Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard I: The student will understand how to measure, calculate, and describe the motion of an object in terms of position, velocity, and acceleration.

Student-Friendly Learning Target Statements

Know	**Knowledge Targets** *"What I need to know"*	I know the difference between distance and displacement. I know the difference between speed, instantaneous velocity, and average velocity. I know that the slope of a position vs. time graph represents the velocity. I know that the slope of a velocity vs. time graph represents the acceleration. I know that the area underneath a velocity vs. time graph can be used to find the displacement. I know that all objects undergoing free fall are accelerated at a constant rate.

Do	**Reasoning Targets** *"What I can do with what I know."*	I can describe the motion of an object by using motion maps, position vs. time graphs, velocity versus time graphs, and acceleration versus time graphs. I can determine whether an object is undergoing constant velocity or accelerated motion.
	Skill Targets *"What I can demonstrate."*	I can use and rearrange equations to solve for the instantaneous velocity, displacement, time, or acceleration of an object. I can find the acceleration, instantaneous velocity, and displacement using position vs. time graphs, velocity vs. time graphs, and acceleration vs. time graphs.
	Product Targets *"What I can make to show my learning."*	I can create motion maps to describe an object's motion. I can create position vs. time graphs to describe an object's motion. I can create velocity vs. time graphs to describe an object's motion. I can create acceleration vs. time graphs to describe an object's motion. I can create a coherent lab report for experiments on constant velocity and accelerated motion that can be duplicated.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.

Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard II: Students will understand the relation between force, mass, and acceleration.

Student-Friendly Learning Target Statements

Know	**Knowledge Targets** *"What I need to know"*	I know Newton's first law and the definition of inertia and equilibrium. I know that Newton's second law describes the relationship between force, mass and acceleration. I know that acceleration and mass are inversely proportional. I know that acceleration is directly proportional to force. I know that Newton's third law describes equal and opposite paired forces.
Do	**Reasoning Targets** *"What I can do with what I know."*	I can compare the acceleration of objects experiencing different forces, or objects of different mass experiencing the same force. I can determine whether or not an object will accelerate due to a net force. I can determine the magnitudes of forces acting on an object by setting up equations from a force diagram. I can distinguish between action and reaction forces, objects they act upon, and their results on the acceleration of the objects.
	Skill Targets *"What I can demonstrate."*	I can calculate the net force on an object. I can solve equations involving forces, mass and acceleration using Newton's second law. I can use the kinematical equations to determine the velocity or displacement of an object once the acceleration is known.
	Product Targets *"What I can make to show my learning."*	I can draw a force diagram for and object and describe each force acting on it. I can make a graph of force vs. acceleration and mass vs. acceleration for an object being accelerated by a force. I can draw acceleration vs. time and force vs. time graphs given a velocity vs. time graph.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.

Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard III: Students will understand the factors determining the strength of gravitational and electrical forces.

Objective I: Relate the strength of the gravitational force to the distance between two objects and the mass of the objects (Newton's law of universal gravitation).

		Student-Friendly Learning Target Statements
Know	**Knowledge Targets** *"What I need to know"*	I know that more mass means more gravitational force (that mass and the gravitational force are directly related). I know the difference between mass and weight. I know that the farther the distance between objects the less the force (force is inversely proportional to the distance squared). I know that the centripetal force is directed toward the center and is what keeps an object moving in a circle or orbit. I know that centrifugal force is a fictitious force that arises from an object's inertia when in an accelerated frame of reference. I know that objects moving in a circle at constant speeds are undergoing constant acceleration and do not have constant velocity (changing direction), but do have a constant period of rotation.
Do	**Reasoning Targets** *"What I can do with what I know."*	I can compare the gravitational forces on objects of different masses. I can compare the gravitational forces on objects at different distances. I can determine whether or not an object will accelerate due to a net central force. I can distinguish between centripetal and centrifugal forces and what causes both. I can compare the speed and period of rotation for objects of different masses or experiencing different net central forces.
	Skill Targets *"What I can demonstrate."*	I can measure the gravitational force on an object using a spring scale. I can solve equations involving gravitational forces, masses, and distances using Newton's law of universal gravitation. I can solve equations to determine the velocity, radius, period, or net central force on an object undergoing uniform circular motion.

