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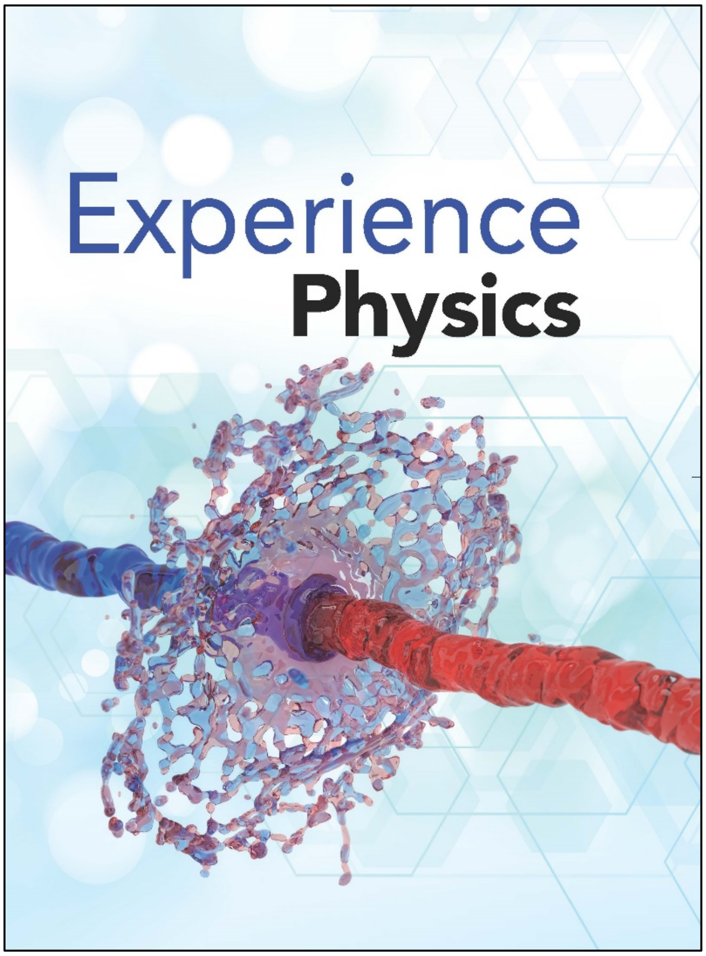

To the

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

Prepared by Savvas Learning Company, formerly Pearson K12 Learning

Introduction

This document demonstrates how ***Experience Physics* ©2022** supports the New York State High School Course Map for Physics. Correlation references include the Experience Notebook, Teacher Guide, and online digital assets.

Savvas Learning Company is excited to introduce ***Experience Physics***!

Students best learn science when they *do* science! Therefore ***Experience Physics*** puts the focus on the student experience. This modern program implements a learning model that organizes learning around phenomena giving students an authentic, real-world experience. ***Experience Physics*** includes a variety of hands-on and digital activities designed to reach every learner, and partners with Flinn Scientific to deliver high-quality inquiry labs, engineering workbenches, and performance assessments.

- **Phenomenal Experiences**
  Begin with a relevant and engaging phenomenon. Learning is organized around learning around phenomena, giving students an authentic, real-world experience. ***Experience Physics*** includes a variety of hands-on and digital activities designed to reach every learner, encouraging students to ask and answer questions, gather evidence, and organize their reasoning as they experience the concepts of physics firsthand.

- **Flinn Scientific Partnership**
  Labs, Engineering Workbenches, dataset activities, and performance tasks enhance the student experience and encourage your class to do more science! Hands-on inquiry labs are available in open-ended, guided, shortened, and advanced versions, perfect for meeting the needs of every student.

- **Personalize Instruction**
  The Teacher Guide allows instructors to personalize their course by selecting from our activities or embedding their own. Enhance instructional plan with Got More Time? Activities, or substitute with Related Phenomena when you want to make a change! Additionally, storyline and Investigation Planners use the 5E model to streamline your prep time.

- **Build Mathematical Fluency**
  Stepped-out examples in the Experience Handbook break down sample problems for clarity and process guidance, while math tutorial videos reinforce mathematical processes. The Physics and Math Skills Workbook includes four pages of review and practice problems for every learning experience. These activities and more guide students as they become more proficient with math and physics concepts.

- **Savvas Realize™ Award-Winning Digital Platform** Access all your digital content, virtual labs, simulations, assessments, and student data in ONE location. Savvas Realize has offline accessibility, so students can study from anywhere.

