Correlation to Utah Science Core Curriculum

CPO Science Physics: A First Course

Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	17	speed defined	10	find speed of car
				17	speed of light	21	measure speed of car
				18	speed units	25	calculate speed of car
				18	calculating speed	3	find the speed of the car
				45	terminal speed	44	experiment and find average speed
				45	skydiving and terminal speed	46	measure speed of car
				56	calculate speed from distance/time graph	6	how can speed be measured?
				143	angular speed	7	measure the speed
						9	why did the speed change?
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.	134	understanding displacement		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	18	speed units	10	find speed of car
				19	velocity defined	11	speed vs. time graph
				40	velocity defined	21	measure speed of car
				48	speed vs. time graph	25	calculate speed of car
				49	speed vs. time graph for accelerating motion	3	find the speed of the car
				51	finding distance from a speed vs. time graph	44	experiment and find average speed
				56	calculate speed from distance/time graph	46	measure speed of car
				110	compare and contrast scalars and vectors	7	measure the speed
				136	speed vs. velocity	9	why did the speed change?
				136	working with velocity vector		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	17	speed defined	10	find speed of car
				17	speed of light	21	measure speed of car
				18	speed units	25	calculate speed of car
				18	calculating speed	3	find the speed of the car
				45	terminal speed	44	experiment and find average speed
				45	skydiving and terminal speed	46	measure speed of car
				56	calculate speed from distance/time graph	6	how can speed be measured?
				143	angular speed	7	measure the speed
						9	why did the speed change?
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.	46	position vs. time graphs	4	position vs. time graph
				47	position vs. time graph for accelerating motion		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
phys.I.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.	32	acceleration of sports cars	11	find acceleration of car
				32	acceleration defined	11	compare and contrast speed and acceleration
				33	calculating acceleration	25	calculate acceleration of car
				33	acceleration and velocity	28	calculate acceleration
				40	acceleration of falling objects	28	investigate acceleration on a ramp
				149	acceleration and circular motion		
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.	17	constant speed	11	investigating net force and acceleration
				35	changes in speed or direction always involve accleration		
				36	zero acceleration explained		
phys.I.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.	48	speed vs. time graph	11	speed vs. time graph
				49	speed vs. time graph for accelerating motion		
				51	finding distance from a speed vs. time graph		

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	143	angular speed formula		
				143	calculating angular speed		
				143	rotations and degrees		
				145	calculating linear speed for a rotating object		
				147	centripetal force		
				148	centripetal force		
				149	Newton's second law and circular motion		
phys.I.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.	17	constant speed	11	find acceleration of car
				32	acceleration of sports cars	11	compare and contrast speed and acceleration
				33	calculating acceleration	11	investigating net force and acceleration
				33	acceleration and velocity	25	calculate acceleration of car
				35	changes in speed or direction always involve accleration	28	calculate acceleration
				36	zero acceleration explained	28	investigate acceleration on a ramp
				40	acceleration of falling objects		
				149	acceleration and circular motion		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	17 17	comparing speeds nothing in the universe stays still	53 54	investigate frames of reference identify frame of reference
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).	17 17	comparing speeds nothing in the universe stays still	53 54	investigate frames of reference identify frame of reference
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.	17 17	comparing speeds nothing in the universe stays still	53 54	investigate frames of reference identify frame of reference

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	31 36 37 113 116	net force explained balanced and unbalanced forces net force and second law calculating using a free-body diagram when net force is zero	11 22 23	investigate net force when net force is zero draw a free body diagram
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.	31 36 37 113 116	net force explained balanced and unbalanced forces net force and second law calculating using a free-body diagram when net force is zero	11 22 23	investigate net force when net force is zero draw a free body diagram
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).	31 36 37 113 116	net force explained balanced and unbalanced forces net force and second law calculating using a free-body diagram when net force is zero	11 22 23	investigate net force when net force is zero draw a free body diagram

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	28 31 37 38 116	force defined net force explained net force and second law calculating force and energy when net force is zero	11 22	investigate net force when net force is zero
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.	111 115	force vectors finding resultant vector	23	use force vectors
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.	30 30	measuring force units of force	19 22 22	measure the force use spring scales measure force
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.	31 37 116	net force explained net force and second law calculating when net force is zero	11 22	investigate net force when net force is zero

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	35	quantitative understanding of second law	10	investigate Newton's second law of motion
				35	Newton's second law	23	Newton's second law of motion
				36	applying Newton's second law properly	25	apply Newton's second law of motion
				37	using second law formula	29	apply Newton's second law of motion
				424	Newton's second law and oscillators	95	Newton's 2nd law of motion and natural frequency
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.	35	quantitative understanding of second law	10	investigate Newton's second law of motion
				35	Newton's second law	23	Newton's second law of motion
				36	applying Newton's second law properly	25	apply Newton's second law of motion
				37	using second law formula	29	apply Newton's second law of motion
				424	Newton's second law and oscillators	95	Newton's 2nd law of motion and natural frequency