		I can calculate the orbital velocity and period of rotation for satellites and planets. I can do rocket science!
	Product Targets *"What I can make to show my learning."*	I can draw a force diagram for an object and describe the resultant net force causing circular motion. I can draw graphs for central force vs. mass, central force vs. radius, and central force vs. speed for objects undergoing uniform circular motion. I can draw graphs for gravitational force vs. mass and gravitational force vs. distance for objects in orbit.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.

Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard III: Students will understand the factors determining the strength of gravitational and electrical forces.

Objective II: Describe the factors that affect the electrical force (Coulomb's law).

Student-Friendly Learning Target Statements

Know	**Knowledge Targets** *"What I need to know"*	I know that more charge means more electric force (that charge and the electric force are directly related). I know that like charges repel and opposite charges attract. I know that the farther the distance between objects the less the force (force is inversely proportional to the distance squared). I know that electric charges produce electric fields around them. I know that objects can be discharged by grounding. I know the difference between conductors and insulators. I know that electric energy can be stored in chemical reactions in batteries to produce charge flows.

Do	**Reasoning Targets** *"What I can do with what I know."*	I can compare the electric forces on objects of different charges. I can compare the electric forces on objects at different distances. I can determine whether objects will repel or attract each other. I can determine whether charge will build up or flow through and object by distinguishing between conductors and insulators.
	Skill Targets *"What I can demonstrate."*	I can measure the electric field around on an object using a voltmeter. I can solve equations involving electric forces, charges, and distances using Coulomb's law.
	Product Targets *"What I can make to show my learning."*	I can draw a force diagram for a charge and describe the resultant net force. I can draw graphs for electric force vs. charge and electric force vs. distance. I can draw electric field lines around charged objects.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.

Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard IV: Students will understand transfer and conservation of energy.

Student-Friendly Learning Target Statements

Know	**Knowledge Targets** *"What I need to know"*	I know that work is done when a force is exerted on an object over a distance. I know that work is a transfer of energy to an object, and that energy is the ability to do work. I know that energy is not created or destroyed (the law of conservation of energy) but that it is changed from one form to another. I know that potential energy is stored in an object lifted above the ground or in a stretched spring (gravitational potential energy and elastic potential energy). I know that objects in motion have kinetic energy. I know that energy can be transferred out of a system through friction, causing heat energy to be transferred. I know that heat energy is often not available to do work on a system and is therefore called dissipated energy.

Do	**Reasoning Targets** *"What I can do with what I know."*	I can describe a closed system in terms of energy. I can determine where a system gets its energy from, what the energy does, and where the energy goes. I can describe energy transformations and determine what type of energy is present in a system.
	Skill Targets *"What I can demonstrate."*	I can calculate the total amount of energy in a system. I can calculate the kinetic energy, gravitational potential energy, elastic potential energy, and dissipated energy in an object. I can use a force vs. distance graph to measure the amount of energy stored in an object.
	Product Targets *"What I can make to show my learning."*	I can draw a force vs. distance graphs and calculate the area underneath to determine the energy stored. I can draw pie charts and bar graphs to show energy transformations and conservation. I can draw energy flow diagrams to show where a system gets its energy from, what it does, and where it goes.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.

Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard V: Students will understand transfer the properties and applications of waves.

Objective 1: Demonstrate an understanding of mechanical waves in terms of general wave properties.

Student-Friendly Learning Target Statements

Know	**Knowledge Targets** *"What I need to know"*	I know that waves are a form of periodic motion. I know that waves are a form of transfer of energy without transferring matter. I know that the frequency of a wave is the number of cycles or waves per second and is measured in Hertz. I know that the wavelength of a wave is the distance between two like points on a wave (crest to crest, trough to trough, compression to compression, etc.). I know that in transverse waves particles oscillate perpendicular to the direction of the wave. I know that in longitudinal waves, particles oscillate parallel to the direction of the wave. I know that the speed of a mechanical wave depends on the medium it travels through. I know that wave reflection and interference can produce standing waves. I know that the frequency of a sound determines its pitch. I know that the intensity of a sound determines its loudness. I know that there is relative motion between a sound source and an observer, the Doppler effect will affect the pitch of the sound heard. I know that interfering sound waves can produce beats and affect the timbre of a sound.

