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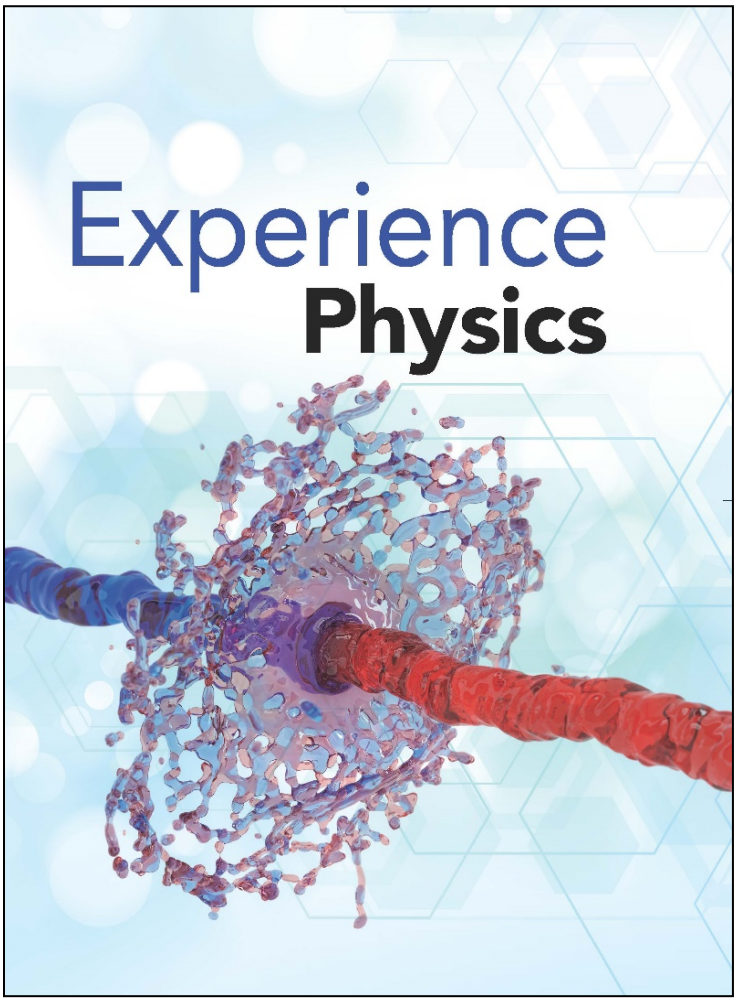

To the

Texas
Essential Knowledge and Skills for Science 2020
High School Physics

Prepared by Savvas Learning Company, formerly Pearson K12 Learning

A Correlation of Experience Physics ©2022 to the
Texas Essential Knowledge and Skills for Science 2020
High School Physics

Introduction

This document demonstrates how ***Experience Physics*©2022** supports the Texas Essential Knowledge and Skills for Science 2020: High School 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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(1) Scientific and engineering practices. The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models.	
(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;	**Experience Notebook:** SEP Define Problems, 5 SEP Define a Problem, 49 SEP Ask Questions, 51 SEP Define Problems, 123 SEP Ask Questions, 155 SEP Ask Questions, 159 SEP Ask Questions, 165 SEP Ask Questions, 243 SEP Ask Questions, 250 SEP Define a Problem, 281 SEP Ask Questions, 281 SEP Ask Questions, 282 SEP Ask Questions, 547 SEP Ask Questions, 569 SEP Ask Questions, 621 SEP Ask Questions, 651 **Teacher Guide:** **Digital Activities:** Force, Mass, and Acceleration in Action; Soap Bubbles; Laser Interference; Light Intensity and Energy **Engineering Workbenches:** Defy Gravity; Earthquake-Resistant Structures; Design a Roller Coaster; Egg Supply Drop; Build an Efficient Travel Mug; Solar Panel Art

