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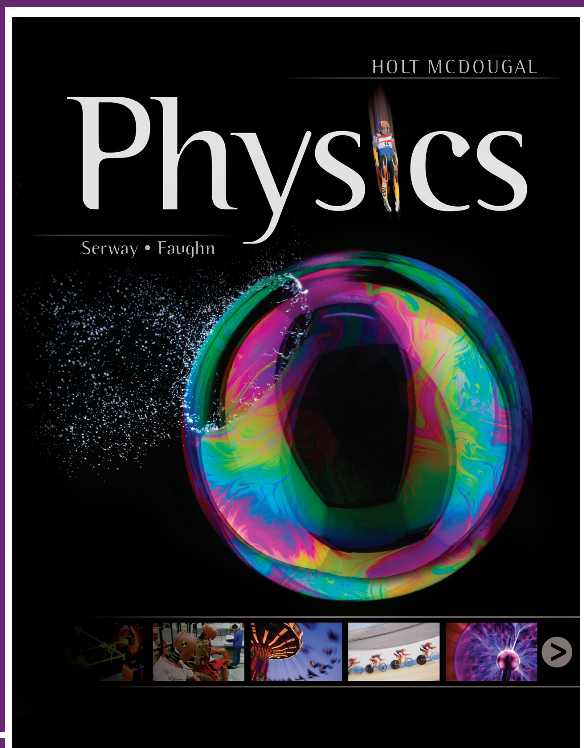
Correlation to the **Oklahoma Academic Standards for Science Physics**



Holt McDougal Physics

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CORRELATIONS WITH OKLAHOMA ACADEMIC STANDARDS

Health, Vocational Education and Computer Education/Instructional Technology and Grades PreK-12 Science, PreK-5 Science Content Reading

Grades 9–12
Physics

Correlation Location	Oklahoma Academic Standards: Physics
HS-PS1-8: Matter and Its Interactions s	
Print or Online SE/TE: Page 783 (figure 2.6) **Print or Online TE Only:** Page 775 (Demonstration: Nuclear Stability) **Online Labs:** **Exploration Lab/Simulation:** Modeling Predation (Section 8.2); **Inquiry Lab/Data Analysis:** Predator-Prey Interactions (Section 8.2); **Exploration/Probeware Lab:** Population Dynamics (Section 8.1)	**Performance Expectation HS-PS1-8** *Students who demonstrate understanding can:* **Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.** **Clarification Statement:** Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations. **Assessment Boundary:** Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 177, 779-788, 789-792 **Print or Online TE Only:** Page 176	**Disciplinary Core Ideas for Standard HS-PS1-8** **Nuclear Processes:** • Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.
Print or Online SE/TE: Pages 6-9, 124, 370 **Print or Online TE Only:** Pages 7, 8, 378, 381, 630, 664, 670, 775 **Online Labs:** **Core Skill Lab(s):** Simple Harmonic Motion of a Pendulum (11.2) **STEM Lab(s):** Parabolic Path (3.3); Parachute (4.4); Power Programming (5.4); Thermal Expansion (9.1); Curved Mirrors (13.3); Design a Circuit (18.3)	**Science and Engineering Practice for Standard HS-PS1-8** **Developing and using models:** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
Print or Online SE/TE: Pages 779-781, 784 **Print or Online TE Only:** Page 782	**Crosscutting Concept for Standard HS-PS1-8** **Energy and Matter:** • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

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Correlation Location	Oklahoma Academic Standards: Physics
HS-PS2-1 Motion and Stability: Forces and Interactions	
Online Labs: **Discovery Lab(s):** Discovering Newton's Laws (4.1) **Core Skill Lab(s):** Free-Fall Acceleration (2.3); Velocity of a Projectile (3.3); Force and Acceleration (4.3)	**Performance Expectation HS-PS2-1** *Students who demonstrate understanding can:* **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.** **Clarification Statement:** Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. **Assessment Boundary:** Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
Print or Online SE/TE: Pages 128-130, 254-255, 256-257 **Print or Online TE Only:** Pages 128, 129	**Disciplinary Core Ideas for Standard HS-PS2-1** **Forces and Motion:** • Newton's second law accurately predicts changes in the motion of macroscopic objects.

