UTAH
Science – Physics
Physics: Principles and Problems © 2005

OBJECTIVES	PAGE REFERENCES
Standard I: Students will understand how to measure, calculate, and describe the motion of an object in terms of position, time, velocity, and acceleration.	
Objective 1: Describe the motion of an object in terms of position, time, and velocity.	
a. Calculate the average velocity of a moving object using data obtained from measurements of position of the object at two or more times.	SE: 43-45, 46-47 TWE: CD 43 CU 47 ICE 45 QD 66
b. Distinguish between distance and displacement.	SE: 34, 36-37, 67 TWE: IM 36 TPK 34
c. Distinguish between speed and velocity.	SE: 43-45, 46-47 *Internet Physics Lab* 20-21 *Launch Lab* 31 TWE: CU 47 QD 44 TPK 43
d. Determine and compare the average and instantaneous velocity of an object from data showing its position at given times.	SE: 43-45, 46-47 TWE: A 47 ICE 45 IM 46 QD 66
e. 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.	SE: 38, 40-42, 43-44 *Internet Physics Lab* 20-21 *Physics Lab* 48-49 TWE: BA 38, 43 D 42 ICE 41, 44
Objective 2: Analyze the motion of an object in terms of velocity, time, and acceleration.	
a. Determine the average acceleration of an object from data showing velocity at given times.	SE: 58-59, 62-64, 65-69, 72-75 *Internet Physics Lab* 76-77 TWE: AML 73 CD 59 ICE 60 RE 70
b. Describe the velocity of an object when its acceleration is zero.	SE: 32-33, 43-47 TWE: BA 38 CU 33 D 34 EX 47 TPK 57

OBJECTIVES	PAGE REFERENCES
c. Collect, graph, and interpret data for velocity vs. time to describe the motion of an object.	SE: 58-63, 66-71 TWE: A 64 CT 59 ICE 60 RE 63
d. Describe the acceleration of an object moving in a circular path at constant speed (i.e., constant speed, but changing direction).	SE: 153-155 *Future Technology* 162 TWE: BA 153 CU 156 ICE 155 QD 154
e. Analyze the velocity and acceleration of an object over time.	SE: 58-63, 66-71, 72-75 TWE: CT 68 ICE 60, 67, 69
Objective 3: Relate the motion of objects to a frame of reference.	
a. Compare the motion of an object relative to two frames of reference.	SE: 34-37, 152, 157-159, 216-217 *Extreme Physics* 78 TWE: CD 157 IM 216
b. 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).	SE: 34-37, 157-159, 216-217 *Extreme Physics* 78 TWE: CD 157 RE 216
c. Describe how selecting a specific frame of reference can simplify the description of the motion of an object.	SE: 34-37, 157-159, 62-63 *Future Technology* 162 *Launch Lab* 57 TWE: CD 34
Objective 4: Use Newton's first law to explain the motion of an object.	
a. Describe the motion of a moving object on which balanced forces are acting.	SE: 94-95, 100-101 TWE: A 93 CT 92 CU 101 IM 88, 90 QD 100
b. Describe the motion of a stationary object on which balanced forces are acting.	SE: 89, 105, 131 TWE: CD 91, 131 RLP 134
c. 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).	SE: 94-95, 100-101 *Technology and Society* 138 TWE: CB 92 IM 88, 90
Standard II: Students will understand the relation between force, mass, and acceleration.	
Objective 1: Analyze forces acting on an object.	
a. 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).	SE: 94, 126-130, 175-176, 652-654 *Launch Lab* 87 *Physics Lab* 136-137 TWE: BA 126 CD 91, 176 RLP 134