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(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	**Experience Notebook:** SEP Plan an Investigation, 5 SEP Plan an Investigation, 54 SEP Plan an Investigation, 67 SEP Design a Solution, 94 SEP Plan an Investigation, 163 SEP Plan an Investigation, 188 SEP Plan an Investigation, 198 SEP Plan an Investigation, 214 SEP Design a Solution, 219 SEP Design a Solution, 269 SEP Design Solutions, 541 SEP Design Solutions, 564 **Teacher Guide:** **Inquiry Labs:** The Buoyant Force; Electromagnets and Magnetism; Induction of Electrical Current; Elastic and Inelastic Collisions; Kinetic Energy; Electric Motors and Generators; Converting Electrical Signals to Sounds **Engineering Workbenches:** Design an Airdrop System; Landslide Prevention; Earthquake-Resistant Structures; Egg Supply Drop; Build an Efficient Travel Mug; Waves and Erosion
(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;	**Teacher Guide:** **Inquiry Labs:** Mechanical Weathering of Rock; Electric Fields; Electrical Resistance and Resistivity; Electromagnets and Magnetism; Induction of Electrical Current; Cohesive Forces and Surface Tension; Gas Particles and Work; Heat Transfer; Convection, Conduction, and Radiation; Electric Motors and Generators; Converting Electrical Signals to Sounds **Performance-Based Assessments:** Heating Curve of Water; Clothing and Sun Protection **Engineering Workbenches:** Build an Efficient Travel Mug

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(D) use appropriate tools such as microscopes, slides, Petri dishes, laboratory glassware, metric rulers, digital balances, pipets, filter paper, micropipettes, gel electrophoresis and polymerase chain reaction (PCR) apparatuses, microcentrifuges, water baths, incubators, thermometers, hot plates, data collection probes, test tube holders, lab notebooks or journals, hand lenses, and models, diagrams, or samples of biological specimens or structures;	**Teacher Guide:** **Inquiry Labs:** Free Fall Acceleration; Forces and Motion; The Buoyant Force; Electric Charges and Coulomb's Law; Magnetic Force and Separation Distance; Cohesive Forces and Surface Tension; Physical Properties of Solid Materials; Structures and Properties of Polymers; Kinetic Energy; Heat Transfer; Convection, Conduction, and Radiation **Engineering Workbenches:** Defy Gravity; Build an Efficient Travel Mug
(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;	**Experience Notebook:** SEP Plan an Investigation, 163 **Teacher Guide:** **Inquiry Labs:** Motion Plots; Forces and Motion; Free Fall Acceleration; Model Projectile Motion; Kepler's Laws of Planetary Motion; Magnetic Force and Separation Distance; Structures and Properties of Polymers; Kinetic Energy; Heat Transfer **Performance-Based Assessments:** Heating Curve of Water; Discovering the Speed of Sound in Open Air
(F) organize quantitative and qualitative data using scatter plots, line graphs, bar graphs, charts, data tables, digital tools, diagrams, scientific drawings, and student-prepared models;	**Experience Notebook:** SEP Analyze and Interpret Data, 13 SEP Analyze and Interpret Data, 20 SEP Use Mathematics, 20 SEP Analyze and Interpret Data, 34 SEP Develop and Use a Model, 64 SEP Analyze and Interpret Data, 66 SEP Analyze and Interpret Data, 478 SEP Develop a Model, 478 SEP Analyze and Interpret Data, 489 **Teacher Guide:** **Inquiry Labs:** Motion Plots; Free Fall Acceleration; Model Projectile Motion; Forces and Motion; Friction; Mechanical Waves; Gas Particles and Work **Digital Activities:** Acceleration on a Ramp **Performance-Based Assessments:** Force, Mass, and Acceleration; Heating Curve of Water

