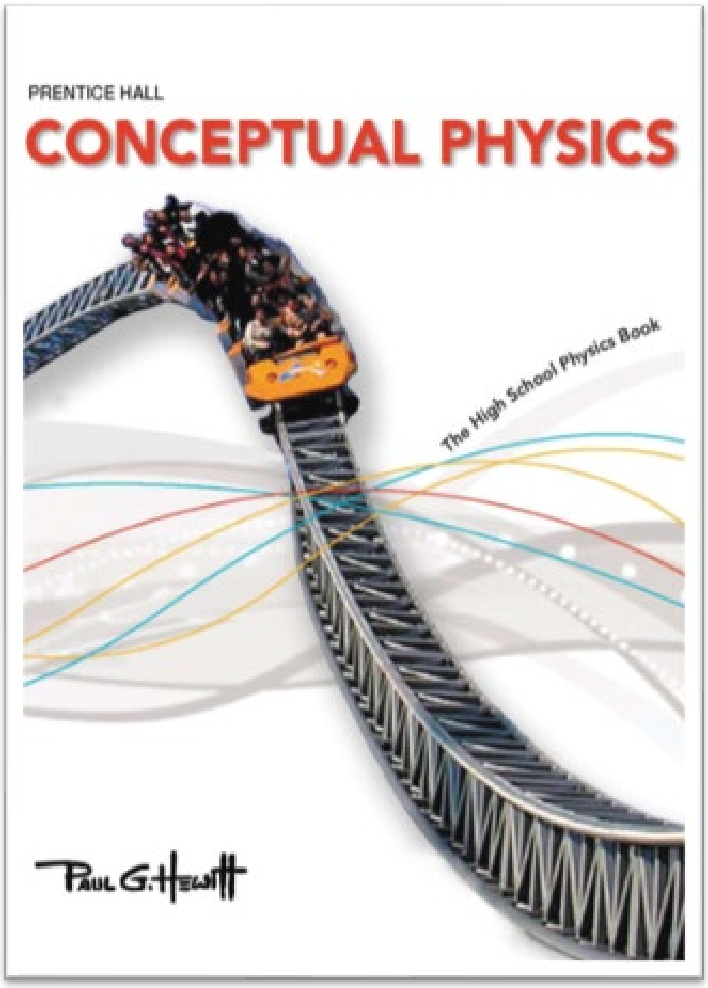
A Correlation of

Conceptual Physics



To the

New York State
Science High School Course Map for Physical Science: Physics

Prepared by Savvas Learning Company, formerly Pearson K12 Learning

A Correlation of Conceptual Physics to the New York State Science High School Course Map for Physical Science: Physics

Introduction

This document demonstrates how ***Conceptual Physics*** supports the New York State High School Course Map for Physics. Correlation references include the student and teacher editions.

Authored by Paul Hewitt, the pioneer of the enormously successful "concepts before computation" approach, ***Conceptual Physics*** boosts student success by first building a solid conceptual understanding of physics.

Program Approach

Conceptual Physics features an innovative concepts-before-computation approach. The program provides comprehensive content and a three-step learning cycle that builds conceptual understanding and offers computational reinforcement.

The Three Step Learning Approach makes physics accessible to today's students

1. *Exploration* - Ignite interest with meaningful examples and hands-on activities.
2. *Concept Development* - Expand understanding with engaging narrative and visuals, multimedia presentations, and a wide range of concept-development questions and exercises.
3. *Application* - Reinforce and apply key concepts with hands-on laboratory work, critical thinking, and problem solving.

With ***Conceptual Physics***, students learn physics by doing physics. Author Paul Hewitt, the pioneer of the enormously successful “concepts before computation” approach, continues to set the standard for clear, accessible writing and a three-step approach to physics that will stimulate students at every learning level. Now with even more problem-solving opportunities, robust technology, and hands-on materials.

