property of matter	146	build a simple electroscope
				419	differences between electric force and gravity	147	investigate the concept of electric charge
				419	electric forces are created between electric charges	149	investigate charged balloons
				420	explanation of coulomb		
				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		
				424	the strength of electric forces		
				425	the force between charges		
				426	gravity is far weaker than electric forces		
				426	charge creates an electric field		
				428	source charges and test charges		
				428	comparison between electric fields and gravitational fields		

Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				430	
				433	
				441	
				442	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.IV.1.a Physics	Students will understand transfer and conservation of energy.	Determine kinetic and potential energy in a system.	Identify various types of potential energy (i.e., gravitational, elastic, chemical, electrostatic, nuclear).	191	the formula for potential energy	68	calculate potential and kinetic energy
				192	the formula for kinetic energy	72	potential to kinetic energy conversion in a pendulum
				193	deriving the formula for kinetic energy	88	potential to kinetic energy conversions of a pendulum
				194	energy transformations		
				196	energy transformation hydroelectric plant		
				199	kinetic and potential energy conversions while bouncing in a trampoline		
				212	energy flow in a pendulum		
				245	kinetic to potential energy changes in motion of an oscillator		
				253	harmonic motion involves both potential and kinetic energy		
253	oscillators exchange energy back and forth between potential and kinetic						

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.IV.1.b Physics	Students will understand transfer and conservation of energy.	Determine kinetic and potential energy in a system.	Calculate the kinetic energy of an object given the velocity and mass of the object.	191	the formula for potential energy	68	calculate potential and kinetic energy
				192	the formula for kinetic energy	72	potential to kinetic energy conversion in a pendulum
				193	deriving the formula for kinetic energy	88	potential to kinetic energy conversions of a pendulum
				194	energy transformations		
				196	energy transformation hydroelectric plant		
				199	kinetic and potential energy conversions while bouncing in a trampoline		
				212	energy flow in a pendulum		
				245	kinetic to potential energy changes in motion of an oscillator		
				253	harmonic motion involves both potential and kinetic energy		
253	oscillators exchange energy back and forth between potential and kinetic						

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.IV.1.c Physics	Students will understand transfer and conservation of energy.	Determine kinetic and potential energy in a system.	Describe the types of energy contributing to the total energy of a given system.	189	energy appears in different forms	66	law of conservation of energy
				190	different forms of energy	68	find the total energy at each position
				190	conversions of energy	72	draw an energy flow diagram
				194	energy transformations	74	investigating collisions and conservation of energy
				195	applying conservation of energy for a marble rolling on a hilly track		
				196	energy transformation hydroelectric plant		
				197	conservation of energy for Hoover Dam		
				202	efficiency and energy conversions		
				205	efficiency in biological systems		
				212	understand basic forms of energy		
				212	energy conversion		
				213	the conversion process of energy flow		
				219	energy flow of a model solar car		
				256	resonant systems accumulate energy		
				277	waves propagate by exchanging energy between two forms		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				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	
				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	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page	
				552	explanation of pressure and energy	
				619	radiation as a flow of energy	
				622	energy of x-rays	
				647	energy from antimatter	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.IV.2.a Physics	Students will understand transfer and conservation of energy.	Describe conservation of energy in terms of systems.	Describe a closed system in terms of its total energy.	190	conversions of energy	66	law of conservation of energy
				194	conservation of energy explained	68	find the total energy at each position
				194	the law of conservation of energy	72	draw an energy flow diagram
				194	energy transformations	74	investigating collisions and conservation of energy
				195	conservation of energy in a closed system		
				195	applying conservation of energy for a marble rolling on a hilly track		
				196	energy transformation hydroelectric plant		
				197	conservation of energy for Hoover Dam		
				202	efficiency and energy conversions		
				203	efficiency and conservation of energy		
				205	efficiency in biological systems		
				206	connection between efficiency and time		
				212	energy conversion		
				213	the conversion process of energy flow		
				215	energy flows in biological systems		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	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
				256	
					resonant systems accumulate energy
				277	
					waves propagate by exchanging energy between two forms
				320	
					photosynthesis converts light energy to chemical energy
				324	
					light from chemical reactions
				356	
					electromagnetic waves exchange energy between electricity and magnetic parts
				370	
					relationship and conservation of mass and 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

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				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	
					conservation of energy in fluids
				553	
					energy conservation and Bernoulli's equation
				629	
					conservation of energy in nuclear reactions