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(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and	**Experience Notebook:** SEP Develop a Model, 35 SEP Develop a Model, 48 SEP Develop and Use a Model, 57 SEP Develop a Model, 78 SEP Develop and Use Models, 136 SEP Develop and Use a Model, 178 SEP Develop and Use a Model, 216 SEP Develop a Model, 284 SEP Develop Models, 425 SEP Develop a Model, 492 SEP Develop a Model, 528 **Teacher Guide:** **Inquiry Labs:** Model Projectile Motion; Friction; Mechanical Weathering of Rock; Model the Orbital Motion of Planets; Indirect Observation of the Atom; Mechanical Waves **Digital Activities:** Acceleration on a Ramp; Pinball Launcher Model; Atmospheric Pressure on a Sealed Container; Modeling Electric Fields; Combining Magnetic Fields; Energy in a Moving Cart; Gasoline Expansion; Nuclear Forces **Engineering Workbenches:** Defy Gravity; Earthquake-Resistant Structures; Design a Roller Coaster
(H) distinguish among scientific hypotheses, theories, and laws.	**Experience Notebook:** Magnitude of Gravitational Force, 118 Inverse-Square Laws, 123 Coulomb's Law, 158 Comparing Electric and Gravitational Forces, 162 The Atom, 242 Particles of Light, 523 The Dual Nature of Light, 524-525 CCC Energy and Matter, 577 Formation of the Solar System, 631 The Formation of the Solar System, 632 SEP Evaluate Scientific Information, 683 **Teacher Guide:** **Inquiry Labs:** Electric Charges and Coulomb's Law **Digital Activities:** Newton's Law of Universal Gravitation; Atomic Theory

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(2) Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs.	
(A) identify advantages and limitations of models such as their size, scale, properties, and materials;	**Teacher Guide:** **Digital Activities:** Acceleration on a Ramp; Pinball Launcher Model; Atmospheric Pressure on a Sealed Container; Eccentric Orbits; Modeling Electric Fields; Combining Magnetic Fields; Energy in a Moving Cart; Momentum and Impulse; Interference; Light Interactions with Molecules
(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	**Experience Notebook:** SEP Analyze and Interpret Data, 20 CCC Patterns, 25 SEP Analyze and Interpret Data, 34 CCC Patterns, 147 CCC Patterns, 351 Calibrating C-14, 624 **Teacher Guide:** **Inquiry Labs:** Free Fall Acceleration **Digital Activities:** Topography; Kepler's Law of Planetary Periods; Dielectric Materials; Geometric Polarity Reversal; Refraction - Snell's Law; Particle-Wave Duality; Valley of Stability
(C) use mathematical calculations to assess quantitative relationships in data; and	**Experience Notebook:** SEP Use Mathematics, 20 SEP Use Mathematics, 27 SEP Use Mathematics, 78 SEP Use Mathematics, 128 SEP Use Mathematics, 135 SEP Use Mathematics, 146 SEP Use Mathematics, 159 SEP Use Mathematics, 287 SEP Use Mathematics, 317 SEP Use Math, 475 **Teacher Guide:** **Inquiry Labs:** Forces and Motion; The Buoyant Force; Investigate Gravity Using Pendulums; Pendulums and the Conservation of Energy; Kinetic Energy; Mechanical Waves **Performance-Based Assessments:** Discovering the Speed of Sound in Open Air

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(D) evaluate experimental and engineering designs.	**Teacher Guide:** **Engineering Workbenches:** Design an Airdrop System; Landslide Prevention; Defy Gravity; Build a Flashlight Without Batteries; Earthquake-Resistant Structures; Design a Roller Coaster; Egg Supply Drop; Build an Efficient Travel Mug; Waves and Erosion
(3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions.	
(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	**Experience Notebook:** SEP Construct an Explanation, 85 SEP Construct an Explanation, 153 SEP Develop and Use a Model, 178 SEP Construct an Explanation, 187 SEP Construct an Explanation, 211 SEP Construct an Explanation, 308 SEP Construct an Explanation, 387 SEP Construct an Explanation, 393 SEP Design a Solution, 434 SEP Design a Solution, 492 SEP Design Solutions, 541 SEP Design Solutions, 564 **Teacher Guide:** **Inquiry Labs:** Model Projectile Motion; Electric Fields; Momentum and Impulse During Collisions; Elastic and Inelastic Collisions; Energy Transmission in Circuits; Mechanical Waves; Electromagnetic Radiation and Matter
(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	**Experience Notebook:** SEP Obtain, Evaluate, and Communicate Information, 238 SEP Communicate Scientific Information, 606 **Teacher Guide:** **Engineering Workbenches:** 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; Waves and Erosion