The Savvas Advantage

Paul Hewitt’s renowned “Concepts before Computation” approach builds conceptual understanding. All-new technology helps you plan, teach, and assess even more effectively. Even more reading and math support is provided for struggling learners.

Hands-on learning with fully correlated activities gets your students excited about physics!

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Topic Area: Structure and Properties of Matter	
Performance Expectation	
(HS-PS1-8) 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.	**SE/TE:** Radioactive Decay, 785-786 Discover!: How Can You Model Nuclear Reactions?, 808 Nuclear Fission, 809-811 Nuclear Fusion, 821-822
Scientific and Engineering Practices: Developing and Using Models	
Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	**SE/TE:** Discover!: How Can You Model Nuclear Reactions?, 808
Disciplinary Core Ideas: PS1.C: Nuclear Process	
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.	**SE/TE:** Radioactive Decay, 785-786 Nuclear Fission, 809-811 Nuclear Fusion, 821-822
Crosscutting Concepts: Energy and Matter	
In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	**SE/TE:** Natural Transmutation of Elements, 792-793 Mass-Energy Equivalence, 817-820
Topic Area: Forces and Interactions	
Performance Expectation	
(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.	**SE/TE:** Newton's Second Law, 88 Do the Math!, 89 Check Concepts, #5, #6, 99 Think and Solve, #62, #65, 104
Scientific and Engineering Practices: Analyzing and Interpreting 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.	**SE/TE:** Do the Math!, 89 Think and Solve, #62, #65, 104
Disciplinary Core Ideas: PS2.A: Forces and Motion	
Newton's second law accurately predicts changes in the motion of macroscopic objects.	**SE/TE:** Newton's Second Law, 88 Check Concepts, #5, #6, 99
Crosscutting Concepts: Cause and Effect	
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** Think and Explain, #44, 102 Activities, #71, 105

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(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.	**SE/TE:** Newton's Third Law, 108 Identifying Action and Reaction, 108-109 Action and Reaction on Different Masses, 110-111 Action Equals Reaction, 116 Conservation of Momentum, 130-131 Do the Math!, 135 Sample Problem, 855 Momentum, #9, #11, #20, 856-857
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical representations of phenomena to describe explanations.	**SE/TE:** Do the Math!, 135 Sample Problem, 855 Momentum, #9, #11, #20, 856-857
Disciplinary Core Ideas: PS2.A: Forces and Motion	
Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.	**SE/TE:** Momentum, 125 Plug and Chug, #24, #25, 140
Disciplinary Core Ideas: PS2.A: Forces and Motion	
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.	**SE/TE:** Impulse Changes Momentum, 125-129 Bouncing, 129-130 Collisions, 132-134 Think and Explain, #32, #34, #48, 140-142
Crosscutting Concepts: Systems and System Models	
When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.	**SE/TE:** Defining Systems, 112-113 The Horse-Cart Problem, 114-115
Performance Expectation	
(HS-PS2-3) Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	For supporting content, please see: **SE/TE:** Newton's Third Law, 108 Identifying Action and Reaction, 108-109 Action Equals Reaction, 116 Momentum, 125 Conservation of Momentum, 130-131 Collisions, 132-134 Think and Explain, #35, #42, 141