OBJECTIVES	PAGE REFERENCES
b. Use vector diagrams to represent the forces acting on an object.	SE: 88-89, 96-101, 105, 148-149 TWE: CD 91
c. Measure the forces on an object using appropriate tools.	SE: *How It Works* 110 *Internet Physics Lab* 108-109 *Physics Lab* 136-137 TWE: AML 132 CD 105 RE 99
d. Calculate the net force acting on an object.	SE: 92, 94-95, 96, 100-101, 105, 131 TWE: CT 92
Objective 2: Using Newton's second law, relate the force, mass, and acceleration of an object.	
a. Determine the relationship between the net force on an object and the object's acceleration.	SE: 90-93, 100-101, 154-155 TWE: CB 92 CD 91, 154 IM 90
b. Relate the effect of an object's mass to its acceleration when an unbalanced force is applied.	SE: 93, 96-98, 154-155 *Future Technology* 162 *Internet Physics Lab* 108-109 TWE: ICE 97, 155
c. Determine the relationship between force, mass, and acceleration from experimental data and compare the results to Newton's second law.	SE: *Internet Physics Lab* 108-109 TWE: QD 94
d. Predict the combined effect of multiple forces (e.g., friction, gravity, and normal forces) on an object's motion.	SE: 88-89, 92, 100-101, 105-107 *Internet Physics Lab* 108-109 *Launch Lab* 87 TWE: CB 92 CD 91 QD 100
Objective 3: Explain that forces act in pairs as described by Newton's third law.	
a. 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).	SE: 102-103, 105-107, 126-130, 564-567 *Internet Physics Lab* 108-109 *Physics Lab* 136-137 TWE: BA 102 CD 105 ICE 106 RE 107
b. Determine the magnitude and direction of the acting force when magnitude and direction of the reacting force is known.	SE: 102-103, 105-107 *Internet Physics Lab* 108-109 TWE: BA 102 CD 105 HSS 104 UM 103

OBJECTIVES	PAGE REFERENCES
c. Provide examples of practical applications of Newton's third law (e.g., forces on a retaining wall, rockets, walking).	SE: 102-105 *Future Technology* 162 *How It Works* 110 *Technology and Society* 138 TWE: BA 102 CB 133 CT 105, 156 D 128 ICE 104
d. 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).	SE: 8-10, 94 TWE: CB 9, 39 HSS 104 RLP 93
Standard III: Students will understand the factors determining the strength of gravitational and electric forces.	
Objective 1: 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).	
a. 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).	SE: 175-178, 179-184 TWE: CB 182 CT 175 CU 185 QD 183
b. Distinguish between mass and weight.	SE: 96, 98-99, 182-184 *How It Works* 110 *Internet Physics Lab* 108-109 TWE: BA 96 CU 185 IM 98 RE 99
c. Describe how distance between objects affects the gravitational force (e.g., effect of gravitational forces of the moon and sun on objects on Earth).	SE: 175-178, 179-181, 182-184 TWE: CT 175 ICE 181 RE 180
d. Explain how evidence and inference are used to describe fundamental forces in nature, such as the gravitational force.	SE: 175, 182-185, 821 *Launch Lab* 541 TWE: CD 176, 542 CT 175 PP 802 TPK 541
e. Research the importance of gravitational forces in the space program.	SE: *Extreme Physics* 179-185, 188, 506 *Future Technology* 162 TWE: AP 180 CB 184

OBJECTIVES	PAGE REFERENCES
Objective 2: Describe the factors that affect the electric force (i.e., Coulomb's law).	
a. Relate the types of charge to their effect on electric force (i.e., like charges repel, unlike charges attract).	SE: 542-543, 546 *Design Your Own Physics Lab* 554-555 TWE: CB 543 CD 542 TPK 546
b. Describe how the amount of charge affects the electric force.	SE: 549-552, 573 TWE: IM 552
c. Investigate the relationship of distance between charged objects and the strength of the electric force.	SE: 549-552 TWE: RE 550
d. 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).	SE: 552-553, 576, 627-628 *Future Technology* 556 *How It Works* 582 *Technology and Society* 608 TWE: CB 572 CH 566, 574 RLP 570, 576
Standard IV: Students will understand transfer and conservation of energy.	
Objective 1: Determine kinetic and potential energy in a system.	
a. Identify various types of potential energy (i.e., gravitational, elastic, chemical, electrostatic, nuclear).	SE: 288-292, 376-378, 569-571 *Technology and Society* 304 TWE: CB 287 CU 292 ICE 290 IM 569
b. Calculate the kinetic energy of an object given the velocity and mass of the object.	SE: 258, 287, 294, 296
c. Describe the types of energy contributing to the total energy of a given system.	SE: 285-292, 593-594 *Launch Lab* 285 TWE: HSS 296
Objective 2: Describe conservation of energy in terms of systems.	
a. Describe a closed system in terms of its total energy.	SE: 293-294, 728-729 *Launch Lab* 285 *Physics Lab* 302-303 TWE: BA 293 CB 298 RT 734
b. 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).	SE: 293-295, 326-328, 675-678 *Mini LAB* 301 TWE: BA 671 IM 326 QD 295, 297 RE 299