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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:** 591, 592, 596, 598, 615, 619 **Inquiry Lab:** Subatomic Particles **Digital Activities:** Nuclear Physics, Fission and Fusion, Radioactive Decay **Performance-Based Assessment:** Model Nuclear Forces
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:** 571, 584, 591, 592, 593, 595, 596, 597, 598, 603, 614, 615, 616, 617, 619 **Inquiry Labs:** Subatomic Particles, Forces and Atomic Nuclei **Digital Activities:** Valley of Stability, Operate a Nuclear Fission Reactor, Nuclear Physics, Fission and Fusion, Radioactive Decay **Engineering Workbench:** Energy Production **Performance-Based Assessment:** Model Nuclear Forces
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:** 575, 584–592, 594–598, 603–604, 610–619
Crosscutting Concepts: Energy and Matter	
In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	**SE:** 575, 584–586, 591, 593, 594–595, 601, 603, 604, 605, 606, 615, 617, 618 **Inquiry Labs:** Subatomic Particles

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

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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.	**Inquiry Lab:** Forces and Motion **Digital Activities:** Force, Mass, and Acceleration; Sliding Down **Performance-Based Assessment:** Force, Mass, and Acceleration
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:** 11–13, 15, 19–20, 22–23, 33–34, 38, 64, 66, 69 **Inquiry Labs:** Motion Plots, Free Fall Acceleration, Forces and Motion, The Buoyant Force, Friction, Model Projectile Motion **Digital Activities:** Acceleration, Fast Cars, Satellites in Circular Orbits, Types of Forces, Vehicle Stopping Distance, Coin Drop **Performance-Based Assessment:** Speed, Acceleration, and Trajectory
Disciplinary Core Ideas: PS2.A: Forces and Motion	
Newton's second law accurately predicts changes in the motion of macroscopic objects.	**SE:** 54, 56, 58–59, 63, 73, 75, 80–81, 82, 87, 89
Crosscutting Concepts: Cause and Effect	
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE:** 5, 48, 51, 52, 54, 70–71, 76, 78, 80, 94 **Inquiry Lab:** Model Projectile Motion **Digital Activities:** Forces, Forces on Systems, Atmospheric Pressure on a Sealed Container **Performance-Based Assessment:** Speed, Acceleration, and Trajectory

SE = Student Edition **TE= Teacher Edition**

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
Performance Expectation	
(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:** 331, 332, 333, 335, 337, 338, 343, 345, 346 **Digital Activity:** Minimizing Car Crash Injuries
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical representations of phenomena to describe explanations.	**SE:** 323, 324, 327, 328, 329, 332, 335, 336–337, 340, 341, 343, 345, 346, 347 **Inquiry Labs:** Momentum and Impulse During Collisions, Elastic and Inelastic Collisions **Digital Activities:** Momentum and Impulse, Momentum and Baseball, Minimizing Car Crash Injuries **Engineering Workbench:** Egg Supply Drop **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle
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:** 322, 323, 326, 329
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:** 336–337, 338–339, 340, 341, 342–343, 345, 346, 347 **Digital Activity:** Minimizing Car Crash Injuries **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle
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:** 324, 326, 330, 338–339, 342–343 **Digital Activities:** Momentum and Baseball, Kinetic Energy and Collisions **Engineering Workbench:** Egg Supply Drop

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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.	**SE:** 347 **Digital Activity:** Minimizing Car Crash Injuries **Engineering Workbench:** Egg Supply Drop **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle
Scientific and Engineering Practices: Constructing Explanations and Designing Solutions	
Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.	**SE:** 347 **Inquiry Labs:** Momentum and Impulse During Collisions, Elastic and Inelastic Collisions **Digital Activity:** Explosions, Kinetic Energy and Collisions **Engineering Workbench:** Egg Supply Drop **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle
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:** 336–337, 338–339, 340, 341, 342–343, 345, 346, 347
Crosscutting Concepts: Cause and Effect	
Systems can be designed to cause a desired effect.	**SE:** 327, 328, 331, 336–337 **Inquiry Lab:** Momentum and Impulse During Collisions **Digital Activities:** Momentum and Impulse, Momentum and Baseball, Minimizing Car Crash Injuries