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	35	quantitative understanding of second law	10	investigate Newton's second law of motion
				35	Newton's second law	23	Newton's second law of motion
				36	applying Newton's second law properly	25	apply Newton's second law of motion
				37	using second law formula	29	apply Newton's second law of motion
				424	Newton's second law and oscillators	95	Newton's 2nd law of motion and natural frequency

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	39	calculations pertaining to free fall	23	use force vectors
				39	effect of gravity on motion	24	investigate effect of friction
				45	effects of air resistance	26	investigate projectile motion
				52	acceleration shown through strobe photography		
				88	work and gravity		
				94	friction and machines		
				101	friction explained		
				111	force vectors		
				112	resolving vectors		
				115	finding resultant vector		
				119	friction explained		
				119	cause of friction		
				120	static and sliding friction		
				122	reducing friction		
				123	useful friction		
				137	projectile explained		
				138	free fall component of a trajectory		
				402	gravitational field		
				418	friction and damping		

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	52 59 60 78 117 128 158	action-reaction pairs Newton's third law sorting out force pairs third law and rockets Newton's third law and springs the third law and physics of walls Newton's third law and helicopters	12 13	investigate Newton's 3rd law of motion relate Newton's 3rd law of motion to car collisions
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.	52 59 60 78 117 128 158	action-reaction pairs Newton's third law sorting out force pairs third law and rockets Newton's third law and springs the third law and physics of walls Newton's third law and helicopters	12 13	investigate Newton's 3rd law of motion relate Newton's 3rd law of motion to car collisions

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Student Text and Investigation Manual

Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	52 59 60 78 117 128 158	action-reaction pairs Newton's third law sorting out force pairs third law and rockets Newton's third law and springs the third law and physics of walls Newton's third law and helicopters	12 13	investigate Newton's 3rd law of motion relate Newton's 3rd law of motion to car collisions
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).	28 52 79	Newton's idea of force contributions of Harold Edgerton contributions of Robert Goddard		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	39 39 52 88 137 138 402	calculations pertaining to free fall effect of gravity on motion acceleration shown through strobe photography work and gravity projectile explained free fall component of a trajectory gravitational field	26	investigate projectile motion
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.	29 43 43 44	mass and inertia calculating weight from mass weight vs. mass weight vs. mass	9	research and define inertia and weight and mass

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	153	Newton's law of universal gravitation explained		
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.	39 39 52 88 137 138 402	calculations pertaining to free fall effect of gravity on motion acceleration shown through strobe photography work and gravity projectile explained free fall component of a trajectory gravitational field	26	investigate projectile motion

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	78	vehicle for space travel		
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).	340 341 341 354	understanding electric charge what causes shocks charged objects and static electricity understanding lightning	72	investigate the nature of electric charge
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.	340 341 341 354 361	understanding electric charge what causes shocks charged objects and static electricity understanding lightning using magnetic forces	72	investigate the nature of electric charge

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	342	electric forces are very strong	70	investigate capacitors
				342	understanding Coulomb's law	75	calculate charge stored in capacitor
				350	how capacitors work		
				351	charging a capacitor		
				351	capacitors and current		
				352	measuring capacitance		
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).	340	understanding electric charge	72	investigate the nature of electric charge
				341	what causes shocks		
				341	charged objects and static electricity		
				342	electric forces are very strong		
				354	understanding lightning		
				361	using magnetic forces		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	67	calculating potential energy	15	calculate potential energy of car
				68	calculating kinetic energy	24	calculate kinetic energy of sled
				68	potential to kinetic energy conversions	47	calculate energy
				69	kinetic energy and stopping distance of a car		
				70	potential to kinetic energy conversions		
				117	potential and kinetic energy in a spring		
				249	mechanical systems and energy		
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.	67	calculating potential energy	15	calculate potential energy of car
				68	calculating kinetic energy	24	calculate kinetic energy of sled
				68	potential to kinetic energy conversions	47	calculate energy
				69	kinetic energy and stopping distance of a car		
				70	potential to kinetic energy conversions		
				117	potential and kinetic energy in a spring		
				249	mechanical systems and energy		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	9	basic forms of energy	14	investigate exchange of energy in car and track system
				67	potential energy explained	15	apply law of energy conservation
				68	kinetic energy explained	45	describe energy changes
				70	law of conservation of energy	46	investigate energy flow in a system
				71	using energy conservation to solve problems	47	identify forms of energy in an experimental system
				240	energy and systems	57	draw energy flow diagram of the circuit
				241	energy exists in many different forms		
				243	energy flow diagrams		
				249	energy flow diagram for mechanical systems		
				251	energy flow in natural systems		