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Scientific and Engineering Practices: Constructing Explanations and Designing Solutions	
Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.	**SE/TE:** Discover!: How Does a Collision Affect the Motion of Marbles?, 124 Collisions, 132-134 Think and Explain, #35, #42, 141
Disciplinary Core Ideas: PS2.A: Forces and Motion	
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.	**SE/TE:** Conservation of Momentum, 130-131 Collisions, 132-134 Concept Check, 134
Crosscutting Concepts: Cause and Effect	
Systems can be designed to cause a desired effect.	**SE/TE:** Think and Explain, #35, #42, 141
Performance Expectation	
(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.	**SE/TE:** Newton's Law of Universal Gravitation, 237-239 Gravity and Distance: The Inverse-Square Law, 240-241 Plug and Chug, #24, #25, #26, #27, 258 Think and Solve, #57, #60, #61, #62, #63, 260-261 Coulomb's Law, 648-650 Do the Math!, 650 Universal Gravitation, #1, #5, 867 Electrostatics, #4, 883
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical representations of phenomena to describe explanations.	**SE/TE:** Plug and Chug, #24, #25, #26, #27, 258 Think and Solve, #57, #60, #61, #62, #63, 260-261 Do the Math!, 650 Universal Gravitation, #1, #5, 867 Electrostatics, #4, 883
Disciplinary Core Ideas: PS2.B: 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.	**SE/TE:** Newton's Law of Universal Gravitation, 237-239 Coulomb's Law, 648-650 Check Concepts, #11, 659

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Disciplinary Core Ideas: PS2.B: 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.	**SE/TE:** Gravitational Field, 242-243 Concept Check, 243 Gravitational Field Inside a Planet, 244 Electric Fields, 665-666 Electric Field Lines, 666-667 Check Concepts, #3, 676
Crosscutting Concepts: 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.	**SE/TE:** Concept Check, 241 Concept Check, 243 Check Concepts, #8, 256 Think and Rank, #21, 257 Think and Explain, #36, 259 Think and Explain, #28, 661
Performance Expectation	
(HS-PS2-5) Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	**SE/TE:** Magnetic Fields, 722-723 The Nature of a Magnetic Field, 723-724 Electric Currents and Magnetic Fields, 726-727 Magnetic Forces on Current-Carrying Wires, 729 Electromagnetic Induction, 741-742 Faraday's Law, 743 Generators and Alternating Current, 743-745 Motor and Generator Comparison, 746 Transformers, 747-749 Induction of Electric and Magnetic Fields, 751
Scientific and Engineering Practices: Planning and Carrying Out Investigations	
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.	For supporting content, please see: **SE/TE:** Discover!: Can You Create an Electric Current Without a Battery?, 740
Disciplinary Core Ideas: PS2.B: 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.	**SE/TE:** The Nature of a Magnetic Field, 723-724 Concept Check, 724 Electric Currents and Magnetic Fields, 726-727 Check Concepts, #3, 735 Induction of Electric and Magnetic Fields, 751

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Crosscutting Concepts: Cause and Effect	
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** Concept Check, 724 Concept Check, 729 Concept Check, 746 Concept Check, 751
Topic Area: Energy	
Performance Expectation	
(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.	**SE/TE:** Discover!: Where Does a Popper Toy Get Its Energy?, 144 Potential Energy, 148-149 Kinetic Energy, 150 Machines, 155-157 Check Concepts, #7, #8, #11, 165 Plug and Chug, #38, #39, #40, 168 Think and Solve, #50, 169 Gravity and Distance: The Inverse-Square Law, 240-241
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Create a computational model or simulation of a phenomenon, designed device, process, or system.	For supporting content, please see: **SE/TE:** Discover!: Where Does a Popper Toy Get Its Energy?, 144 Machines, 155-157 Think and Rank, #29, #31, 167
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.	**SE/TE:** Mechanical Energy, 147 Potential Energy, 148-149 Kinetic Energy, 150 Conservation of Energy, 153-154 Think and Solve, #50, 169
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.	**SE/TE:** Conservation of Energy, 153-154
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.	**SE/TE:** Potential Energy, 148-149 Kinetic Energy, 150 Work-Energy Theorem, 151-152 Plug and Chug, #38, #39, #40, 168