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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:** 119, 120, 122, 128, 159, 160, 161, 173, 174, 175 **Inquiry Lab:** Electric Charges and Coulomb's Law
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Use mathematical representations of phenomena to describe explanations.	**SE:** 119, 120, 128, 159, 160, 161, 173, 174, 175, 208, 209, 210, 214, 215, 218, 221, 223, 260, 261, 262 **Inquiry Labs:** Model Projectile Motion, Investigate Gravity Using Pendulums, Model the Orbital Motion of Planets, Electric Charges and Coulomb's Law, Cohesive Forces and Surface Tension
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:** 116–120, 156–162, 251, 252 **Inquiry Lab:** Electric Charges and Coulomb's Law **Performance-Based Assessment:** Build and Test and Electroscope
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:** 121, 122, 129–132, 171–180, 198-199, 200, 202, 203, 205, 207, 209, 211, 213–214, 216–217, 219, 220–222, 252, 255 **Inquiry Labs:** Magnetic Force and Separation Distance, Electromagnets and Magnetism, Induction of Electrical Current, Electric Fields
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:** 137, 138, 152, 220, 247–248, 255 **Inquiry Lab:** Physical Properties of Solid Materials **Digital Activities:** Atoms and Atomic Structure, Forces Between Atoms, Geomagnetic Polarity Reversal, Breaking Magnets **Performance-Based Assessment:** Design an Airdrop System

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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.	**Inquiry Labs:** Electromagnets and Magnetism, Induction of Electrical Current, Electric Motors and Generators **Digital Activities:** Generator Testing, Magnetic Fields, Inducing Current **Engineering Workbench:** Build a Flashlight Without Batteries **Performance-Based Assessment:** Build a DC Motor
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.	**Inquiry Labs:** Electromagnets and Magnetism, Induction of Electrical Current, Electric Motors and Generators **Digital Activities:** Generator Testing, Magnetic Fields, Inducing Current **Engineering Workbench:** Build a Flashlight Without Batteries **Performance-Based Assessment:** Build a DC Motor
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:** 199–200, 203–209, 211, 213–225, 230–237, 436–443 **Inquiry Lab:** Induction of Electrical Current **Digital Activities:** Magnetic Forces, Combining Magnetic Fields, Magnetic Fields, Magnetic Field in a Moving Wire, Inducing Current, Properties of Electric Motors **Engineering Workbench:** Build a Flashlight Without Batteries
Crosscutting Concepts: Cause and Effect	
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE:** 229 **Inquiry Labs:** Electromagnets and Magnetism, Induction of Electrical Current, Electric Motors and Generators **Digital Activities:** Generator Testing, Magnetic Forces, Combining Magnetic Fields, Magnetic Fields, Inducing Current, Properties of Electric Motors **Performance-Based Assessment:** Build a DC Motor

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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:** 305, 311, 315, 318 **Performance-Based Assessment:** Energy Conversion
Scientific and Engineering Practices: Using Mathematics and Computational Thinking	
Create a computational model or simulation of a phenomenon, designed device, process, or system.	**SE:** 286, 287, 288, 291, 292, 296, 299, 301, 303, 305, 307, 308, 313, 315, 318 **Inquiry Labs:** Gas Particles and Work, The Impact of Position on Energy, Pendulums and the Conservation of Energy **Digital Activities:** Classifying Energy and Work, Hooke's Law and Elastic Potential Energy **Performance-Based Assessment:** Energy Conversion
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:** 294–297, 299, 300–301, 302, 303, 305, 306, 308
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:** 289, 291, 292, 303, 305, 306, 309, 311, 312, 313, 315, 316–317, 318
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:** 295–297, 299, 300–301, 303, 305, 306
The availability of energy limits what can occur in any system.	**SE:** 287, 288, 294, 299, 303, 305, 306, 307, 315, 318

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Energy exists in many forms, and when these forms change, energy is conserved.	**SE:** 309, 313, 318 **PhET Simulation:** Conservation of Energy **Digital Activity**: Conservation of Energy Video **Writing About Science**: Skills in Conversation of Energy
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:** 283, 285–286, 288, 295, 300, 303, 305, 306, 308, 310, 311, 318 **Inquiry Lab:** Gas Particles and Work **Digital Activities:** Energy in a Moving Cart, Mechanical Energy, Asteroid Impact Models, Conservation of Energy, Rocket Launch **Performance-Based Assessment:** Energy Conversion
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:** 285–286, 288, 289, 294, 295, 302, 306, 308 **Inquiry Lab:** The Impact of Position on Energy **Digital Activities:** Energy, Energy in a Moving Cart, Mechanical Energy, Asteroid Impact Models