Do	**Reasoning Targets** *"What I can do with what I know."*	I can relate simple harmonic motion to the periodic motion of waves. I can distinguish between the frequency and period of a wave. I can label properties of waves of such as the wavelength, amplitude, crest, trough, compression, and rarefaction. I can compare and contrast a wave pulse, transverse wave, and a longitudinal wave. I can relate the wave speed to the wavelength and frequency of a wave. I can describe what happens when a wave reaches a boundary (reflection and refraction) and how echoes are produced. I can describe how waves interfere with each other and describe the resulting wave. I can use the principle of superposition to describe resonance and standing waves. I can distinguish between nodes and antinodes on a standing wave. I can explain why sounds experience the Doppler shift and describe some of its applications. I can use the principle of superposition to describe how beats and timbre are produced.
	Skill Targets *"What I can demonstrate."*	I can calculate the velocity, frequency, period, and wavelength of a wave. I can determine the distance between a sound source and a barrier from an echo using the wave equation. I can determine the number of beats will be produced when two sound waves interfere with each other.
	Product Targets *"What I can make to show my learning."*	I can make waves of different frequencies and wavelength on a spring. I can draw transverse and longitudinal waves and label their properties. I can draw waves that result from interference of two other waves.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.

Physics Core Learning Targets

Department: Science
Course: Physics/Physics with Technology

Standard V: Students will understand transfer the properties and applications of waves.

Objective 2: Describe the nature of electromagnetic radiation and visible light

		Student-Friendly Learning Target Statements
Know	**Knowledge Targets** *"What I need to know"*	I know that the energy of an electromagnetic wave is related to its frequency. I know the different types of waves that make up the electromagnetic spectrum. I know that electromagnetic waves do not require a medium to travel through. I know that all electromagnetic waves travel at the same speed through empty space. I know that colors seen are different wavelengths of visible light reflecting off a surface or transmitted through when others are absorbed. I know why the sky is blue during the day and what produces colorful sunsets and rainbows. I know that light waves can be approximated using rays. I know that electromagnetic waves slow down and refract when entering different media. I know that refraction of light rays produces mirages. I know that total internal reflection occurs when light waves traveling through a medium of high index of refraction to a medium of low index of refraction are sent at or beyond the critical angle and that this is the basis for fiber optics. I know that the Doppler shift affects the frequency of electromagnetic waves when there is relative motion between the source and the observer. I know that mirrors and lenses can produce real and virtual images and that only real images can be projected onto a screen. I know that waves diffract around edges or corners. I know that laser light is coherent and monochromatic, and what the acronym stands “laser” stands for. I know that light waves can interfere with one another.

Do	**Reasoning Targets** *"What I can do with what I know."*	I can relate the wave speed to the wavelength and frequency of a wave. I can differentiate between the different types of electromagnetic radiation. I can determine what color is produced by mixing colors of light and pigment. I can describe wave motion upon reflection and refraction. I can distinguish between diffuse and specular reflection. I can explain what happens to light waves that travel through a polarizer. I can determine whether a diverging lens or a converging lens is necessary to correct vision problems. I can describe patterns of interference of light waves and diffraction.
	Skill Targets *"What I can demonstrate."*	I can calculate the energy, velocity, frequency, period, and wavelength of a wave. I can label waves on the electromagnetic spectrum and describe applications of each type.
	Product Targets *"What I can make to show my learning."*	I can draw color wheels to show the mixing of colored light and pigment. I can draw ray diagrams to determine image position, height, and whether it is a real or a virtual image for plane mirrors, convex mirrors, and concave mirrors. I can draw ray diagrams to determine image position, height, and whether it is a real or a virtual image for convex lenses and concave lenses. I can make a periscope or a telescope to show understanding of reflection and refraction of light.

Essential Learning: The critical knowledge, skills, and dispositions each student must acquire as a result of this unit of instruction.