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Disciplinary Core Ideas: PS3.B: Conservation of Energy and Energy Transfer	
The availability of energy limits what can occur in any system.	**SE/TE:** Discover!: Where Does a Popper Toy Get Its Energy?, 144 Machines, 155 Energy for Life, 160
Disciplinary Core Ideas: PS3.B: Conservation of Energy and Energy Transfer	
Energy exists in many forms, and when these forms change, energy is conserved.	**SE/TE:** Potential Energy, 148-149 Kinetic Energy, 150 Conservation of Energy, 153-154 Sources of Energy, 161-162 Think and Solve, #50, 169
Crosscutting Concepts: 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.	**SE/TE:** Discover!: Where Does a Popper Toy Get Its Energy?, 144
Crosscutting Concepts: 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.	**SE/TE:** Conservation of Energy, 153-154 Newton's Law of Universal Gravitation, 237 Gravity and Distance: The Inverse-Square Law, 240-241
Performance Expectation	
(HS-PS3-2) 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 position of particles (objects).	**SE/TE:** Potential Energy, 148-149 Temperature and Kinetic Energy, 408 Concept Check, 408 Heat, 409 Internal Energy, 411 Thermal Expansion, 416 Cooling Air, 435 Condensation, 452-453 Freezing, 456 Absolute Zero, 469 Electric Fields, 665-666 Electrical Potential Energy, 669-670

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Scientific and Engineering Practices: Developing and Using Models	
Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**SE/TE:** Figure 21.13, 420 Figure 22.9, 435 Figure 23.4, 453 Figure 23.8, 456 Figure 26.5, 517 Figure 33.4, 666 Figure 33.11, 670 Figure 36.4, 722 Figure 36.10, 725 Figure 36.11, 726
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.	**SE/TE:** Temperature and Kinetic Energy, 408 Concept Check, 408 Heat, 409
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.	**SE/TE:** Potential Energy, 148-149 Temperature and Kinetic Energy, 408 Electrical Potential Energy, 669-670
Disciplinary Core Ideas: PS3.A: Definitions of 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.	**SE/TE:** Temperature and Kinetic Energy, 408 Internal Energy, 411 Think and Explain, #36, 427 Radiation, 436 Electrical Potential Energy, 669-670
Crosscutting Concepts: Energy and Matter	
Energy can be transferred between one place and another place, between objects and/or fields, or between systems.	**SE/TE:** Heat, 409 Concept Check, 409 Conduction, 431 Convection, 433-435 Concept Check, 435 Radiation, 436

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Performance Expectation	
(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.	**SE/TE:** Solar Power, 161 Fuel Cells, 162 Science, Technology, and Society: Power Production, 248 Discover!: Can You Create an Electric Current Without a Battery?, 740
Scientific and Engineering Practices: Constructing Explanations and Designing Solutions	
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.	**SE/TE:** Solar Power, 161 Fuel Cells, 162 Science, Technology, and Society: Power Production, 248 Discover!: Can You Create an Electric Current Without a Battery?, 740
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.	**SE/TE:** Solar Power, 161 Nuclear and Geothermal Energy, 162
Disciplinary Core Ideas: ETS1.A: Defining the 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.	**SE/TE:** Solar Power, 161 Fuel Cells, 162 Science, Technology, and Society: Power Production, 248 Discover!: Can You Create an Electric Current Without a Battery?, 740
Crosscutting Concepts: 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.	**SE/TE:** Figure 9.18, 162 Concept Check, 162
Crosscutting Concepts: 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.	**SE/TE:** Nuclear and Geothermal Energy, 162 Science, Technology, and Society: Power Production, 248