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(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.	**Experience Notebook:** SEP Argue from Evidence, 15 SEP Argue from Evidence, 61 SEP Argue from Evidence, 127 SEP Argue from Evidence, 205 SEP Argue from Evidence, 216 SEP Argue from Evidence, 303 SEP Argue from Evidence, 343 SEP Argue from Evidence, 383 SEP Argue from Evidence, 489 SEP Argue from Evidence, 515 SEP Argue from Evidence, 523 **Teacher Guide:** **Digital Activities:** Position vs. Time Graphs; Force, Mass, and Acceleration in Action; Forces and Movement; Breaking Magnets; Combining Materials; Pendulum Decay; Kinetic Energy and Collisions; Properties of Electric Motors; Laser Interference; Antennas; Generating Fission; Radiometric Dating
(4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society.	
(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;	**Experience Notebook:** SEP Evaluate Claims, 250 SEP Evaluate Information, 318 SEP Evaluate Claims, 521 SEP Evaluate Claims, 535 SEP Evaluate Claims, 536 **Teacher Guide:** **Digital Activities:** Repelling Water; Breaking Magnets; Combining Materials; Kinetic Energy and Collisions; Antennas; Penetrating Particles; Radiometric Dating; Craters; Origins of the Universe **Engineering Workbenches:** Landslide Prevention; Earthquake-Resistant Structures; Waves and Erosion

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(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and	**Experience Notebook:** Launching a Satellite, 129 The Atom, 242 Electrons, 244 The Nucleus, 246 Costs and Benefits, 452-453 Costs and Benefits: Nuclear Power, 456 Transition to the Future, 459 Diffraction, 494-495 Snell's Law, 499 Radioactivity, 610 **Teacher Guide:** **Digital Activities:** Atomic Theory
(C) research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) field in order to investigate STEM careers.	**Teacher Guide:** **Career Connections:** Mechanical Engineer; Astronaut; Wind Turbine Engineer; Highway Engineer; Materials Scientist; Aerospace Engineer; Geologist; Civil Engineer; Robotics Engineer; Nuclear Engineer; Paleontologist
(5) Science concepts. The student knows and applies the laws governing motion in a variety of situations.	
(A) analyze different types of motion by generating and interpreting position versus time, velocity versus time, and acceleration versus time using hand graphing and real-time technology such as motion detectors, photogates, or digital applications;	**Experience Notebook:** Position Graphs, 12 SEP Develop a Model, 12 Speed and Velocity, 13 SEP Analyze and Interpret Data, 13 Sample Problem: An Ant on a Meter Stick, 14 Speed and Velocity Graphs, 15 Modeling Uniform Motion, 16-17 SEP Develop a Model, 17 SEP Construct an Explanation, 17 SEP Analyze and Interpret Data, 20 SEP Use Mathematics, 20 Acceleration, 23 Constant Acceleration, 26-27 SEP Develop a Model, 26 CCC Patterns, 26 SEP Analyze and Interpret Data, 34 **Teacher Guide:** **Inquiry Labs:** Motion Plots **Digital Activities:** Acceleration on a Ramp **Performance-Based Assessments:** Speed, Acceleration, and Trajectory