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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).	**Inquiry Lab:** Kinetic Energy **Digital Activity:** Temperature **Performance-Based Assessment:** Heating Curve of Water
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:** 380 **Inquiry Labs:** Gas Particles and Work, The Impact of Position on Energy, Pendulums and the Conservation of Energy, Kinetic Energy **Digital Activities:** Energy in a Moving Cart, Conservation of Energy, Simple Harmonic Motion, Pendulum Decay, Gasoline Expansion
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:** 309, 310, 311, 312, 313, 377, 379 **Digital Activity:** Temperature
At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	**SE:** 310, 311, 374–375, 376 **Inquiry Lab:** Kinetic 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:** 306, 367, 369, 371–372, 377 **Inquiry Lab:** Kinetic Energy **Digital Activity:** Temperature

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Crosscutting Concepts: Energy and Matter	
Energy can be transferred between one place and another place, between objects and/or fields, or between systems.	**SE:** 310, 365, 371, 380 **Inquiry Labs:** Pendulums and the Conservation of Energy, Kinetic Energy **Digital Activities:** Energy, Conservation of Energy, Thermal Energy, Rocket Launch, Meltdown at the Pool, Temperature, Gasoline Expansion **Performance-Based Assessment:** Heating Curve of Water
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.	**Inquiry Labs:** Build a Battery, Electric Motors and Generators **Engineering Workbench:** Design a Roller Coaster **Performance-Based Assessment:** Design, Build, and Refine a Wind-Turbine Rotor
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:** 409, 425, 426, 434, 436, 439, 444, 486, 492 **Inquiry Labs:** Build a Battery, Energy Transmission in Circuits, Electric Motors and Generators **Digital Activities:** Electromagnetic Energy, Junkyard Electromagnet, Potential Difference in a Battery, Series and Parallel Circuits, Properties of Electric Motors **Engineering Workbench:** Energy Sources: Costs and Benefits **Performance-Based Assessment:** Design, Build, and Refine a Wind-Turbine Rotor
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:** 411, 412, 422, 426, 442
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:** 492 **Inquiry Lab:** Build a Battery **Digital Activity:** Junkyard Electromagnet **Engineering Workbench:** Energy Sources: Costs and Benefits **Performance-Based Assessment:** Design, Build, and Refine a Wind-Turbine Rotor

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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:** 411, 422, 423, 430, 434, 437, 444, 479, 485, 486, 487, 488, 490–491 **Inquiry Lab:** Build a Battery **Digital Activity:** Power Generation
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:** 421, 422, 423, 424–425, 426, 427, 428, 430, 431, 434, 435, 437, 436, 439, 441, 442, 443, 444, 484, 485, 486, 489 **Inquiry Labs:** Build a Battery, Energy Transmission in Circuits, Electric Motors and Generators **Digital Activities:** Electromagnetic Energy, Junkyard Electromagnet, Electric Potential, Potential Difference in a Battery, Energy in Electric Circuits, Electric Circuits, Series and Parallel Circuits, Power Generation **Engineering Workbench:** Energy Sources: Costs and Benefits **Performance-Based Assessment:** Design a Roller Coaster; Design, Build, and Refine a Wind-Turbine Rotor
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).	**Inquiry Lab:** Heat Transfer **Digital Activity:** Thermal Equilibrium and Heat Flow **Engineering Workbench:** Build an Efficient Travel Mug
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:** 365 **Inquiry Labs:** Kinetic Energy, Heat Transfer **Digital Activity:** Thermal Equilibrium and Heat Flow **Engineering Workbench:** Build an Efficient Travel Mug
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:** 381, 382–383, 384–385, 386, 393

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
Energy exists in many forms, and when these forms change, energy is conserved.	**SE:** 385, 386, 387 **Inquiry Lab:** Heat Transfer
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:** 385, 386, 388–389, 390–391, 392, 393 **Inquiry Lab:** Kinetic Energy **Digital Activities:** Thermal Equilibrium and Heat Flow, Why Metals Feel Cool **Engineering Workbench:** Build an Efficient Travel Mug
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.	**Inquiry Lab:** Magnetic Force and Separation Distance **Digital Activity:** Junkyard Electromagnet **Performance-Based Assessment:** Build and Test an Electroscope
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:** 202, 203, 204, 205, 212, 213, 216, 217, 220, 222, 224, 226, 411, 416, 418, 420, 424, 425, 437, 439, 444 **Inquiry Labs:** Electric Motors and Generators, Magnetic Force and Separation Distance, **Digital Activities:** Electromagnetic Energy, Energy in Electric Circuits, Series and Parallel Circuits, Power Generation, Properties of Electric Motors, Magnetic Forces, Magnetism, Geomagnetic Polarity Reversal, Breaking Magnets, Magnetic Fields, Combining Magnetic Fields **Engineering Workbench:** Energy Sources: Costs and Benefits, Build a Flashlight Without Batteries **Performance-Based Assessment:** Build a DC Motor
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:** 171, 178, 203, 205, 206, 207, 213–214, 224-225, 410–419, 436–439, 443

