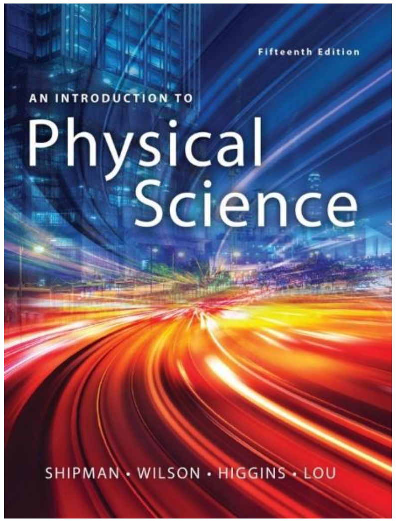

Correlation of

An Introduction to Physical Science, 15/E,
by James T. Shipman/ Jerry D. Wilson, © 2021,

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to

Indiana Academic Science Standards
Integrated Chemistry & Physics

Standards	Where Addressed
High School	
Integrated Chemistry & Physics	
HS-ICP1-1 Matter and its Interactions	
HS-ICP1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. Reference: NGSS HS-PS1-1	322-324, Appendix A-20
Science and Engineering Practices	
SEP.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 world(s).	
▪ Use a model to predict the relationships between systems or between components of a system.	The opportunity to address this Science and Engineering Practice exists. For example, see: 6
Disciplinary Core Ideas	
PS1.A: Structure and Properties of Matter	
▪ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.	259-262, 269-273
▪ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.	270, 325, 343, Appendix A-20
Crosscutting Concepts	
CC.1: 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.	601, 610

Standards	Where Addressed
HS-ICP1-2 Matter and its Interactions	
HS-ICP1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. Reference: NGSS HS-PS1-2	319-325, 320f, 342-343, 369, 369f, Appendix J, p. A-20
Science and Engineering Practices	
SEP.6: Constructing Explanations and Designing Solutions 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.	
▪ Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	54-68, 66f, 659-690
Disciplinary Core Ideas	
PS1.A: Structure and Properties of Matter	
▪ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.	The opportunity to address this Disciplinary Core Idea exists. For example, see: Appendix A-20
PS1.B: Chemical Reactions	
▪ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	317, 321, 342, 368-400
Crosscutting Concepts	
CC.1: 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.	601, 610

Standards	Where Addressed
HS-ICP1-3 Matter and its Interactions	
HS-ICP1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. Reference: NGSS HS-PS1-3	95, 284, 300-302
Science and Engineering Practices	
SEP.3: Planning and Carrying Out Investigations Planning and carrying out investigations 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.	The opportunity to address this Science and Engineering Practice exists. For example, see: 1-3
Disciplinary Core Ideas	
PS1.A: Structure and Properties of Matter	
▪ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.	108-111, 309-312, 309f
Crosscutting Concepts	
CC.1: 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.	108-111, 149, 158, 220, 221f, 256, 259
HS-ICP1-4 Matter and its Interactions	
HS-ICP1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. Reference: NGSS HS-PS1-4	296, 373, 374f, 395, 397, 566
Science and Engineering Practices	
SEP.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.	This Science and Engineering Practice is not directly addressed in this edition of *An Introduction to Physical Science*.

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Standards	Where Addressed
Disciplinary Core Ideas	
PS1.A: Structure and Properties of Matter	
▪ A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart.	353-354
PS1.B: Chemical Reactions	
▪ Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	95-96, 343, 369, 370f
Crosscutting Concepts	
CC.5: 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.	85-86, 309-312, 309f
HS-ICP1-5 Matter and its Interactions	
HS-ICP1-5. 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. Reference: NGSS HS-PS1-8	118-119, 273, 276, 279f, 282, 286-289, 287f, 640, 727-728
Science and Engineering Practices	
SEP.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.	85-86, 309-312, 309f
Disciplinary Core Ideas	
PS1.C: 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.	118-119, 273, 276, 279f, 282, 286-289, 287f, 640, 727-728
Crosscutting Concepts	
CC.5: Energy and Matter	
• In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	276, 294

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Standards	Where Addressed
HS-ICP2-1 Forces	
HS-ICP2-1. 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. Reference: NGSS HS-PS2-1	57-63, 77, 79
Science and Engineering Practices	
SEP.4: 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.	This Science and Engineering Practice is addressed throughout. For example, see: Important Equations, 50, 79, 105, 235, 305
Connections to Nature of Science	
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	
▪ Theories and laws provide explanations in science.	This Connection to Nature of Science is addressed throughout. For example, see: 4, 4f, 54-67, 66f, 202, 338-339, 340-342, 342f
▪ Laws are statements or descriptions of the relationships among observable phenomena.	This Connection to Nature of Science is addressed throughout. For example, see: 4, 4f, 54-67, 66f, 202, 338-339, 340-342, 342f
Disciplinary Core Ideas	
PS2.A: Forces and Motion	
▪ Newton's second law accurately predicts changes in the motion of macroscopic objects.	57-62
Crosscutting Concepts	
CC.2: Cause and Effect	
• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	723-724, 724f