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(B) define scalar and vector quantities related to one- and two-dimensional motion and combine vectors using both graphical vector addition and the Pythagorean theorem;	**Experience Notebook:** Representing Displacement, 7 SEP Develop a Model, 7 Vector Mathematics, 8-9 SEP Use Mathematics, 9 Sample Problem: Row, Row, Row Your Boat, 10 **Teacher Guide:** **Digital Activities:** Displacement and Velocity
(C) describe and analyze motion in one dimension using equations with the concepts of distance, displacement, speed, velocity, frames of reference, and acceleration;	**Experience Notebook:** Displacement, 6-7 SEP Use Mathematics, 6 Speed and Velocity, 13 Sample Problem: An Ant on a Meter Stick, 14 SEP Use Mathematics, 20 Acceleration, 23 Sample Problem: Rolling Down the Hill, 24 Constant Acceleration, 26-27 SEP Use Mathematics, 27 Sample Problem: A Scared Bunny, 29 Sample Problem: Hitting the Brakes, 30 SEP Develop a Model, 34 **Teacher Guide:** **Digital Activities:** Fast Cars **Performance-Based Assessments:** Speed, Acceleration, and Trajectory
(D) describe and analyze acceleration in uniform circular and horizontal projectile motion in two dimensions using equations;	**Experience Notebook:** Projectile Motion, 38-39 Modeling Projectile Motion, 40 CCC Patterns, 40 Solving Projectile Motion Problems, 41 Sample Problem: Hang Time, 42 Circular Motion, 44-45 Sample Problem: Artificial Gravity, 46 Graphing Circular Motion, 47 **Teacher Guide:** **Inquiry Labs:** Model Projectile Motion **Digital Activities:** Satellites in Circular Orbits **Performance-Based Assessments:** Coin Drop

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(E) explain and apply the concepts of equilibrium and inertia as represented by Newton's first law of motion using relevant real-world examples such as rockets, satellites, and automobile safety devices;	**Experience Notebook:** Changing Motion, 52 CCC Cause and Effect, 52 Inertia, 53 SEP Argue from Evidence, 53 CCC Patterns, 53 **Teacher Guide:** **Performance-Based Assessments:** Gravitational Forces on Satellites; Minimizing Car Crash Injuries **Engineering Workbenches:** Defy Gravity
(F) calculate the effect of forces on objects, including tension, friction, normal, gravity, centripetal, and applied forces, using free body diagrams and the relationship between force and acceleration as represented by Newton's second law of motion;	**Experience Notebook:** Force Causes an Acceleration, 54 Sample Problem: Mowing the Lawn, 55 Representing Forces, 58-59 Modeling Force, 60-61 Sample Problem: Will the Wire Break?, 62 SEP Analyze and Interpret Data, 64 Weight, 66 SEP Analyze and Interpret Data, 66 Tension, 69 Surface Forces, 70-71 Solving Two-Dimensional Force Problems, 73 Sample Problem: Pulling a Sled, 74 Centripetal Force, 76 Sample Problem: Sticking to the Wall, 77 SEP Develop and Use a Model, 78 **Teacher Guide:** **Inquiry Labs:** Forces and Motion; The Buoyant Force; Friction **Digital Activities:** Force, Mass, and Acceleration; Types of Forces; Forces on Systems **Performance-Based Assessments:** Force, Mass, and Acceleration

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(G) illustrate and analyze the simultaneous forces between two objects as represented in Newton's third law of motion using free body diagrams and in an experimental design scenario; and	**Experience Notebook:** I Push You, and You Push Back, 57 SEP Communicate Information, 57 SEP Develop and Use a Model, 57 Representing Forces, 58-59 SEP Develop a Model, 59 SEP Construct an Explanation, 66 Forces in Systems, 80-81 Solving System Problems, 86 SEP Develop a Model, 119 **Teacher Guide:** **Performance-Based Assessments:** Force, Mass, and Acceleration
(H) describe and calculate, using scientific notation, how the magnitude of force between two objects depends on their masses and the distance between their centers, and predict the effects on objects in linear and orbiting systems using Newton's law of universal gravitation.	**Experience Notebook:** Gravitational Force, 118-119 SEP Use a Model, 119 SEP Develop a Model, 119 Sample Problem: Earth and the Moon, 120 SEP Use Mathematics, 128 SEP Construct an Explanation, 128 **Teacher Guide:** **Inquiry Labs:** Investigate Gravity Using Pendulums **Digital Activities:** Universal Gravitation
(6) Science concepts. The student knows the nature of forces in the physical world.	
(A) use scientific notation and predict how the magnitude of the electric force between two objects depends on their charges and the distance between their centers using Coulomb's law;	**Experience Notebook:** Electric Charge, 156 Electric Force, 158-159 SEP Use Mathematics, 159 Electric Force and Vectors, 160 SEP Argue from Evidence, 160 Sample Problem: Electric Force Between Particles, 161 SEP Use Mathematics, 162 **Teacher Guide:** **Inquiry Labs:** Electric Charges and Coulomb's Law **Digital Activities:** Coulomb's Law **Performance-Based Assessments:** Build and Test an Electroscope