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CORRELATIONS WITH OKLAHOMA ACADEMIC STANDARDS

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 21-23, 55, 61, 70-71, 99 **Online Labs:** **Core Skill Lab(s):** Free-Fall Acceleration (2.3); Force and Acceleration (4.3); Conservation of Mechanical Energy (5.3); Machines and Efficiency (7.4); Half-Life (22.2) **Open Inquiry Lab(s):** Black Box (1.1); Collisions (6.3); Relationships Between Heat and Work (10.1); Pendulum Trials (11.1); Electric Force (16.2) **Forensic Lab(s):** Air Pressure and Piston Design (Probeware) **STEM Lab(s):** Parabolic Path (3.3); Power Programming (5.4); Centripetal Roller Coaster (7.1)	**Science and Engineering Practice for Standard HS-PS2-1** **Analyzing and interpreting data:** Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
Print or Online SE/TE: Pages 6-9 **Online Labs:** **Core Skill Lab(s):** Force and Acceleration (4.3) **STEM Lab(s):** Parachute (4.4); Buoyant Vehicle (8.1)	**Crosscutting Concept for Standard HS-PS2-1-2** **Cause and Effect:** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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Correlation Location	Oklahoma Academic Standards: Physics
HS-PS2-2 Motion and Stability: Forces and Interactions	
Print or Online SE/TE: Pages 200, 210-211 **Print or Online TE Only:** Page 199 **Online Labs:** **Core Skill Lab(s):** Conservation of Momentum (6.2) **Open Inquiry Lab(s):** Collisions (6.3)	**Performance Expectation HS-PS2-2** *Students who demonstrate understanding can:* **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.** **Clarification Statement:** Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. **Assessment Boundary:** Assessment is limited to systems of two macroscopic bodies moving in one dimension.
Print or Online SE/TE: Pages 190-196, 197-203	**Disciplinary Core Ideas for Standard HS-PS2-2** **Forces and Motion:** • Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 6-7, 21-25 **Online Labs:** **Core Skill Lab(s):** Conservation of Momentum (6.2); Machines and Efficiency (7.4); Simple Harmonic Motion of a Pendulum (11.2) **Open Inquiry Lab(s):** Work (5.1); Collisions (6.3)	**Science and Engineering Practice for Standard HS-PS2-2** **Using mathematics and computational thinking:** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical representations of phenomena to describe explanations.
Print or Online SE/TE: Pages 7, 340	**Crosscutting Concept for Standard HS-PS2-2** **Systems and System Models:** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.
HS-PS2-3 Motion and Stability: Forces and Interactions	
Print or Online SE/TE: Page 219 (Alternative Assessment, #4) **Print or Online TE Only:** Page 199 **Online Lab:** **STEM Lab:** Parachute (4.4)	**Performance Expectation HS-PS2-3** *Students who demonstrate understanding can:* **Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*** **Clarification Statement:** Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.

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Correlation Location	Oklahoma Academic Standards: Physics
	Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.
Print or Online SE/TE: Pages 192-196, 197-203, 328-329, 624-625, 669, 688-689	**Disciplinary Core Ideas for Standard HS-PS2-3** **Forces and Motions:** • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. **Defining and Delimiting Engineering Problems:** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
Print or Online SE/TE: Page 219 (Alternative Assessment, #4) **Online Labs:** **Open Inquiry Lab(s):** Magnetism From Electricity (19.2) **STEM Lab(s):** Parachute (4.4); Power Programming (5.4); Centripetal Roller Coaster (7.1); Buoyant Vehicle (8.1); Design a Circuit (18.3)	**Science and Engineering Practice for Standard HS-PS2-3** **Constructing explanations (for science) and designing solutions (for engineering):** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
Print or Online SE/TE: Pages 178, 316, 347, 354 **Online Labs:** **STEM Lab(s):** Parachute (4.4); Buoyant Vehicle (8.1)	**Crosscutting Concept for Standard HS-PS2-3** **Cause and Effect:** • Systems can be designed to cause a desired effect.