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.IV.2.b Physics	Students will understand transfer and conservation of energy.	Describe conservation of energy in terms of systems.	Relate the transformations between kinetic and potential energy in a system (e.g., moving magnet induces electricity in a coil of wire, roller coaster, internal combustion engine).	194 energy transformations 196 energy transformation hydroelectric plant 199 kinetic and potential energy conversions while bouncing in a trampoline 212 energy flow in a pendulum 245 kinetic to potential energy changes in motion of an oscillator 253 oscillators exchange energy back and forth between potential and kinetic	72 potential to kinetic energy conversion in a pendulum 88 potential to kinetic energy conversions of a pendulum
phys.IV.2.c Physics	Students will understand transfer and conservation of energy.	Describe conservation of energy in terms of systems.	Gather data and calculate the gravitational potential energy and the kinetic energy of an object (e.g., pendulum, water flowing downhill, ball dropped from a height) and relate this to the conservation of energy of a system.	191 the formula for potential energy 192 the formula for kinetic energy 193 deriving the formula for kinetic energy 253 harmonic motion involves both potential and kinetic energy	68 calculate potential and kinetic energy

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.IV.2.d Physics	Students will understand transfer and conservation of energy.	Describe conservation of energy in terms of systems.	Evaluate social, economic, and environmental issues related to the production and transmission of electrical energy.	196	environmental impacts of hydroelectric power	143	the cost of using electrical appliances
				197	efficiency of the Hoover Dam		
				217	advantages of tidal energy		
				602	hydrogen as a fuel		
				608	alternate fuels to gasoline		
				618	power released by radioactive decay		
				631	nuclear power application		
				632	nuclear energy		
				632	nuclear energy		
634	comparison of fission and fusion						

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.IV.3.a Physics	Students will understand transfer and conservation of energy.	Describe common energy transformations and the effect on availability of energy.	Describe the loss of useful energy in energy transformations.	188 for all machines work out cannot exceed work in 195 friction can divert some energy 203 how friction affects machines 206 friction and the arrow of time 216 tidal energy represents frictional energy from the Earth-moon system 245 friction causes damping in oscillators	64 compare output and input work 67 friction as a source of energy dissipation
phys.IV.3.b Physics	Students will understand transfer and conservation of energy.	Describe common energy transformations and the effect on availability of energy.	Investigate the transfer of heat energy by conduction, convection, and radiation.	522 heat conduction 523 heat conduction 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	182 investigate convection in a liquid

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.IV.3.c Physics	Students will understand transfer and conservation of energy.	Describe common energy transformations and the effect on availability of energy.	Describe the transformation of mechanical energy into electrical energy and the transmission of electrical energy.	467	concept of electromagnetic induction	165	investigate electromagnetic induction
				470	generating electricity by induction	166	build a generator
				471	transformers operate on electromagnetic induction		
phys.IV.3.d Physics	Students will understand transfer and conservation of energy.	Describe common energy transformations and the effect on availability of energy.	Research and report on the transformation of energy in electrical generation plants	197	efficiency of the Hoover Dam	166	build a generator
				470	generating electricity by induction		
				631	nuclear power application		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator		Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.V.1.a Physics	Students will understand the properties and applications of waves.	Demonstrate an understanding of mechanical waves in terms of general wave properties.	Differentiate between period, frequency, wavelength, and amplitude of waves.	242	what is a cycle?	81	investigate the motion of a pendulum
				244	concepts of period and frequency explained	88	if frequency is increased what happens to total energy?
				245	concept of amplitude explained	90	study the speed of the wave pulse
				249	analyze the motion of the cycle of a pendulum	94	investigate the wavelength of standing waves
				251	systems tends to have a preferred frequency	94	investigate the frequency of standing waves
				258	identify period and frequency and cycle and amplitude	124	use a spectrometer to measure wavelength of different colors of light
				260	calculate speed of an oscillator		
				264	frequency and amplitude and wavelength in waves		
				265	concept of speed of a wave		
				266	formula for speed of a wave		
				266	speed of a wave is the speed at which a cycle moves		
				277	energy of a wave is proportional to frequency and amplitude		
				278	wavelength of a standing wave		

**Correlation to Utah Science Core Curriculum
CPO Science Foundations of Physics
Student Text and Investigation Manual**

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
				282	
					describe relationship between wave characteristics
				292	
					importance of wavelength of sound waves
				357	
					relationship between frequency and energy and color of light
				375	
					relate color to frequency for visible light
				452	
					MRI--each nucleus is a resonant oscillator

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.V.1.b Physics	Students will understand the properties and applications of waves.	Demonstrate an understanding of mechanical waves in terms of general wave properties.	Investigate and compare reflection, refraction, and diffraction of waves.	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	study reflection in a prism
				272	waves and diffraction and boundaries	113	study how refraction works
				274	resonance and reflection	123	study light diffraction patterns
				315	light bends as it moves into a material		
				315	light rays bounce off a surface		
				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		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page	
				345	diffraction spot size image defect	
				356	electromagnetic waves are oscillations of an energy field	
				362	diffraction grating	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.V.1.c Physics	Students will understand the properties and applications of waves.	Demonstrate an understanding of mechanical waves in terms of general wave properties.	Provide examples of waves commonly observed in nature and/or used in technological applications.	262 waves are all around us 277 standing waves are used to store energy 281 use of microwaves in microwave ovens 311 fluorescent bulbs create UV light 320 the energy of IR and UV light 320 visible light has just the right energy for life 359 description and examples of infrared waves 359 descriptions of radio waves and microwaves and infrared rays 360 description and examples of ultraviolet waves 360 visible light waves 360 x-rays and gamma rays 452 MRI uses radio waves 531 thermal radiation and infrared light 624 UV light is ionizing radiation	122 study properties of the electromagnetic spectrum