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(B) identify and describe examples of electric and magnetic forces and fields in everyday life such as generators, motors, and transformers;	**Experience Notebook:** Modeling a Simple Motor, 219 SEP Design a Solution, 219 Electric Generators, 435 Alternating Current Generators, 436 SEP Construct an Explanation, 436 Direct Current Generators, 437 SEP Develop a Model, 437 Motors, 439 SEP Use Models, 439 Induction Devices, 442 Metal Detectors and Their Application, 443 SEP Develop and Use a Model, 444 **Teacher Guide:** **Inquiry Labs:** Build a Battery; Electric Motors and Generators **Digital Activities:** Properties of Electric Motors; How Power Gets to Your House **Performance-Based Assessments:** Build a DC Motor; Generator Testing; Junkyard Electromagnet **Engineering Workbenches:** Build a Flashlight Without Batteries
(C) investigate and describe conservation of charge during the processes of induction, conduction, and polarization using different materials such as electroscopes, balloons, rods, fur, silk, and Van de Graaf generators;	**Experience Notebook:** Electric Charge, 156 Charge by Contact, 163 Charge by Induction, 164 Induction Devices, 442 **Teacher Guide:** **Inquiry Labs:** Electric Charges and Coulomb's Law **Performance-Based Assessments:** Build and Test an Electroscope **Engage Everyday Phenomenon:** How can charge affect objects at a distance?

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(D) analyze, design, and construct series and parallel circuits using schematics and materials such as switches, wires, resistors, lightbulbs, batteries, voltmeters, and ammeters; and	**Experience Notebook:** Series and Parallel Resistance, 190-191 Circuit Elements and Diagrams, 424-425 SEP Develop Models, 424 SEP Develop Models, 425 SEP Communicate Technical Information, 425 **Teacher Guide:** **Inquiry Labs:** Energy Transmission in Circuits **Digital Activities:** Electric Current; Electric Circuits; Energy in Electric Circuits; Series and Parallel Circuits
(E) calculate current through, potential difference across, resistance of, and power used by electric circuit elements connected in both series and parallel circuits using Ohm's law.	**Experience Notebook:** Current and Resistivity, 189 Ohm's Law, 422 SEP Use Mathematics, 422 Joule's Law, 427 SEP Use Mathematics, 427 Kirchhoff's Loop Rule, 428 Analyzing a Circuit, 431 **Teacher Guide:** **Inquiry Labs:** Energy Transmission in Circuits
(7) Science concepts. The student knows that changes occur within a physical system and applies the laws of conservation of energy and momentum.	
(A) calculate and explain work and power in one dimension and identify when work is and is not being done by or on a system;	**Experience Notebook:** Positive, Negative and Zero Work, 282-283 SEP Analyze Data, 283 Calculating Work, 284 SEP Use Models, 284 Work Done by a Gas, 285-286 SEP Use Mathematics, 286 Kinetic Energy and the Work-Energy Theorem, 288 Power, 292 SEP Use Mathematics, 293 CCC Cause and Effect, 293 Power - The Rate of Energy Transfer, 316-317 SEP Analyze Data, 317 **Teacher Guide:** **Inquiry Labs:** Gas Particles and Work **Performance-Based Assessments:** Energy Conversion