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Performance Expectation	
(HS-PS3-4) 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).	**SE/TE:** Second and Third Laws of Thermodynamics, 474-475 Heat Engines and the Second Law, 475-478 Order Tends to Disorder, 479 Entropy, 480-481
Scientific and Engineering Practices: Planning and Carrying Out Investigations	
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.	**SE/TE:** Second and Third Laws of Thermodynamics, 474-475 Heat Engines and the Second Law, 475-478 Order Tends to Disorder, 479 Entropy, 480-481
Disciplinary Core Ideas: PS3.B: Conservation of Energy and Energy Transfer	
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).	**SE/TE:** Order Tends to Disorder, 479 Entropy, 480-481 Concept Check, 481
Disciplinary Core Ideas: Conservation of Energy and Energy Transfer	
Energy exists in many forms, and when these forms change, energy is conserved.	**SE/TE:** Heat Engine Mechanics, 475-476
Crosscutting Concepts: Systems 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.	**SE/TE:** Figure 24.9, 475
Performance Expectation	
(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.	**SE/TE:** Electric Fields, 665-666 Electric Field Lines, 666-667 Electrical Potential Energy, 669-670 Electrical Potential, 670-671 Magnetic Fields, 722-723 The Nature of a Magnetic Field, 723-724 Electric Currents and Magnetic Fields, 726-727 Magnetic Forces on Moving Charged Particles, 728 Magnetic Forces on Current-Carrying Wires, 729 Generators and Alternating Current, 743-745

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Scientific and Engineering Practices: Developing and Using Models	
Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**SE/TE:** Figure 33.3, 666 Figure 33.4, 666 Figure 36.4, 722 Figure 36.10, 725 Figure 36.11, 726 Activities, #47, 739 Figure 37.6, 743 Figure 37.8, 745
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.	**SE/TE:** Electrical Potential Energy, 669-670 Concept Check, 670 Check Concepts, #11, #12, 676 Think and Explain, #35, 737 Magnetic Forces on Moving Charged Particles, 728 Magnetic Forces on Current-Carrying Wires, 729 Generators and Alternating Current, 743-745
Crosscutting Concepts: 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.	**SE/TE:** Check Concepts, #12, 676 Concept Check, 722 Concept Check, 728 Concept Check, 729
Performance Expectation	
(HS-PS3-6) Analyze data to support the claim that Ohm's Law describes the mathematical relationship among the potential difference, current, and resistance of an electric circuit.	**SE/TE:** Ohm's Law, 685 Electric Power, 693-694 Think and Solve, #62, #63, #65, #66, #68, 700
Scientific and Engineering Practices: Analyzing and Interpreting 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.	**SE/TE:** Think and Solve, #62, #63, #65, #66, #68, 700
Disciplinary Core Ideas: PS3.B: Conservation of Energy and Energy Transfer	
Electrical power and energy can be determined for electric circuits.	**SE/TE:** Electric Power, 693-694 Think!, 694 Plug and Chug, #37, 698 Think and Solve, #66, #71, #74 700-701

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Crosscutting Concepts: 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.	**SE/TE:** Check Concepts, #13, #14, 696 Think and Explain, #50, #53, 699-700 Think and Solve, #73, 701
Mathematical representations can be used to identify certain patterns.	**SE/TE:** Concept Check, 685 Concept Check, 694 Check Concepts, #12, #13, #14, 696 Think and Explain, #50, #53, 699-700
Topic Area: Waves and Electromagnetic Radiation	
Performance Expectation	
(HS-PS4-1) Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	**SE/TE:** Wave Description, 491-493 Wave Speed, 495-496 Do the Math!, 496 Think and Solve, #61, #63, #64, #65, 513 Chapter 25: Vibrations and Waves, #7, #8, #10, 878
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.	**SE/TE:** Do the Math!, 496 Think and Solve, #61, #63, #64, #65, 513 Chapter 25: Vibrations and Waves, #7, #8, #10, 878
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.	**SE/TE:** Wave Speed, 495-496 Check Concepts, #9, #10, 508
Crosscutting Concepts: Cause and Effect	
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE/TE:** Check Concepts, #10, 508 Think and Explain, #34, 510
Performance Expectation	
(HS-PS4-2) Evaluate questions about the advantages of using a digital transmission and storage of information.	For supporting content, please see: **SE/TE:** Link to Technology: The Digital Camera, 611 Link to Technology: Magnetic Storage, 751
Scientific and Engineering Practices: Asking Questions and Defining Problems	
Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.	For supporting content, please see: **SE/TE:** Link to Technology: The Digital Camera, 611 Link to Technology: Magnetic Storage, 751