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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:** 229, 409, 421, 435, 442 **Digital Activities:** Junkyard Electromagnet, Electric Potential, Potential Difference in a Battery, Energy in Electric Circuits, Electric Circuits, Magnetic Forces, Combining Magnetic Fields
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:** 188, 189, 190, 191, 192-193, 422-423 **Inquiry Lab:** Energy Transmission in Circuits **Video:** Electric Potential
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:** 189, 192, 193, 431, 434 **Inquiry Launch:** How does electric charge move through a wire? **Inquiry Lab:** Electric Resistance and Resistivity **Analyzing Data:** Dielectric Materials **Performance-Based Assessment:** Design, Build, and Refine a Wind-Turbine Rotor **Virtual Lab PBA:** Junkyard Electromagnet
Disciplinary Core Ideas: PS3.B: Conservation of Energy and Energy Transfer	
Electrical power and energy can be determined for electric circuits.	**SE:** 186, 424-425, 426, 431 **Inquiry Launch:** How does electric charge move through a wire? **PhET Simulation:** Electric Current, Energy in Electric Circuits **Video:** Series and Parallel Circuits **Inquiry Lab:** Energy Transmission in Circuits
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:** 186, 192, 194, 422-423 **Video:** Series and Parallel Circuits **Peer Review Rubric:** Evaluate Modeling Currents, Evaluate Series and Parallel Circuits

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Mathematical representations can be used to identify certain patterns.	**SE:** 187, 188, 189, 191, 192, 195, 422-423, 427 **Analyzing Data:** Dielectric Materials Writing About Science: Skills in Energy in Electric Circuits
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:** 467, 469, 471 **Inquiry Lab:** Mechanical Waves **Digital Activities:** Making Waves, Properties of Waves, Waves and Shallow Water
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:** 467, 469, 470, 474, 477, 478, 481, 482, 483, 484, 487, 489, 490, 492, 499, 504, 505, 507 **Inquiry Labs:** Mechanical Waves, Interference of Sound Waves **Digital Activities:** Making Waves, Properties of Waves, Waves and Shallow Water **Performance-Based Assessment:** The Speed of Sound in Open Air
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:** 467–475, 477, 480–481, 485–487, 490, 491, 492 **Inquiry Lab:** Mechanical Waves **Digital Activity:** Properties of Waves
Crosscutting Concepts: Cause and Effect	
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	**SE:** 469, 473, 475, 491, 498 **Inquiry Labs:** Mechanical Waves, Interference of Sound Waves, Reflection and Refraction **Digital Activities:** Waves, Making Waves, Properties of Waves, Wave Speed, Wave Behavior and Energy, Interference, Wave Optics, Refraction **Engineering Workbench:** Waves

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Performance Expectation	
(HS-PS4-2) Evaluate questions about the advantages of using a digital transmission and storage of information.	**SE:** 548 **Inquiry Lab:** Binary Logic **Digital Activity:** Music Storage for Home Recording **Performance-Based Assessment:** Send Messages with a Telegraph
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.	**SE:** 547 **Inquiry Lab:** Binary Logic **Digital Activity:** Music Storage for Home Recording **Engineering Workbench:** Rover
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:** 542–547, 549–553, 554–555 **Digital Activity:** Music Storage for Home Recording **Engineering Workbench:** Rover
Crosscutting Concepts: Stability and Change	
Systems can be designed for greater or lesser stability.	**SE:** 547 **Digital Activity:** Music Storage for Home Recording **Performance-Based Assessment:** Send Messages with a Telegraph
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:** 545, 549–554 **Digital Activities:** Music Storage for Home Recording, Transistors and Integrated Circuits **Performance-Based Assessment:** Send Messages with a Telegraph
Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	**SE:** 545, 549–554 **Digital Activities:** Music Storage for Home Recording, Transistors and Integrated Circuits **Performance-Based Assessment:** Send Messages with a Telegraph

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
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:** 521, 523 **Inquiry Lab:** Particle Nature of Light **Digital Activities:** Particle-Wave Duality of Light, Particle-Wave Duality
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:** 489, 502, 508, 509, 513, 515, 516, 528 **Inquiry Labs:** Diffraction, Particle Nature of Light **Digital Activities:** Electromagnetic Radiation, Particle-Wave Duality of Light, Laser Interference, Particle-Wave Duality, Light Intensity and Energy
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:** 490, 491, 494, 498, 499, 502, 503, 519, 521, 522 **Digital Activities:** Electromagnetic Waves and Their Properties, Laser Interference, Particle-Wave Duality, Light Intensity and Energy
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:** 482–487, 494–495, 501–502 **Digital Activity:** Electromagnetic Waves and Their Properties
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:** 495–507, 512–518, 520–525, 52-530 **Inquiry Lab:** Particle Nature of Light