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(B) investigate and calculate mechanical, kinetic, and potential energy of a system;	**Experience Notebook:** Defining Energy of Motion, 287 SEP Use Mathematics, 287 SEP Use Mathematics, 293 Potential Energy, 294 CCC Energy and Matter, 294 Gravitational Potential Energy, 295 SEP Analyze Data, 295 Elastic Potential Energy, 296-297 Electromagnetic Potential Energy, 300-301 Mechanical Energy and Work, 302-303 **Teacher Guide:** **Inquiry Labs:** Gas Particles and Work; The Impact of Position on Energy **Digital Activities:** Energy in a Moving Cart; Mechanical Energy **Performance-Based Assessments:** Rocket Launch
(C) apply the concept of conservation of energy using the work-energy theorem, energy diagrams, and energy transformation equations, including transformations between kinetic, potential, and thermal energy;	**Experience Notebook:** Kinetic Energy and the Work-Energy Theorem, 288 Energy Bar Charts, 289 Mechanical Energy Bar Charts, 303 CCC Energy and Matter, 308 Energy - A Conserved Quantity, 309 Modeling Systems, 311 Expanded Work-Energy Theorem, 312 Energy Transformed Within a System, 313 Sample Problem: Roller Coaster Energy, 314-315 SEP Evaluate Information, 318 SEP Use Mathematics, 318 CCC Energy and Matter, 318 **Teacher Guide:** **Inquiry Labs:** Pendulums and the Conservation of Energy **Digital Activities:** Conservation of Energy; Pendulum Decay **Performance-Based Assessments:** Energy Conversion; Rocket Launch **Engineering Workbenches:** Design a Roller Coaster

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(D) calculate and describe the impulse and momentum of objects in physical systems such as automobile safety features, athletics, and rockets; and	**Experience Notebook:** Introduction to Linear Momentum, 322 Momentum - a Vector Quantity, 323 SEP Use Mathematics, 323 Net Momentum, 324 SEP Use Mathematics, 324 Impulse, 327 SEP Use Mathematics, 327 SEP Use Mathematics (11), 329 **Teacher Guide:** **Inquiry Labs:** Momentum and Impulse During Collisions **Digital Activities:** Momentum and Baseball; Demonstrating How Helmets Affect Impulse and Impact Force **Performance-Based Assessments:** Minimizing Car Crash Injuries
(E) analyze the conservation of momentum qualitatively in inelastic and elastic collisions in one dimension using models, diagrams, and simulations.	**Experience Notebook:** Conserving Momentum, 331 Impulse-Momentum Theorem, 336-337 Impulse and Momentum in Collisions, 338 Comparing Momenta in Systems, 339 Types of Collisions, 342-343 SEP Argue from Evidence, 343 SEP Use Mathematics, 343 SEP Argue from Evidence, 347 SEP Use Mathematics, 347 **Teacher Guide:** **Inquiry Labs:** Elastic and Inelastic Collisions **Digital Activities:** Conservation of Momentum; Kinetic Energy and Collisions

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(8) Science concepts. The student knows the characteristics and behavior of waves.	
(A) examine and describe simple harmonic motion such as masses on springs and pendulums and wave energy propagation in various types of media such as surface waves on a body of water and pulses in ropes;	**Experience Notebook:** Mechanical Waves, 466 Standing Waves, 485 Waves on a String, 486 Sample Problem: Standing Waves on a Rope, 487 Energy in Waves, 490-491 SEP Develop a Model, 492 **Teacher Guide:** **Inquiry Labs:** Mechanical Waves **Digital Activities:** Simple Harmonic Motion; Waves and Shallow Water; Properties of Waves **Performance-Based Assessments:** Making Waves
(B) compare the characteristics of transverse and longitudinal waves, including electromagnetic and sound waves;	**Experience Notebook:** Mechanical Waves, 466 Transverse Waves, 468-469 Longitudinal Waves, 472-473 Electromagnetic Waves, 512-513 Properties of EM Waves, 514-515 **Teacher Guide:** **Inquiry Labs:** Mechanical Waves
(C) investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationships between wave speed, frequency, and wavelength;	**Experience Notebook:** Properties of Waves, 467 SEP Analyze and Interpret Data, 469 Sample Problem: Wave on a Rope, 470 CCC Cause and Effect, 473 Sample Problem: Properties of Sound Waves, 474 Modeling Waves, 475 SEP Use Mathematics, 475 Sample Problem: Modeling a Sound Wave, 476 SEP Analyze and Interpret Data, 478 **Teacher Guide:** **Inquiry Labs:** Mechanical Waves **Digital Activities:** Waves and Shallow Water; Properties of Waves; Wave Speed **Performance-Based Assessments:** Discovering the Speed of Sound in Open Air; Making Waves