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Correlation Location	Oklahoma Academic Standards: Physics
HS-PS2-4 Motion and Stability: Forces and Interactions	
Print or Online SE/TE: Pages 232, 235 (Quick Lab), 555, 557-558, 559, 560, 564-565 **Print or Online TE Only:** Pages 231, 563	**Performance Expectation HS-PS2-4** *Students who demonstrate understanding can:* **Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.** **Clarification Statement:** Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields. **Assessment Boundary:** Assessment is limited to systems with two objects.
Print or Online SE/TE: Pages 118-119, 230-232, 234-237, 554-556, 560-561, 664-668, 670-672 **Print or Online TE Only:** Pages 558, 673, 676, 677 **Online Labs:** **Open Inquiry Lab:** Electric Force (16.2);	**Disciplinary Core Ideas for Standard HS-PS2-4** **Types of Interactions:** • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. • Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

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Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 6-7, 21-25 **Online Labs:** **Core Skill Lab(s):** Conservation of Momentum (6.2); Machines and Efficiency (7.4); Simple Harmonic Motion of a Pendulum (11.2) **Open Inquiry Lab(s):** Work (5.1); Collisions (6.3)	**Science and Engineering Practice for Standard HS-PS2-4** **Using mathematics and computational thinking:** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical representations of phenomena to describe explanations.
Print or Online TE Only: Page 385 **Online Labs:** **Discovery Lab(s):** Discovering Newton's Laws (4.1); Magnetism (19.1) **Open Inquiry Lab(s):** Work (5.1); Buoyancy (8.1); Relationship Between Heat and Work (10.1); Pendulum Trials (11.1); Standing Waves (12.3); Double-Slit Interference (15.1); Magnetism From Electricity (19.2) **STEM Lab(s):** Parabolic Path (3.3); Power Programming (5.4); Centripetal Roller Coaster (7.1); Thermal Expansion (9.1); Design a Circuit (18.3)	**Crosscutting Concept for Standard HS-PS2-4** **Patterns:** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

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<table>
<tr><th>Correlation Location</th><th>Oklahoma Academic Standards: Physics</th></tr>
<tr><td colspan="2">HS-PS2-5 Motion and Stability: Forces and Interactions</td></tr>
<tr><td><u>Print or Online SE/TE:</u>
Page 671 (Quick Lab)

<u>Print or Online TE Only:</u>
Pages 670, 673

<u>Online Labs:</u>
Core Skill Lab(s): Electrostatics (16.1); Current and Resistance (17.3); Magnetic Field of a Conducting Wire (19.2); Electromagnetic Induction (20.1)
Open Inquiry Lab(s): Magnetism From Electricity (19.2)</td><td>Performance Expectation HS-PS2-5

Students who demonstrate understanding can:

<u>Plan and conduct an investigation to provide evidence</u> that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

Clarification Statement:
N/A

Assessment Boundary:
Assessment is limited to designing and conducting investigations with provided materials and tools.</td></tr>
<tr><td><u>Print or Online SE/TE:</u>
Pages 119, 132, 554-556, 560-561, 604-607, 664-668, 670-672

<u>Print or Online TE Only:</u>
Pages 558, 673, 676, 677</td><td>Disciplinary Core Ideas for Standard HS-PS2-5

Types of Interactions:
• Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.
• Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

Definitions of Energy: (secondary to HS-PS2-5)
• “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents.</td></tr>
</table>

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online TE Only: Pages 328, 438, 625, 811 **Online Labs:** **Core Skill Labs:** Physics and Measurement (1.2) **Open Inquiry Lab(s):** Electric Force (16.2); Magnetism From Electricity (19.2) **STEM Lab(s):** Thermal Expansion (9.1); Fiber Optics (14.3); Design a Circuit (18.3); Motors (20.2)	**Science and Engineering Practice for Standard HS-PS2-5** **Planning and carrying out investigations:** Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
Print or Online SE/TE: Pages 6-9 **Online Labs:** **Core Skill Lab(s):** Force and Acceleration (4.3) **STEM Lab(s):** Parachute (4.4); Buoyant Vehicle (8.1)	**Crosscutting Concept for Standard HS-PS2-5** **Cause and Effect:** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
HS-PS3-1 Energy	
Print or Online SE/TE: Page 170 **Print or Online TE Only:** Pages 158, 169, 171 **Online Labs:** **Core Skill Lab(s):** Conservation of Mechanical Energy (5.3) **STEM Lab(s):** Thermal Expansion (9.1)	**Performance Expectation HS-PS3-1** *Students who demonstrate understanding can:* **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.** **Clarification Statement:** Emphasis is on explaining the meaning of mathematical expressions used in