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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:** 482, 483, 491, 508, 511, 519, 511, 521, 522, 528 **Digital Activities:** Electromagnetic Waves and Their Properties, Particle-Wave Duality
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.	**Inquiry Lab:** Electromagnetic Radiation and Matter **Digital Activity:** Sunscreen and UV Protection **Performance-Based Assessment:** Clothing and Sun Protection
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.	**SE:** 535, 536 **Inquiry Lab:** Electromagnetic Radiation and Matter **Digital Activity:** Sunscreen and UV Protection **Performance-Based Assessment:** Clothing and Sun Protection
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:** 529–536 **Inquiry Lab:** Electromagnetic Radiation and Matter **Digital Activity:** EM Radiation and Matter
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:** 534–535 **Performance-Based Assessment:** Clothing and Sun Protection

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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:** 549, 552, 556 **Inquiry Labs:** Converting Electrical Signals to Sounds, Converting Sunlight to Electricity **Digital Activities:** Antennas, Solar Panels on a Cloudy Day **Performance-Based Assessment:** Send Messages with a Telegraph
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:** 489, 555, 561 **Inquiry Labs:** Reflection and Refraction, Converting Electrical Signals to Sounds, Converting Sunlight to Electricity **Engineering Workbench:** Rover
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:** 542–547, 549–553, 554–555 **Performance-Based Assessment:** Send Messages with a Telegraph
Disciplinary Core Ideas: PS4.B: Electromagnetic Radiation	
Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	**SE:** 522, 523, 558–559 **Inquiry Lab:** Converting Sunlight to Electricity
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:** 486, 489, 492, 549–553, 554–555 **Inquiry Lab:** Converting Electrical Signals to Sounds **Performance-Based Assessment:** Send Messages with a Telegraph
Crosscutting Concepts: Cause and Effect	
Systems can be designed to cause a desired effect.	**Inquiry Lab:** Converting Sunlight to Electricity **Digital Activity:** Solar Panels on a Cloudy Day

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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).	**SE:** 556, 561, 563, 564 **Inquiry Lab:** Converting Electrical Signals to Sounds **Digital Activities:** Refraction - Snell's Law, Storage for Home Recording, Antennas, Capturing and Transmitting Energy **Engineering Workbench:** Waves
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:** 556, 561, 564 **Inquiry Lab:** Converting Sunlight to Electricity **Digital Activities:** Information and Instrumentation, Capturing and Transmitting Information **Engineering Workbench:** Waves
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:** 502-503, 504, 505, 506 **TE:** 300
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:** 503, 504, 505, 506, 507 **TE:** 300 **Discussion Rubric:** Refraction
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:** 501, 502-503, 504, 505, 506 **TE:** 299 **Inquiry Launch:** Why do fun mirrors in amusement parks produce different kinds of images?
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:** 501

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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:** 505, 507 **Writing About Science:** Skills in Wave Optics
Mathematical representations can be used to identify certain patterns.	**SE:** 503, 507 **Discussion Rubric:** Refraction
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.	**SE:** 681, 682, 683, 684, 685, 687 **Inquiry Lab:** The Expansion of the Universe **Digital Activity:** Origins of the Universe
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:** 682, 684, 685, 687 **Inquiry Labs:** Elemental Composition of Stars, The Expansion of the Universe **Digital Activities:** Origins of the Universe, Elemental Composition of the Solar System
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:** 679, 680–681, 682, 683, 684, 685 **Digital Activity:** Origins of the Universe
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:** 685 **Inquiry Lab:** Elemental Composition of Stars **Engineering Workbench:** The Colors of Light
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:** 679, 682, 683, 684, 685, 686, 688

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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.	**SE:** 680–681, 683, 685
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:** 634, 636, 679, 680, 683, 684, 685 **Digital Activity:** Origins of the Universe
Science assumes the universe is a vast single system in which basic laws are consistent.	**SE:** 634, 636, 679, 680, 683, 684, 685 **Digital Activity:** Origins of the Universe