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.V.1.d Physics	Students will understand the properties and applications of waves.	Demonstrate an understanding of mechanical waves in terms of general wave properties.	Identify the relationship between the speed, wavelength, and frequency of a wave.	264	frequency and amplitude and wavelength in waves	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
				265	concept of speed of a wave	
				266	formula for speed of a wave	
				277	energy of a wave is proportional to frequency and amplitude	
				278	wavelength of a standing wave	
				282	describe relationship between wave characteristics	
				292	importance of wavelength of sound waves	
phys.V.1.e Physics	Students will understand the properties and applications of waves.	Demonstrate an understanding of mechanical waves in terms of general wave properties.	Explain the observed change in frequency of a mechanical wave coming from a moving object as it approaches and moves away (i.e., Doppler effect).	293	definition of the Doppler effect	
				294	Doppler effect and supersonic and subsonic motion	
				307	understanding of Doppler effect	
				638	Doppler effect and red shift	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.V.1.f Physics	Students will understand the properties and applications of waves.	Demonstrate an understanding of mechanical waves in terms of general wave properties.	Explain the transfer of energy through a medium by mechanical waves.	265	wave pulse	89	making wave pulses on a string
				267	transverse and longitudinal waves	89	study wave pulses on elastic cord
				267	water waves are transverse and Slinky is longitudinal	91	is your water wave transverse or longitudinal?
				268	one- and two- and three-dimensional waves	91	making circular waves in a ripple tank
				275	standing waves on a string	91	make different types of waves in a ripple tank
				277	standing waves on a string	91	making plane waves in a ripple tank
				278	modes of a wave		
				279	modes of vibration		
				283	type of wave represented by a spring		
				286	sound is a wave of pressure		
				289	vibrations create sound		
				291	how we know sound is a wave		
				292	sound is a longitudinal wave		
				294	effect of medium and temperature on speed of sound wave		
				306	list evidence that sound is a wave		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page		
phys.V.2.a Physics	Students will understand the properties and applications of waves.	Describe the nature of electromagnetic radiation and visible light.	Describe the relationship of energy to wavelength or frequency for electromagnetic radiation.	311	fluorescent bulbs create UV light	109	examining the spectrum of a light source
				316	white light is the combination of all the colors	122	study properties of the electromagnetic spectrum
				320	the energy of IR and UV light	124	use a spectrometer to measure wavelength of different colors of light
				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	description and examples of infrared waves		
				360	description and examples of ultraviolet waves		
				360	visible light waves		
				375	relate color to frequency for visible light		
				531	thermal radiation and infrared light		
				624	UV light is ionizing radiation		

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.V.2.b Physics	Students will understand the properties and applications of waves.	Describe the nature of electromagnetic radiation and visible light.	Distinguish between the different parts of the electromagnetic spectrum (e.g., radio waves and x-rays or visible light and microwaves).	262 waves are all around us 277 standing waves are used to store energy 281 use of microwaves in microwave ovens 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	122 study properties of the electromagnetic spectrum

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

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Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page
phys.V.2.c Physics	Students will understand the properties and applications of waves.	Describe the nature of electromagnetic radiation and visible light.	Explain that the different parts of the electromagnetic spectrum all travel through empty space and at the same speed.	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 frequency and wavelength of light 358 speed of light is frequency multiplied by length 373 wave fronts of light	
phys.V.2.d Physics	Students will understand the properties and applications of waves.	Describe the nature of electromagnetic radiation and visible light.	Explain the observed change in frequency of an electromagnetic wave coming from a moving object as it approaches and moves away (i.e., Doppler effect, red/blue shift).	293 definition of the Doppler effect 294 Doppler effect and supersonic and subsonic motion 307 understanding of Doppler effect 638 Doppler effect and red shift	

Correlation to Utah Science Core Curriculum

CPO Science Foundations of Physics

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	Volume One Student Text Page	Volume Two Investigation Manual Page	
phys.V.2.e Physics	Students will understand the properties and applications of waves.	Describe the nature of electromagnetic radiation and visible light.	Provide examples of the use of electromagnetic radiation in everyday life (e.g., communications, lasers, microwaves, cellular phones, satellite dishes, visible light).	262 277 281 359 360 452	waves are all around us standing waves are used to store energy use of microwaves in microwave ovens descriptions of radio waves and microwaves and infrared rays x-rays and gamma rays MRI uses radio waves	