Correlation Location	Oklahoma Academic Standards: Physics
Probeware Lab(s): Newton's Law of Cooling (9.2)	the model. **Assessment Boundary:** Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, potential energy and/or the energies in gravitational, magnetic, or electric fields.
Print or Online SE/TE: Pages 158-166, 167-171, 299-300, 305-307, 309-311, 442-445, 717-718 **Print or Online TE Only:** Pages 167, 168, 172, 298, 719	**Disciplinary Core Ideas for Standard HS-PS3-1** **Definitions of Energy:** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. **Conservation of Energy and Energy Transfer:** • Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • The availability of energy limits what can occur in any system.

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online TE Only: Pages 158, 169, 171 **Online Labs:** **Core Skill Lab(s):** Conservation of Mechanical energy (5.3) **STEM Lab(s):** Power Programming (5.4) **Probeware Lab(s):** Newton's Law of Cooling (9.2)	**Science and Engineering Practice for Standard HS-PS3-1** **Using mathematics and computational thinking:** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create a computational model or simulation of a phenomenon, designed device, process, or system.
Print or Online SE/TE: Page 9 **Print or Online TE Only:** Page 8	**Crosscutting Concept for Standard HS-PS3-1** **Systems and System Models:** • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
HS-PS3-2 Energy	
Print or Online SE/TE: Page 309 (Quick Lab) **Print or Online TE Only:** Page 388 **Online Labs:** **Core Skill Lab(s):** Resistors in Series and in Parallel (18.2) **Open Inquiry Lab(s):** Relationship Between Heat and Work (10.1) **STEM Lab(s):** Power Programming (5.4); Thermal Expansion (9.1); Design a Circuit (18.3); Motors (20.2)	**Performance Expectation HS-PS3-2** *Students who demonstrate understanding can:* **Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.** **Clarification Statement:** Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams,

Correlation Location	Oklahoma Academic Standards: Physics
	drawings, descriptions, and computer simulations. **Assessment Boundary:** Assessment does not include quantitative calculations.
Print or Online SE/TE: Pages 158-166, 298-299, 299-300, 305-307, 378-384, 717-718, 793-794 **Print or Online TE Only:** Pages 167, 298, 388	**Disciplinary Core Ideas for Standard HS-PS3-2** **Definitions of Energy:** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

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Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 6-9, 169, 671 (Quick Lab) **Print or Online TE Only:** Pages 381, 630, 664, 670 **Online Labs:** **Core Skill Lab(s):** Simple Harmonic Motion of a Pendulum (11.2); Resistors in Series and in Parallel (18.2) **Open Inquiry Lab(s):** Relationship Between Heat and Work (10.1) **STEM Lab(s):** Parabolic Path (3.3); Parachute (4.4); Power Programming (5.4); Thermal Expansion (9.1); Curved Mirrors (13.3); Design a Circuit (18.3)	**Science and Engineering Practice for Standard HS-PS3-2** **Developing and using models:** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
Print or Online SE/TE: Pages 167-172, 305-318	**Crosscutting Concept for Standard HS-PS3-2** **Energy and Matter** • Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.
HS-PS3-3 Energy	
Print or Online SE/TE: Page 625 **Online Labs:** **STEM Lab(s):** Thermal Expansion (9.1); Design a Circuit (18.3); Motors (20.2)	**Performance Expectation HS-PS3-3** *Students who demonstrate understanding can:* **Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*** **Clarification Statement:** Emphasis is on both qualitative and quantitative evaluations of devices.