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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.	**Inquiry Labs:** Converting Sunlight to Electricity, Natural Resource Management **Digital Activities:** Resource Use and Biodiversity Trade Offs, Operate a Nuclear Fission Reactor **Engineering Workbench:** Design an Airdrop System, Egg Supply Drop, Earthquake-Resistant Structures **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle, Minimizing Car Crash Injuries **Problem-Based Learning:** Staying Fit to Mars and Back, Ultraviolet Radiation
Scientific and Engineering Practices: Asking Questions and Defining Problems	
Analyze complex real-world problems by specifying criteria and constraints for successful solutions.	**SE:** 49, 123, 528 **Digital Activity:** Operate a Nuclear Fission Reactor **Engineering Workbench:** Design an Airdrop System, Landslide Prevention, Defy Gravity, Design an Electronic Quiz Board, Build a Flashlight Without Batteries, Earthquake-Resistant Structures, Design a Roller Coaster, Egg Supply Drop, Build an Efficient Travel Mug, Energy Sources: Costs and Benefits, Waves and Erosion, Solar Panel Art, Rover, Energy Production, Build a Glove Box, The Colors of Light **Performance-Based Assessment:** Send Messages with a Telegraph **Problem-Based Learning:** Energy in Complex Machines, Staying Fit to Mars and Back, Ultraviolet Radiation
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:** 317 **Inquiry Lab:** Natural Resource Management **Digital Activities:** Resource Use and Biodiversity Trade Offs, Junkyard Electromagnet, Operate a Nuclear Fission Reactor **Engineering Workbench:** Design an Airdrop System, Egg Supply Drop, Energy Sources: Costs and Benefits, Earthquake-Resistant Structures, Waves and Erosion, Landslide Prevention **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle, Minimizing Car Crash Injuries **Problem-Based Learning:** Energy in Complex Machines, Staying Fit to Mars and Back, Ultraviolet Radiation

New York State Science High School Course Map for Physical Science: Physics	Experience Physics ©2022
Disciplinary Core Ideas: ETS1.A: Defining and Delimiting Engineering Problems	
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:** 100, 103, 109, 274–275, 409, 445–446, 458–459, 465, 534-535, 599 **Inquiry Labs:** Converting Sunlight to Electricity, Natural Resource Management **Digital Activities:** Resource Use and Biodiversity Trade Offs, Operate a Nuclear Fission Reactor **Engineering Workbench:** Energy Sources: Costs and Benefits, Energy Production **Performance-Based Assessment:** Design, Build and Refine a Wind-Turbine Rotor, Design a Roller Coaster **Problem-Based Learning:** Staying Fit to Mars and Back, Ultraviolet Radiation
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:** 447, 599 **Digital Activities:** Resource Use and Biodiversity Trade Offs, Operate a Nuclear Fission Reactor **Engineering Workbench:** Design an Airdrop System, Landslide Prevention, Defy Gravity, Design an Electronic Quiz Board, Build a Flashlight Without Batteries, Earthquake-Resistant Structures, Design a Roller Coaster, Egg Supply Drop, Build an Efficient Travel Mug, Energy Sources: Costs and Benefits, Waves and Erosion, Solar Panel Art, Rover, Energy Production, Build a Glove Box, The Colors of Light **Performance-Based Assessment:** Send Messages with a Telegraph **Problem-Based Learning:** Staying Fit to Mars and Back, Ultraviolet Radiation

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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.	**SE:** 447, 599 **Digital Activities:** Resource Use and Biodiversity Trade Offs, Operate a Nuclear Fission Reactor **Engineering Workbench:** Design an Airdrop System, Landslide Prevention, Defy Gravity, Design an Electronic Quiz Board, Build a Flashlight Without Batteries, Earthquake-Resistant Structures, Design a Roller Coaster, Egg Supply Drop, Build an Efficient Travel Mug, Energy Sources: Costs and Benefits, Waves and Erosion, Solar Panel Art, Rover, Energy Production, Build a Glove Box, The Colors of Light **Performance-Based Assessment:** Send Messages with a Telegraph **Problem-Based Learning:** Staying Fit to Mars and Back, Ultraviolet Radiation
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.	**SE:** 45, 84, 94, 124, 164, 206, 212, 219, 232, 238, 393, 497, 528, 551 **Digital Activities:** Junkyard Electromagnet **Engineering Workbench:** Landslide Prevention, Defy Gravity, Earthquake-Resistant Structures, Design a Roller Coaster, The Colors of Light **Performance-Based Assessment:** Design, Build and Refine a Wind-Turbine Rotor
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.	**SE:** 561 **Inquiry Labs:** Build a Battery, Electric Motors and Generators, Natural Resource Management **Digital Activities:** Junkyard Electromagnet, Operate a Nuclear Fission Reactor **Engineering Workbench:** Design an Airdrop System, Egg Supply Drop, Landslide Prevention, Defy Gravity, Design an Electronic Quiz Board, Energy Sources: Costs and Benefits, Build a Flashlight Without Batteries, Design a Roller Coaster, Build an Efficient Travel Mug, The Colors of Light **Performance-Based Assessment:** Build Your Own Egg-Transport Vehicle, Minimizing Car Crash Injuries, Build and Test an Electroscope, Build a DC Motor, Design, Build and Refine a Wind-Turbine Rotor