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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.	10 67 68 70 71 240 243 249 251	conservation of energy potential energy explained kinetic energy explained law of conservation of energy using energy conservation to solve problems energy and systems energy flow diagrams energy flow diagram for mechanical systems energy flow in natural systems	14 15 42 45 46 47 57	investigate exchange of energy in car and track system apply law of energy conservation model how atoms exchange energy describe energy changes investigate energy flow in a system draw an energy flow diagram draw energy flow diagram of the circuit
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).	68 70 117 249	potential to kinetic energy conversions potential to kinetic energy conversions potential and kinetic energy in a spring mechanical systems and energy		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	67	calculating potential energy	15	calculate potential energy of car
				68	calculating kinetic energy	24	calculate kinetic energy of sled
				69	kinetic energy and stopping distance of a car	47	calculate energy
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.	247	sources of electrical power in the United States	157	compare economic and environmental impact of using different energy sources
				247	burning gasoline and low efficiency	157	research electricity generation methods
				254	generating electricity from the ocean's energy		
				255	impact of generating electricity on the environment		
				255	energy in the ocean		
				335	using hybrid cars		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	94 101	work and simple machines output work is always less than input work	18 44 47	compare and contrast input and output work friction and energy dissipation investigate friction as a part of energy flow
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.	181 183 184	heat conduction natural and forced convection thermal radiation	30	investigating heat transfer
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.	364 365 387 389	electromagnets building an electromagnet electromagnetic induction explained how a generator works	85 87	investigate electromagentic induction investigate how generators work
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	247 247 254 255 389	sources of electrical power in the United States burning gasoline and low efficiency generating electricity from the ocean's energy energy in the ocean how a generator works	157 87	research electricity generation methods investigate how generators work

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	414	a pendulum's cycle	101	investigate standing waves and frequency
				414	understanding a cycle	123	how colors of light relate to frequency and wavelength
				416	frequency explained	123	measure wavelengths of visible light using a spectrometer
				416	period is the time for one cycle	92	explore harmonic motion using a pendulum
				417	frequency is the inverse of period	92	explore the meaning of cycle
				418	amplitude explained	92	explore the meaning of amplitude
				430	identify period and frequency and cycle and amplitude	93	measure the period of a pendulum
				437	frequency and amplitude and wavelength of waves	94	investigate harmonic motion with a pendulum
				438	the speed of waves		
				461	wavelength of sound		
				483	color and light		
				524	energy and color of light		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	442 442 443 482 482 501 503 504 528 530	refracted waves reflected waves diffraction explained refraction of light reflection of light reflection explained understanding refraction angles of incidence and refraction diffraction and light diffraction gratings and spectrometers	120 121 122	investigate reflection of light investigate refraction of light investigate diffraction of light
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.	435 523 524 526 527 536 537	waves and technology electromagnetic spectrum wavelength and frequency of visible light low-energy electromagnetic waves high-energy electromagnetic waves the electromagnetic spectrum infrared telescopes	111 123	mixing primary colors of light investigate visible light wavelengths

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	437	frequency and amplitude and wavelength of waves	101	investigate standing waves and frequency
				438	the speed of waves		
				461	wavelength of sound		
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).	457	understanding the Doppler effect		
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.	415	sound is a wave	100	study water waves
				436	longitudinal waves	104	properties of sound waves
				436	transverse waves	105	investigate sound wave interference
				440	standing waves on a vibrating string	124	relating transverse waves on a spring to light waves
				454	sound is a wave	98	study waves on a string
				458	how sound is recorded	99	explore transverse waves
				459	sound is a wave		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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.	483	white light is a mixture of colors	111	mixing primary colors of light
				483	color and light	122	observe white light through diffraction glasses
				523	electromagnetic spectrum	123	investigate visible light wavelengths
				524	wavelength and frequency of visible light	123	how colors of light relate to frequency and wavelength
				524	energy and color of light	123	measure wavelengths of visible light using a spectrometer
				526	low-energy electromagnetic waves		
				527	high-energy electromagnetic waves		
				536	the electromagnetic spectrum		
				537	infrared telescopes		
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).	435	waves and technology	111	mixing primary colors of light
				523	electromagnetic spectrum	123	investigate visible light wavelengths
				524	wavelength and frequency of visible light		
				536	the electromagnetic spectrum		
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.	481	speed of light		

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Standard #: Curriculum	Standard	Objective	Indicator	student text pg	detail	investigation pg	detail
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).	457	understanding the Doppler effect		
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).	435	waves and technology		