Correlation Location	Oklahoma Academic Standards: Physics
	Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. **Assessment Boundary:** Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.
Print or Online SE/TE: Pages 158-166 **Print or Online SE/TE:** 328-329, 624-625, 669, 688-689 ——————————————————————— **Print or Online SE/TE:** Pages 13, 328-329, 438-439, 624-625, 688-689, 810-811 **Print or Online TE Only:** Pages 363, 403, 663, 691	**Disciplinary Core Ideas for Standard HS-PS3-3** **Definitions of Energy:** • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **Defining and Delimiting Engineering Problems:** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ——————————————————————— * Connections to Engineering, Technology, and Application of Science **Interdependence of Science, Engineering, and Technology:** • Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 5, 31 (Alternative Assessment) **Online Labs:** **Forensic Lab(s):** Micro-Voltaic Cells (Probeware) ; Air Pressure and Piston Design (Probeware); Evaporation and Ink Solvents (Probeware); A Leaky Reaction (Probeware)	**Science and Engineering Practice for Standard HS-PS3-3** **Constructing explanations (for science) and designing solutions (for engineering):** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student- generated sources of evidence consistent with scientific ideas, principles, and theories. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Print or Online SE/TE: Pages 305-318	**Crosscutting Concept for Standard HS-PS3-3** **Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
HS-PS3-4 Energy	
Print or Online SE/TE: Page 309 (Quick Lab) **Print or Online TE Only:** Page 300 **Online Labs:** **STEM Lab(s):** Thermal Expansion (9.1) **Probeware Lab(s):** Newton's Law of Cooling (9.2)	**Performance Expectation HS-PS3-4** *Students who demonstrate understanding can:* **Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).** **Clarification Statement:** Emphasis is on analyzing data from student investigations and using

Correlation Location	Oklahoma Academic Standards: Physics
	mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. **Assessment Boundary:** Assessment is limited to investigations based on materials and tools provided to students.
Print or Online SE/TE: Pages 167-172, 309-311 **Print or Online TE Only:** Page 172	**Disciplinary Core Ideas for Standard HS-PS3-4** **Conservation of Energy and Energy Transfer:** • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).
Online Labs: **STEM Lab(s):** Thermal Expansion (9.1) **Probeware Lab(s):** Newton's Law of Cooling (9.2)	**Science and Engineering Practice for Standard HS-PS3-4** **Planning and carrying out investigations:** Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 7, 340	**Crosscutting Concept for Standard HS-PS3-4** **System and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
HS-PS3-5 Energy	
Print or Online SE/TE: Pages 667 (Quick Lab), 685 (Alternative Assessment) **Online Labs:** **Core Skill Lab(s):** Electrostatics (16.1); Current and Resistance (17.3); Magnetic Field of a Conducting Wire (19.2); Electromagnetic Induction (20.1) **Open Inquiry Lab(s):** Magnetism From Electricity (19.2) **Discovery Lab(s):** Magnetism (19.1)	**Performance Expectation HS-PS3-5** *Students who demonstrate understanding can:* **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.** **Clarification Statement:** Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other, including an explanation of how the change in energy of the objects is related to the change in energy of the field. **Assessment Boundary:** Assessment is limited to systems containing two objects.
Print or Online SE/TE: Pages 163-166, 554-556, 560-561, 562-568 **Print or Online TE Only:** Pages 548, 552	**Disciplinary Core Ideas for Standard HS-PS3-5** **Relationship Between Energy and Forces:** • When two objects interacting through a field change relative position, the energy stored in the field is changed.

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OKLAHOMA ACADEMIC STANDARDS

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 6-9, 671 (Quick Lab) **Print or Online TE Only:** Pages 664, 670 **Online Labs:** **Core Skill Lab(s):** Electrostatics (16.1); Current and Resistance (17.3); Magnetic Field of a Conducting Wire (19.2); Electromagnetic Induction (20.1) **Open Inquiry Lab(s):** Magnetism From Electricity (19.2) **Discovery Lab(s):** Magnetism (19.1)	**Science and Engineering Practice for Standard HS-PS3-5** **Developing and using models:** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
Print or Online SE/TE: Pages 163-164, 554, 562-564	**Crosscutting Concept for Standard HS-PS3-5** **Energy and Matter** • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
HS-PS4-1 Waves and Their Applications in Technologies for Information Transfer	
Print or Online SE/TE: Page 397 #3 (Alternative Assessment) **Print or Online TE Only:** Pages 378, 380, 381, 382, 383 **Online Labs:** **Core Skill Lab(s):** Speed of Sound (12.1); Diffraction (15.2) **Open Inquiry Lab(s):** Standing Waves (12.3); Double-Slit Interference (15.1)	**Performance Expectation HS-PS4-1** *Students who demonstrate understanding can:* **Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** **Clarification Statement:** Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic

Correlation Location	Oklahoma Academic Standards: Physics
Discovery Lab(s): Resonance and the Nature of Sound (12.1)	waves traveling through the Earth. **Assessment Boundary:** Assessment is limited to algebraic relationships and describing those relationships qualitatively.
Print or Online SE/TE: Pages 382-383	**Disciplinary Core Ideas for Standard HS-PS4-1** **Wave Properties:** • The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.
Print or Online SE/TE: Page 397 #3 (Alternative Assessment) **Print or Online TE Only:** Pages 378, 380, 381, 382, 383 **Online Labs:** **Core Skill Lab(s):** Speed of Sound (12.1); Diffraction (15.2) **Open Inquiry Lab(s):** Standing Waves (12.3); Double-Slit Interference (15.1) **Discovery Lab(s):** Resonance and the Nature of Sound (12.1)	**Science and Engineering Practice for Standard HS-PS4-1** **Using mathematics and computational thinking:** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.
Print or Online SE/TE: Pages 362-390, R18 **Online Labs:** **Core Skill Lab(s):** Speed of Sound (12.1); Diffraction (15.2) **Open Inquiry Lab(s):** Standing Waves (12.3); Double-Slit Interference (15.1)	**Crosscutting Concept for Standard HS-PS4-1** **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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CORRELATIONS WITH
OKLAHOMA ACADEMIC STANDARDS

Correlation Location	Oklahoma Academic Standards: Physics
Discovery Lab(s): Resonance and the Nature of Sound (12.1)	
HS-PS4-2 Waves and Their Applications in Technologies for Information Transfer	
Print or Online SE/TE: Pages 406-409, 428-429, 513 (#6), 536-537 **Print or Online TE Only:** Pages 382, 403 **Online Lab:** **STEM Lab:** Fiber Optics (14.3)	**Performance Expectation HS-PS4-2** *Students who demonstrate understanding can:* **Evaluate questions about the advantages and disadvantages of using a digital transmission and storage of information.*** **Clarification Statement:** Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft. **Assessment Boundary:** N/A
Print or Online SE/TE: Pages 406-409, 428-429, 513 (#6), 536-537 **Print or Online TE Only:** Pages 382, 403 ————————————————————— **Print or Online SE/TE:** Pages 13, 328-329, 438-439, 624-625, 688-689, 810-811 **Print or Online TE Only:** Pages 13, 363, 403, 663, 691	**Disciplinary Core Ideas for Standard HS-PS3-4** **Wave Properties:** • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. ————————————————————— * Connections to Engineering, Technology, and Application of Science **Interdependence of Science, Engineering, and Technology:** • Modern civilization depends on major technological systems. • Engineers continuously modify these technological systems by

Correlation Location	Oklahoma Academic Standards: Physics
	applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
Print or Online SE/TE: Pages 6-9 **Online Lab:** **STEM Lab:** Fiber Optics (14.3)	**Science and Engineering Practice for Standard HS-PS3-4** **Asking questions (for science) and defining problems (for engineering):** Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
Print or Online SE/TE: Pages 178, 316, 347, 354 **Online Labs:** **STEM Lab(s):** Parachute (4.4); Buoyant Vehicle (8.1)	**Crosscutting Concept for Standard HS-PS3-4** **Stability and Changes** • Systems can be designed for greater or lesser stability.
HS-PS4-3 Waves and Their Applications in Technologies for Information Transfer	
Print or Online SE/TE: Pages 391-392 **Print or Online TE Only:** Page 736	**Performance Expectation HS-PS4-3** *Students who demonstrate understanding can:* **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.** **Clarification Statement:** Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a

Correlation Location	Oklahoma Academic Standards: Physics
	phenomenon could include resonance, interference, diffraction, and photoelectric effect. **Assessment Boundary:** Assessment does not include using quantum theory.
Print or Online SE/TE: Pages 385, 426-427, 442-445, 518-519, 715-717, 718-719, 720-721, 753-756 **Print or Online TE Only:** Page 388	**Disciplinary Core Ideas for Standard HS-PS4-3** **Wave Properties:** • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. • Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up. **Electromagnetic Radiation:** • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. • The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.
Print or Online SE/TE: Pages 325 #2 (Alternative Assessment)	**Science and Engineering Practice for Standard HS-PS4-3** **Engaging in argument from evidence:** Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. • Evaluate the claims, evidence, and reasoning behind currently