OBJECTIVES	PAGE REFERENCES
c. 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.	SE: 288-290, 293-296 *Physics Lab* 302-303 TWE: CB 298 HSS 288, 296 QD 295 RE 299
d. Evaluate social, economic, and environmental issues related to the production and transmission of electrical energy.	SE: 603-605, 812-813 TWE: CT 602 D 603 EX 605 RLP 630
Objective 3: Describe common energy transformations and the effect on availability of energy.	
a. Describe the loss of useful energy in energy transformations.	SE: 295, 326-327, 603-604 *Launch Lab* 285 TWE: BA 293 CD 327 IM 326 TPK 323
b. Investigate the transfer of heat energy by conduction, convection, and radiation.	SE: 317, 724-725 TWE: CD 327 CT 316, 326, 724 TPK 323 TT 317
c. Describe the transformation of mechanical energy into electrical energy and the transmission of electrical energy.	SE: 592-593, 603-605 TWE: CT 602 D 603
d. Research and report on the transformation of energy in electrical generation plants (e.g., chemical to heat to electricity, nuclear to heat to mechanical to electrical, gravitational to kinetic to mechanical to electrical), and include energy losses during each transformation.	SE: 592-593, 603-605, 812-813 TWE: CT 602 CU 814 D 603
Standard V: Students will understand the properties and applications of waves.	
Objective 1: Demonstrate an understanding of mechanical waves in terms of general wave properties.	
a. Differentiate between period, frequency, wavelength, and amplitude of waves.	SE: 375, 382-384, 406-407 *Design Your Own Physics Lab* 392-393 TWE: CT 383 QD 382
b. Investigate and compare reflection, refraction, and diffraction of waves.	SE: 390-391, 486-489, 524-531 *Design Your Own Physics Lab* 532-533 *Extreme Physics* 506 TWE: CD 486 CH 489 CU 391 RE 390 UA 488

OBJECTIVES	PAGE REFERENCES
c. Provide examples of waves commonly observed in nature and/or used in technological applications.	SE: 381-382, 404-406, 411-414, 708, 713 *Technology and Society* 394 TWE: A 422 CT 708 IM 710 RLP 389, 725
d. Identify the relationship between the speed, wavelength, and frequency of a wave.	SE: 382-386, 436-438, 445-446, 708 *Physics Lab* 420-421 TWE: CB 385 RE 390 RT 386
e. 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).	SE: 407-410, 445-446 *Extreme Physics* 422 TWE: CD 407 D 410 ICE 409 QD 408 RE 446
f. Explain the transfer of energy through a medium by mechanical waves.	SE: 381-383, 404-405 *Extreme Physics* 422 *Technology and Society* 394 TWE: BA 403 CT 383 RLP 389
Objective 2: Describe the nature of electromagnetic radiation and visible light.	
a. Describe the relationship of energy to wavelength or frequency for electromagnetic radiation.	SE: 709-712, 725, 727 *Problem-Solving Strategies* 728
b. Distinguish between the different parts of the electromagnetic spectrum (e.g., radio waves and x-rays or visible light and microwaves).	SE: 708, 712-713 TWE: DIN 707 IM 710 PP 711 RLC 708
c. Explain that the different parts of the electromagnetic spectrum all travel through empty space and at the same speed.	SE: 437-438, 445, 706 TWE: CD 440
d. 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).	SE: 445-446 *Astronomy Connection* 447 TWE: RE 446
e. Provide examples of the use of electromagnetic radiation in everyday life (e.g., communications, lasers, microwaves, cellular phones, satellite dishes, visible light).	SE: 708, 712-713 *Applying Physics* 764 *How It Works* 534, 740 *Technology and Society* 450, 716 TWE: HSS 490 IM 710 PP 711

Codes Used for TWE Pages

A	Activity
AML	Additional Mini Lab
AP	Applying Physics
BA	Bellringer Activity
CB	Content Background
CD	Concept Development
CH	Challenge
CT	Critical Thinking
CU	Check Understanding
D	Discussion
DIN	Differentiated Instruction
EX	Extension
HSS	Helping Struggling Students
ICE	In-Class Example
IM	Identifying Misconceptions
PP	Physics Project
QD	Quick Demo
RE	Reinforcement
RLC	Real Life Careers
RLP	Real Life Physics
RT	Reteach
TPK	Tie to Prior Knowledge
TT	Teacher to Teacher
UA	Using an Analogy
UM	Using Models