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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.	**Inquiry Labs**: Momentum and Impulse, Electric Motors and Generators, Natural Resource Management **Digital Activities:** Vehicle Stopping Distance, Generator Testing, Transistors and Integrated Circuits, Junkyard Electromagnet, Operate a Nuclear Fission Reactor **Engineering Workbench:** Landslide Prevention, Energy Sources: Costs and Benefits, Waves and Erosion, Solar Panel Art, Rover, Earthquake-Resistant Structures **Performance-Based Assessment:** Design, Build and Refine a Wind-Turbine Rotor
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:** 49, 109, 269, 409, 434, 455, 459, 492, 541, 564 **Digital Activities:** Enantiomers, Electric Circuits, Resource Use and Biodiversity Trade Offs **Engineering Workbench:** Design an Airdrop System, Landslide Prevention, Defy Gravity, Design an Electronic Quiz Board, Build a Flashlight Without Batteries, Earthquake-Resistant Structures, Design a Roller Coaster, Egg Supply Drop, Build an Efficient Travel Mug, Energy Sources: Costs and Benefits, Waves and Erosion, Solar Panel Art, Rover, Energy Production, Build a Glove Box, The Colors of Light **Performance-Based Assessment:** Design, Build and Refine a Wind-Turbine Rotor **Problem-Based Learning:** Electromagnetic Roller Coaster, A Mystery on Planet K

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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:** 109, 452–453, 455–456, 457, 601–602 **Inquiry Labs:** Momentum and Impulse, Natural Resource Management **Digital Activities:** Vehicle Stopping Distance, Electric Circuits, Generator Testing, Transistors and Integrated Circuits, Junkyard Electromagnet, Operate a Nuclear Fission Reactor **Engineering Workbench:** Waves and Erosion, Energy Sources: Costs and Benefits, Solar Panel Art, Rover, Landslide Prevention, Earthquake-Resistant Structures **Performance-Based Assessment:** Design, Build and Refine a Wind-Turbine Rotor, Send Messages with a Telegraph **Problem-Based Learning:** Electromagnetic Roller Coaster
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:** 453, 545 **Digital Activities:** Vehicle Stopping Distance, Enantiomers, Electric Circuits, Resource Use and Biodiversity Trade Offs, Transistors and Integrated Circuits, Junkyard Electromagnet **Engineering Workbench:** Design an Airdrop System, Landslide Prevention, Defy Gravity, Design an Electronic Quiz Board, Build a Flashlight Without Batteries, Earthquake-Resistant Structures, Design a Roller Coaster, Egg Supply Drop, Build an Efficient Travel Mug, Energy Sources: Costs and Benefits, Waves and Erosion, Solar Panel Art, Rover, Energy Production, Build a Glove Box, The Colors of Light **Performance-Based Assessment:** Design, Build and Refine a Wind-Turbine Rotor

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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.	**Inquiry Lab:** Natural Resource Management **Digital Activities:** Generator Testing, Junkyard Electromagnet **Engineering Workbench:** Rover, Energy Sources: Costs and Benefits
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.	**SE:** 38, 446, 448, 457, 504 **Digital Activities:** Vehicle Stopping Distance, Resource Use and Biodiversity Trade Offs **Engineering Workbench:** Rover, Defy Gravity, Design an Electronic Quiz Board, Design a Roller Coaster, Energy Production **Performance-Based Assessment:** Build and Test an Electroscope, Structure-Property Relationships, Energy Conversion
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.	**SE:** 121, 402, 403 **Inquiry Lab:** Natural Resource Management **Digital Activities:** Generator Testing, Junkyard Electromagnet **Engineering Workbench:** Rover, Energy Sources: Costs and Benefits
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:** 319, 511, 524, 539 **Digital Activity:** Electric Circuits **Engineering Workbench:** Rover, Design an Electronic Quiz Board, Energy Sources: Costs and Benefits, Design a Roller Coaster **Performance-Based Assessment:** Build and Test an Electroscope, Structure-Property Relationships