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Standards	Where Addressed
HS-ICP3-1 Energy	
HS-ICP3-1.* **Quantitatively analyze various scenarios to describe how the change of energy in one component in a system responds to the change in energy of the other components and flow of energy into and out of the system are known.**	The opportunity to address this standard exists. For example, see: 85-86
Science and Engineering Practices	
SEP.5: 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.	This Science and Engineering Practice is addressed throughout. For example, see: Important Equations, 50, 79, 105, 235, 305
Disciplinary Core Ideas	
PS3.A: 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.	82, 85-86, 89-92, 95, 6, 94t, 97-102, 373-374
PS3.B: 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.	82, 89-92, 95
▪ Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	123-124, 142, 204
▪ 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.	89-92, 95
▪ The availability of energy limits what can occur in any system.	6-12, 19, 70, 90, 135

* Denotes Indiana Specific Standards

Standards	Where Addressed
Crosscutting Concepts	
CC.4: 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.	6-12, 19, 70, 90, 135
Connections to Nature of Science	
Scientific Knowledge Assumes an Order and Consistency in Natural Systems	
• Science assumes the universe is a vast single system in which basic laws are consistent.	520, 549-550, 550f, 549-552, 551f
HS-ICP3-2 Energy	
HS-ICP3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). Reference: NGSS HS-PS3-2	181, 300-302,546
Science and Engineering Practices	
SEP.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 and use a model based on evidence to illustrate the relationships between systems or between components of a system.	6-12, 19, 70, 90, 135
Disciplinary Core Ideas	
PS3.A: 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.	81-106
▪ At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	This objective is evidenced throughout the text. For examples, see: 81-109, 114, 133-134, 141-165, 525, 532

Standards	Where Addressed
▪ 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.	181, 300-302, 546
Crosscutting Concepts	
CC.5: Energy and Matter	
• Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.	81-106
HS-ICP3-3 Energy	
HS-ICP3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. Reference: NGSS HS-PS3-3	The opportunity to address this standard exists. For example, see: 96
Science and Engineering Practices	
SEP.6: Constructing Explanations and Designing Solutions 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.	This Science and Engineering Practice is addressed throughout. For example, see: 25, 49, 79, 105, 139, 164, 519, 716
Disciplinary Core Ideas	
PS3.A: Definitions of Energy	
▪ At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	This Disciplinary Core Idea is addressed throughout. For example, see: 28-49, 52-79, 141-165
PS3.D: Energy in Chemical Processes	
▪ Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment.	95, 133-134, 525, 532
ETS1.A: Defining and Delimiting an Engineering Problem	
▪ 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. *(secondary)*	This Disciplinary Core Idea is not directly addressed in this edition of *An Introduction to Physical Science.*

Standards	Where Addressed
Crosscutting Concepts	
CC.5: 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.	81-106, 117, 124-126, 309f, 309-312
Connections to Engineering, Technology, and Applications of Science	
Influence of Science, Engineering and Technology on Society and the Natural World	
• 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.	The opportunity to address this Crosscutting Concept exists. For example, see: 230
HS-ICP3-4 Energy	
HS-ICP3-4. 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. Reference: NGSS HS-PS3-5	189f, 201, 234, 236, 273f, 284, 294, 305, 601
Science and Engineering Practices	
SEP.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 world(s).	
▪ Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	81-106
Disciplinary Core Ideas	
PS3.C: Relationship Between Energy and Forces	
▪ When two objects interacting through a field change relative position, the energy stored in the field is changed.	81-106
Crosscutting Concepts	
CC.2: 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.	81-106

Standards	Where Addressed
HS-ICP3-5 Energy	
HS-ICP3-5.*[*] Gather data to build a model to describe and explain the flow of current through series and parallel electric circuits.	209, 212-218, 234
Science and Engineering Practices	
SEP.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 world(s).	
▪ Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	81-106
Disciplinary Core Ideas	
PS3.B: 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.	The opportunity to address this Disciplinary Core Idea exists. For example, see: 89-92
▪ Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	84, 113, 131, 149, 159-162
▪ 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.	82, 85-86, 89-90, 112, 116
▪ The availability of energy limits what can occur in any system.	81-106
Crosscutting Concepts	
CC.5: 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.	81-106

[*] Denotes Indiana Specific Standards

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Standards	Where Addressed
Connections to Engineering, Technology, and Applications of Science	
Influence of Science, Engineering and Technology on Society and the Natural World	
• 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.	The opportunity to address this Crosscutting Concept exists. For example, see: 230
HS-ICP4-1 Waves and their Applications in Technologies for Information Transfer	
HS-ICP4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves. Reference: NGSS HS-PS4-1	166-199
Science and Engineering Practices	
SEP.5: 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.	This Science and Engineering Practice is addressed throughout. For example, see: Important Equations, 50, 79, 105, 235, 305
Disciplinary Core Ideas	
PS4.A: 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.	166-197
Crosscutting Concepts	
CC.2: Cause and Effect	
• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	166-197