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Disciplinary Core Ideas: PS4.A: 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.	**SE/TE:** Link to Technology: The Digital Camera, 611 Link to Technology: Magnetic Storage, 751
Crosscutting Concepts: Stability and Change	
Systems can be designed for greater or lesser stability.	**SE/TE:** Link to Technology: Magnetic Storage, 751
Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science **Influence of Engineering, Technology, and Science on Society and the Natural World**	
Modern civilization depends on major technological systems.	**SE/TE:** Science, Technology, and Society, 5 Link to Technology: Magnetic Storage, 751
Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	For supporting content, please see: **SE/TE:** Science, Technology, and Society, 5 Link to Technology: The Digital Camera, 611 Link to Technology: Magnetic Storage, 751
Performance Expectation	
(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.	**SE/TE:** Electromagnetic Waves, 753-755 Light Quanta, 768 The Photoelectric Effect, 769-770 Waves as Particles, 770 Concept Check, 770 Particles as Waves, 771 Electron Waves, 772-773 Check Concepts, #9, #10, #11, #17, 779-780 Think and Explain, #23, #39, 780-781
Scientific and Engineering Practices: Engaging in Argument from Evidence	
Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**SE/TE:** Concept Check, 770 Check Concepts, #9, #10, #11, #17, 779-780 Think and Explain, #23, #39, 780-781
Scientific and Engineering Practices: Connection to Nature of Science **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**	
A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	**SE/TE:** Models, 767 Support for the Particle Model of Light, 769-770 De Broglie's Theory, 772-773

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Disciplinary Core Ideas: PS4.A: 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.)	**SE/TE:** De Broglie's Theory, 772-773 Check Concepts, #16, 779
Disciplinary Core Ideas: PS4.B: 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.	**SE/TE:** Light Quanta, 768 The Photoelectric Effect, 769-770 Waves as Particles, 770 Concept Check, 770 Particles as Waves, 771
Crosscutting Concepts: Systems and System Models	
Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales.	**SE/TE:** Models, 767 Concept Check, 767 Figure 38.4, 769 Figure 38.9, 772 Check Concepts, #1, #9, 779
Performance Expectation	
(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.	For supporting content, please see: **SE/TE:** Science, Technology, and Society, 756 Radiation Penetrating Power, 786-787 Radiation and You, 800-801 Activity, #68, 807
Scientific and Engineering Practices: Obtaining, Evaluating, and Communicating Information	
Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.	For supporting content, please see: **SE/TE:** Science, Technology, and Society, 756 Radiation Penetrating Power, 786-787 Radiation and You, 800-801 Activity, #68, 807
Disciplinary Core Ideas: PS4.B: 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-rays, gamma rays) can ionize atoms and cause damage to living cells.	**SE/TE:** Radiation Penetrating Power, 786-787 Gamma Rays, 801 Radiation Safety, 801

A Correlation of Conceptual Physics to the New York State Science High School Course Map for Physical Science: Physics

New York State High School Science Course Map for Physical Science: Physics	Conceptual Physics
Crosscutting Concepts: 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.	**SE/TE:** Check Concepts, #25, 804
Performance Expectation	
(HS-PS4-5) 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.	**SE/TE:** Science, Technology, and Society: Communications Satellites, 275 Link to Technology: Ultrasound Imaging, 518 The Hologram, 635-636 Concept Check, 636
Scientific and Engineering Practices: Obtaining, Evaluating, and Communicating Information	
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).	**SE/TE:** Science, Technology, and Society: Communications Satellites (Critical Thinking), 275 Concept Check, 636
Disciplinary Core Ideas: PS4.A: 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.	**SE/TE:** Science, Technology, and Society: Communications Satellites, 275
Disciplinary Core Ideas: PS4.B: Electromagnetic Radiation	
Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	**SE/TE:** The Photoelectric Effect, 769-770
Disciplinary Core Ideas: PS4.C: 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.	**SE/TE:** Science, Technology, and Society: Communications Satellites, 275 Link to Technology: Ultrasound Imaging, 518 Check Concepts, #17, 638
Crosscutting Concepts: Cause and Effect	
Systems can be designed to cause a desired effect.	**SE/TE:** Check Concepts, #19, 639
Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science **Interdependence of Science, Engineering, and Technology**	
Science and engineering complement each other in the cycle known as research and development (R&D).	For supporting content, please see: **SE/TE:** The State of Fusion Research, 823

