Indiana Department of Education

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Physics Correlation Guide
2016 Science Indiana Academic Standards to 2022 Performance Expectations*

2016 Indiana Academic Standard	2022 Performance Expectation
PI.1.2 Describe the slope of the graphical representation of position vs. clock reading (time) in terms of the velocity of the object. **PI.1.3** Rank the velocities of objects in a system based on the slope of a position vs. clock reading (time) graphical representation. Recognize that the magnitude of the slope representing a negative velocity can be greater than the magnitude of the slope representing a positive velocity. **PI.1.4** Describe the differences between the terms “distance,” “displacement,” “speed,” “velocity,” “average speed,” and “average velocity” and be able to calculate any of those values given an object moving at a single constant velocity or with different constant velocities over a given time interval. **PI.2.2** Describe the slope of the graphical representation of velocity vs. clock reading (time) in terms of the acceleration of the object. **PI.2.3** Rank the accelerations of objects in a system based on the slope of a velocity vs. clock reading (time) graphical representation. Recognize that the magnitude of the slope representing a negative acceleration can be greater than the magnitude of the slope representing a positive acceleration. **PI.2.4** Given a graphical representation of the position, velocity, or acceleration vs. clock reading (time), be able to identify or sketch the shape of the other two graphs. **PI.3.1** Understand Newton’s first law of motion and describe the motion of an object in the absence of a net external force according to Newton’s first law.	**HS-PS2-1.** Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

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PI.3.4 Understand Newton's third law of motion and describe the interaction of two objects using Newton's third law and the representation of action-reaction pairs of forces.	
PI.3.1 Understand Newton's first law of motion and describe the motion of an object in the absence of a net external force according to Newton's first law. **PI.4.5** Understand and apply the principle of conservation of energy to determine the total mechanical energy stored in a closed system and mathematically show that the total mechanical energy of the system remains constant as long as no dissipative (i.e. nonconservative) forces are present. **PI.5.2** Operationally define "impulse" as the area under a force vs. change in clock reading (time) curve and be able to determine the change in linear momentum of a system acted on by an external force. Predict the change in linear momentum of an object from the average force exerted on the object and time interval during which the force is exerted. **PI.5.6** Mathematically determine the center of mass of a system consisting of two or more masses. Given a system with no external forces applied, show that the linear momentum of the center of mass remains constant during any interaction between the masses.	**HS-PS2-2.** Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
PI.5.4 Determine the individual and total linear momentum for a two-body system before and after an interaction (e.g. collision or separation) between the two objects and show that the total linear momentum of the system remains constant when no external force is applied consistent with Newton's third law.	**HS-PS2-3.** Apply scientific and engineering ideas to design, evaluate, and refine a device for example, one that minimizes the force on a macroscopic object during a collision.

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PI.3.5 Develop graphical and mathematical representations that describe the relationship between the gravitational mass of an object and the force due to gravity and apply those representations to qualitatively and quantitatively describe how changing the gravitational mass will affect the force due to gravity acting on the object. **PI.3.6** Describe the slope of the force due to gravity vs. gravitational mass graphical representation in terms of gravitational field. **PI.3.7** Explain that the equivalence of the inertial and gravitational masses leads to the observation that acceleration in free fall is independent of an object's mass.	**HS-PS2-4.** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
Standard 6: Simple Harmonic Oscillating Systems.	**HS-PS2-6.** Use mathematical representations to represent simple harmonic motion and pendulums.
PI.4.1 Evaluate the translational kinetic, gravitational potential, and elastic potential energies in simple situations using the mathematical definitions of these quantities and mathematically relate the initial and final values of the translational kinetic, gravitational potential, and elastic potential energies in the absence of a net external force. **PI.4.6** Develop and apply pictorial, mathematical or graphical representations to qualitatively and quantitatively predict changes in the mechanical energy (e.g. translational kinetic, gravitational, or elastic potential) of a system due to changes in position or speed of objects or non-conservative interactions within the system.	**HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
PI.4.6 Develop and apply pictorial, mathematical or graphical representations to qualitatively and quantitatively predict	**HS-PS3-2.** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination

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changes in the mechanical energy (e.g. translational kinetic, gravitational, or elastic potential) of a system due to changes in position or speed of objects or non-conservative interactions within the system.	of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
	HS.PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
	HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
Standard 8: Simple Circuit Analysis.	**HS-PS3-6.** Design, develop and analyze simple circuits and circuit elements.
PI.7.3 Develop graphical and mathematical representations that describe the relationship between the frequency of a mechanical wave and the wavelength of the wave and apply those representations to qualitatively and quantitatively describe how changing the frequency of a mechanical wave affects the wavelength and vice versa.	**HS-PS4-1.** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
	HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
	HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

*Performance expectations are three dimensional. All three dimensions (Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts) must be included as part of effective instruction.

For more information, see the Indiana Department of Education's Indiana Academic Standards webpage or contact the Office of Teaching and Learning.