Correlation Location	Oklahoma Academic Standards: Physics
	accepted explanations or solutions to determine the merits of arguments.
Print or Online SE/TE: Pages 21-23 **Online Labs:** **Open Inquiry Lab(s):** Pendulum Trials (11.1); Standing Waves (12.3); Double-Slit Interference (15.1); Electric Force (16.2); Magnetism From Electricity (19.2) **STEM Lab(s):** Buoyant Vehicle (8.1); Curved Mirrors (13.3); Fiber Optics (14 Why It Matters) **Core Skill Lab(s):** Brightness of Light (13.1); The Photoelectric Effect (21.1)	**Crosscutting Concept for Standard HS-PS4-3** **Cause and Effect** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between system at different scales.
HS-PS4-4 Waves and Their Applications in Technologies for Information Transfer	
Print or Online SE/TE: Pages 325 (#5, 6); 435 (#6); 727 (#4) **Print or Online TE Only:** Pages 392, 569	**Performance Expectation HS-PS4-4** *Students who demonstrate understanding can:* **Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.** **Clarification Statement:** Emphasis is on the idea that different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.

Correlation Location	Oklahoma Academic Standards: Physics
	Assessment Boundary: Assessment is limited to qualitative descriptions
Print or Online SE/TE: Pages 308, 442-445, 715-717, 718-719, 720-721	**Disciplinary Core Ideas for Standard HS-PS4-4** **Electromagnetic Radiation:** • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). • Shorter wavelength electromagnetic radiation (ultraviolet, X-ray s, gamma rays) can ionize atoms and cause damage to living cells. • Photoelectric materials emit electrons when they absorb light of a high-enough frequency
Print or Online SE/TE: Pages 325 (#5, 6); 435 (#6); 727 (#4) **Print or Online TE Only:** Pages 392, 569	**Science and Engineering Practice for Standard HS-PS4-4** **Obtaining, evaluating, and communicating information:** Obtaining, evaluating, and communicating information in 9–12 builds on K –8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.
Print or Online SE/TE: Pages 163-164, 554, 562-564	**Crosscutting Concept for Standard HS-PS4-4** **Cause and Effect** • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

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CORRELATIONS WITH

OKLAHOMA ACADEMIC STANDARDS

Correlation Location	Oklahoma Academic Standards: Physics
HS-PS4-5 Waves and Their Applications in Technologies for Information Transfer	
Print or Online SE/TE: Pages 435, 542 **Print or Online TE Only:** Pages **Online Labs:**	**Performance Expectation HS-PS4-5** *Students who demonstrate understanding can:* **Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*** **Clarification Statement:** Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology. **Assessment Boundary:** Assessments are limited to qualitative information. Assessments do not include band theory
Print or Online SE/TE: Pages 406-409, 428-429, 536-537, 610-611, 669, 738-743 **Print or Online TE Only:** Pages 382, 403	**Disciplinary Core Ideas for Standard HS-PS4-5** **Energy in Chemical Processes:** (secondary to HS-PS4-5) • Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. **Wave Properties:** • Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. **Electromagnetic Radiation:** • Photoelectric materials emit electrons when they absorb light of a high enough frequency.

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 13, 328-329, 438-439, 624-625, 688-689, 810-811 **Print or Online TE Only:** Pages 363, 403, 663, 691	**Information Technologies and Instrumentation:** • Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. ——————————————————— * Connections to Engineering, Technology, and Application of Science **Interdependence of Science, Engineering, and Technology:** • Modern civilization depends on major technological systems.
Print or Online SE/TE: Pages 31, 113, 185, 265, 325, 397, 435, 513, 575, 621, 685, 727, 807	**Science and Engineering Practice for Standard HS-PS4-5** **Obtaining, evaluating, and communicating information:** Obtaining, evaluating, and communicating information in 9–12 builds on K –8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Correlation Location	Oklahoma Academic Standards: Physics
Print or Online SE/TE: Pages 178, 316, 347, 354 **Online Labs:** **STEM Lab(s):** Parachute (4.4); Buoyant Vehicle (8.1)	**Crosscutting Concept for Standard HS-PS4-5** **Cause and Effect** • Systems can be designed to cause a desired effect.