A Correlation of Conceptual Physics to the
New York State Science High School Course Map for
Physical Science: Physics

New York State High School Science Course Map for Physical Science: Physics	Conceptual Physics
Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science **Influence of Engineering, Technology, and Science on Society and the Natural World**	
Modern civilization depends on major technological systems.	**SE/TE:** Science, Technology, and Society: Communications Satellites, 275
Performance Expectation	
(HS-PS4-6) Use mathematical models to determine relationships among the size and location of images, size and location of objects, and focal lengths of lenses and mirrors.	**SE/TE:** The Law of Reflection, 580 Mirrors, 580-582 Check Concepts, #6, 597 Activities, #53, #54, 601 Converging and Diverging Lenses, 603-604 Image Formation by a Lens, 604-606 Constructing Images Through Ray Diagrams, 606-609 Think and Rank, #17, #18, #19, 619 Think and Explain, #28, 620
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.	**SE/TE:** Check Concepts, #6, 597 Activities, #53, #54, 601 Constructing Images Through Ray Diagrams, 606-609 Think and Rank, #17, #18, #19, 619 Think and Explain, #28, 620
Disciplinary Core Ideas: PS4.A: Wave Properties	
The location and size of an image are related to the location and size of an object for a plane mirror. The location and size of an image (real or virtual) are related to the location and size of an object and the focal distance for convex and concave mirrors.	**SE/TE:** Mirrors, 580-582 Check Concepts, #6, 597
The location and size of an image (real or virtual) are related to the location and size of an object and the focal distance for biconvex and biconcave lenses.	**SE/TE:** Discover!: What Types of Images Are Formed by Convex and Concave Lenses?, 602 Converging and Diverging Lenses, 603-604 Image Formation by a Lens, 604-606 Image Formation Summarized, 610
Crosscutting Concepts: 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.	**SE/TE:** Check Concepts, #6, 597 Activities, #53, #54, 601 Discover!: What Types of Images Are Formed by Convex and Concave Lenses?, 602

A Correlation of Conceptual Physics to the New York State Science High School Course Map for Physical Science: Physics

New York State High School Science Course Map for Physical Science: Physics	Conceptual Physics
Crosscutting Concepts: Patterns	
Mathematical representations can be used to identify certain patterns.	**SE/TE:** Figure 29.3, 580 Figure 29.5, 581 Figure 30.6, 605 Figure 30.10, 608 Think and Rank, #17, #18, #19, 619
Topic Area: Space Systems	
Performance Expectation	
(HS-ESS1-2) Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	For supporting content, please see: **SE/TE:** The Expanding Universe, 253
Scientific and Engineering Practices: Constructing Explanations and Designing Solutions	
Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, 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.	**SE/TE:** Think and Explain, #50, 260
Scientific and Engineering Practices: Connection to Nature of Science **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**	
A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.	**SE/TE:** The Expanding Universe, 253 Newton's Impact on Science, 254 Think and Explain, #50, #52, 260
Disciplinary Core Ideas: PS4.B: Electromagnetic Radiation	
Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	**SE/TE:** The Atomic Color Code – Atomic Spectra, 571-573 Concept Check, #24, 576
Crosscutting Concepts: Energy and Matter	
Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems.	**SE/TE:** The Expanding Universe, 253