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(D) investigate behaviors of waves, including reflection, refraction, diffraction, interference, standing wave, the Doppler effect and polarization and superposition; and	**Experience Notebook:** Wave Interactions, 479 Moving Wave Source, 480 Modeling Wave Interactions, 482-483 Standing Waves, 485 SEP Develop a Model, 492 Diffraction, 494-495 Reflection, 496-497 Refraction, 498-499 SEP Develop a Model, 508 Wave Behavior of EM Radiation, 516 Polarization, 517 **Teacher Guide:** **Inquiry Labs:** Interference of Sound Waves; Reflection and Refraction; Diffraction **Digital Activities:** Interference; Refraction - Snell's Law; Wave Optics; Refraction; Laser Interference
(E) compare the different applications of the electromagnetic spectrum, including radio telescopes, microwaves, and x-rays;	**Experience Notebook:** Waves of the Electromagnetic Spectrum, 515 Medical Imaging, 552-553 Antennas, 554 Wireless Wonders, 555 Capturing an EM Wave's Energy, 557-559 Cooking, 562 Radiotherapy, 563 **Teacher Guide:** **Inquiry Labs:** Converting Sunlight to Electricity **Digital Activities:** Antennas; Solar Panels on a Cloudy Day
(F) investigate the emission spectra produced by various atoms and explain the relationship to the electromagnetic spectrum; and	**Experience Notebook:** Photon-Electron Interactions, 529 CCC Energy and Matter, 529 Photon Energy Absorption by Matter, 530-531 SEP Construct an Explanation, 531 CCC Energy and Matter, 669 **Teacher Guide:** **Inquiry Labs:** Elemental Composition of Stars **Digital Activities:** Light Interactions with Molecules

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(G) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens.	**Experience Notebook:** Forming a Mirror Image, 497 Lenses, 501 Formation of Images, 502-503 SEP Use a Model, 503 The Lens Equation, 504 SEP Use Computational Thinking, 504 Sample Problem: Image of a Rubber Duck, 505 Sample Problem: Reading with a Magnifying Glass, 506
(9) Science concepts. The student knows examples of quantum phenomena and their applications.	
(A) describe the photoelectric effect and emission spectra produced by various atoms and how both are explained by the photon model for light;	**Experience Notebook:** Photoelectric Effect, 522 Particles of Light, 523 Photon-Electron Interactions, 529 CCC Energy and Matter, 529 Photon Energy Absorption by Matter, 530-531 **Teacher Guide:** **Inquiry Labs:** Particle Nature of Light **Digital Activities:** Light Interactions with Molecules
(B) investigate Malus's Law and describe examples of applications of wave polarization, including 3-D movie glasses and LCD computer screens;	For supporting content, please see: **Experience Notebook:** Polarization, 517 SEP Plan an Investigation, 517 SEP Construct an Explanation, 519
(C) compare and explain how superposition of quantum states is related to the wave-particle duality nature of light; and	**Experience Notebook:** Anchoring Phenomenon, 463 Shortcomings of the Wave Theory, 520-521 Particles of Light, 523 The Dual Nature of Light, 524-525 SEP Argue from Evidence, 537
(D) give examples of applications of quantum phenomena, including the Heisenberg uncertainty principle, quantum computing, and cybersecurity.	For supporting content, please see: **Experience Notebook:** Anchoring Phenomenon, 463 Revisit Anchoring Phenomenon, 509 Revisit Anchoring Phenomenon, 537 Revisit Anchoring Phenomenon, 565