New York State High School Science Course Map for Physical Science: Physics	Conceptual Physics
Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science **Interdependence of Science, Engineering, and Technology**	
Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.	For supporting content, please see: **SE/TE:** Physics on the Job: Astronomer, 254
Crosscutting Concepts: Connections to Nature of Science **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**	
Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.	**SE/TE:** Figure 13.27, 251 The Expanding Universe, 253
Science assumes the universe is a vast single system in which basic laws are consistent.	**SE/TE:** The Expanding Universe, 253
Topic Area: Engineering Design	
Performance Expectation	
(HS-ETS1-1) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	**SE/TE:** Science, Technology, and Society: Energy Conservation, 163 Global Warming and the Greenhouse Effect, 441-443 Controlling Nuclear Fusion, 822-823 A Potential Energy Source, 824
Scientific and Engineering Practices: Asking Questions and Defining Problems	
Analyze complex real-world problems by specifying criteria and constraints for successful solutions.	**SE/TE:** Science, Technology, and Society: Energy Conservation (Critical Thinking), 163
Disciplinary Core Ideas: ETS1.A: 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.	**SE/TE:** Science, Technology, and Society: Energy Conservation (Critical Thinking), 163
Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	**SE/TE:** Science, Technology, and Society: Energy Conservation, 163 Consequences of the Greenhouse Effect, 442-443 Controlling Nuclear Fusion, 822-823 A Potential Energy Source, 824
Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World**	
New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.	**SE/TE:** Activities, #56, 829

A Correlation of Conceptual Physics to the
New York State Science High School Course Map for
Physical Science: Physics

New York State High School Science Course Map for Physical Science: Physics	Conceptual Physics
Performance Expectation	
(HS-ETS1-2) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	For supporting content, please see: **SE/TE:** Science, Technology, and Society: Energy Conservation, 163
Scientific and Engineering Practices: Constructing Explanations and Designing Solutions	
Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	For supporting content, please see: **SE/TE:** Science, Technology, and Society: Energy Conservation (Critical Thinking), 163
Disciplinary Core Ideas: ETS1.C: Optimizing the Design Solution	
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	For supporting content, please see: **SE/TE:** Science, Technology, and Society: Energy Conservation (Critical Thinking), 163
Performance Expectation	
(HS-ETS1-3) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	**SE/TE:** Science, Technology, and Society: Energy Conservation, 163 Activities, #56, 829
Scientific and Engineering Practices: Constructing Explanations and Designing Solutions	
Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	**SE/TE:** Science, Technology, and Society: Energy Conservation (Critical Thinking), 163
Disciplinary Core Ideas: ETS1.B: Developing Possible Solutions	
When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	**SE/TE:** A Potential Energy Source, 824 Activities, #56, 829
Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science **Influence of Science, Engineering, and Technology on Society and the Natural World**	
New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.	**SE/TE:** Science, Technology, and Society, 756 Activities, #56, 829

A Correlation of Conceptual Physics to the New York State Science High School Course Map for Physical Science: Physics

New York State High School Science Course Map for Physical Science: Physics	Conceptual Physics
Performance Expectation	
(HS-ETS1-4) Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	For supporting content, please see: **SE/TE:** Science, Technology, and Society: Energy Conservation, 163 Global Warming and the Greenhouse Effect, 441-443
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.	For supporting content, please see: **SE/TE:** Figure 22.17, 442 Figure 22.18, 442 Figure 22.19, 443
Disciplinary Core Ideas: ETS1.B: Developing Possible Solutions	
Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	For supporting content, please see: **SE/TE:** Figure 22.17, 442 Figure 22.18, 442 Figure 22.19, 443
Crosscutting Concepts: Systems and System Models	
Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.	**SE/TE:** Figure 22.17, 442 Figure 22.18, 442 Figure 22.19, 443