Main Criteria: Next Generation Science Standards (NGSS Comprehensive)
Secondary Criteria: Open Stax_TEA Physics
Subject: Science
Grade: 9,10,11,12
Correlation Options: Show All

Next Generation Science Standards (NGSS Comprehensive)
Science

Grade: **9,10,11,12** - Adopted: **2013**

STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-1.	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-2.	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-3.	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. Open Stax_TEA Physics • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-4.	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. Open Stax_TEA Physics • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.3 Phase Change and Latent Heat
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-5.	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-6.	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1-7.	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. No Correlations
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

FOUNDATION		of fission, fusion, and radioactive decay. Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.2 Nuclear Forces and Radioactivity • Physics: Chapter 22 The Atom: Section 22.3 Half Life and Radiometric Dating • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion • Physics: Chapter 22 The Atom: Section 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation • Physics: Chapter 23 Particle Physics: Section 23.1 The Four Fundamental Forces
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.SEP.	Science and Engineering Practices
ELEMENT	HS-PS1.SEP.1.	Developing and Using Models - Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
INDICATOR	HS-PS1.SEP.1.1.	Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4), (HS-PS1-8) No Correlations
INDICATOR	HS-PS1.SEP.1.2.	Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.SEP.	Science and Engineering Practices
ELEMENT	HS-PS1.SEP.2.	Planning and Carrying Out Investigations - Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
INDICATOR	HS-PS1.SEP.2.1.	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. (HS-PS1-3) Open Stax_TEA Physics • Physics: Chapter 01 What is Physics?: Section 1.2 The Scientific Methods
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.SEP.	Science and Engineering Practices
ELEMENT	HS-PS1.SEP.3.	Using Mathematics and Computational Thinking - Mathematical and computational thinking at the 9–12 level builds on K–8 and

		progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-PS1.SEP.3.1.	Use mathematical representations of phenomena to support claims. (HS-PS1-7) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.SEP.	Science and Engineering Practices
ELEMENT	HS-PS1.SEP.4.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-PS1.SEP.4.1.	Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) No Correlations
INDICATOR	HS-PS1.SEP.4.2.	Construct and revise 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. (HS-PS1-2) No Correlations
INDICATOR	HS-PS1.SEP.4.3.	Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.DCI.	Disciplinary Core Ideas
ELEMENT	PS1.A:	Structure and Properties of Matter
INDICATOR	PS1.A:1.	Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) Open Stax TEA Physics • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.1 Temperature and Thermal Energy • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 22 The Atom: Section 22.1 The Structure of the Atom • Physics: Chapter 22 The Atom: Section 22.2 Nuclear Forces and Radioactivity • Physics: Chapter 22 The Atom: Section 22.3 Half Life and

		Radiometric Dating • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion • Physics: Chapter 22 The Atom: Section 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation • Physics: Chapter 23 Particle Physics: Section 23.2 Quarks
INDICATOR	PS1.A:2.	The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1), (HS-PS1-2) No Correlations
INDICATOR	PS1.A:3.	The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3), (secondary to HS-PS2-6) Open Stax_TEA Physics • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field
INDICATOR	PS1.A:4.	Stable forms of matter are those in which the electric and magnetic field energy is minimized. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.DCI.	Disciplinary Core Ideas
ELEMENT	PS1.B:	Chemical Reactions
INDICATOR	PS1.B:1.	Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5) No Correlations
INDICATOR	PS1.B:2.	In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6) No Correlations
INDICATOR	PS1.B:3.	The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.DCI.	Disciplinary Core Ideas
ELEMENT	PS1.C:	Nuclear Processes
INDICATOR	PS1.C:1.	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. (HS-PS1-8) Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.C:	Optimizing the Design Solution
INDICATOR	ETS1.C:1.	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. (secondary to HS-PS1-6) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.CC.	Crosscutting Concepts
ELEMENT	HS-PS1.CC.1.	Patterns
INDICATOR	HS-PS1.CC.1.1.	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. (HS-PS1-1), (HS-PS1-2), (HS-PS-3), (HS-PS1-5) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.CC.	Crosscutting Concepts
ELEMENT	HS-PS1.CC.2.	Energy and Matter
INDICATOR	HS-PS1.CC.2.1.	In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8) Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.2 Nuclear Forces and Radioactivity • Physics: Chapter 22 The Atom: Section 22.3 Half Life and Radiometric Dating • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion • Physics: Chapter 22 The Atom: Section 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation • Physics: Chapter 23 Particle Physics: Section 23.1 The Four Fundamental Forces
INDICATOR	HS-PS1.CC.2.2.	The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) No Correlations
INDICATOR	HS-PS1.CC.2.3.	Changes of energy and matter in a system can be described in terms

		of energy and matter flows into, out of, and within that system. (HS-PS1-4) Open Stax_TEA Physics • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.3 Phase Change and Latent Heat • Physics: Chapter 12 Thermodynamics: Section 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.CC.	Crosscutting Concepts
ELEMENT	HS-PS1.CC.3.	Stability and Change
INDICATOR	HS-PS1.CC.3.1.	Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS1.	Matter and Its Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS1.CNS.	Connections to Nature of Science
ELEMENT	HS-PS1.CNS.1.	Scientific Knowledge Assumes an Order and Consistency in Natural Systems
INDICATOR	HS-PS1.CNS.1.1.	Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 08 Momentum: Section 8.2 Conservation of

		Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity
PERFORMANCE EXPECTATION / FOUNDATION	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.* Open Stax_TEA Physics • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force • Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2-6.	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.SEP.	Science and Engineering Practices
ELEMENT	HS-PS2.SEP.1.	or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.
INDICATOR	HS-PS2.SEP.1.1.	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. (HS-PS2-5)

		<u>Open Stax_TEA Physics</u> • Physics: Chapter 01 What is Physics?: Section 1.2 The Scientific Methods • Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement • Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs • Physics: Chapter 03 Acceleration: Section 3.1 Acceleration • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.SEP.	Science and Engineering Practices
ELEMENT	HS-PS2.SEP.2.	Analyzing and Interpreting Data - Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
INDICATOR	HS-PS2.SEP.2.1.	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. (HS-PS2-1)

		Open Stax_TEA Physics • Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement • Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs • Physics: Chapter 02 Motion in One Dimension: Section 2.4 Velocity vs. Time Graphs • Physics: Chapter 03 Acceleration: Section 3.1 Acceleration • Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.SEP.	Science and Engineering Practices
ELEMENT	HS-PS2.SEP.3.	Using Mathematics and Computational Thinking - Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-PS2.SEP.3.1.	Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) Open Stax_TEA Physics • Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement • Physics: Chapter 02 Motion in One Dimension: Section 2.2 Speed and Velocity • Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs • Physics: Chapter 02 Motion in One Dimension: Section 2.4 Velocity vs. Time Graphs • Physics: Chapter 03 Acceleration: Section 3.1 Acceleration • Physics: Chapter 03 Acceleration: Section 3.2 Representing Acceleration with Equations and Graphs • Physics: Chapter 05 Motion in Two Dimensions: Section 5.1 Vector Addition and Subtraction: Graphical Methods • Physics: Chapter 05 Motion in Two Dimensions: Section 5.2 Vector Addition and Subtraction: Analytical Methods • Physics: Chapter 05 Motion in Two Dimensions: Section 5.3

		Projectile Motion • Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.3 Rotational Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force • Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers • Physics: Chapter 21 The Quantum Nature of Light: Section 21.1 Planck and Quantum Nature of Light • Physics: Chapter 21 The Quantum Nature of Light: Section 21.2 Einstein and the Photoelectric Effect • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.SEP.	Science and Engineering Practices
ELEMENT	HS-PS2.SEP.4.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-PS2.SEP.4.1.	Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3) No Correlations

STRAND	**NGSS.HS-PS.**	**PHYSICAL SCIENCE**
TITLE	**HS-PS2.**	**Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:**
PERFORMANCE EXPECTATION / FOUNDATION	**HS-PS2.SEP.**	**Science and Engineering Practices**
ELEMENT	**HS-PS2.SEP.5.**	**Obtaining, Evaluating, and Communicating Information - Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.**
INDICATOR	**HS-PS2.SEP.5.1.**	**Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)** **Open Stax_TEA Physics** **• Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement** **• Physics: Chapter 02 Motion in One Dimension: Section 2.2 Speed and Velocity** **• Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs** **• Physics: Chapter 02 Motion in One Dimension: Section 2.4 Velocity vs. Time Graphs** **• Physics: Chapter 03 Acceleration: Section 3.1 Acceleration** **• Physics: Chapter 03 Acceleration: Section 3.2 Representing Acceleration with Equations and Graphs** **• Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.1 Force** **• Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.2 Newton's First Law of Motion: Inertia** **• Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion** **• Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.4 Newton's Third Law of Motion** **• Physics: Chapter 05 Motion in Two Dimensions: Section 5.1 Vector Addition and Subtraction: Graphical Methods** **• Physics: Chapter 05 Motion in Two Dimensions: Section 5.2 Vector Addition and Subtraction: Analytical Methods** **• Physics: Chapter 05 Motion in Two Dimensions: Section 5.3 Projectile Motion** **• Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes** **• Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion** **• Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity** **• Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion** **• Physics: Chapter 06 Circular and Rotational Motion: Section 6.3 Rotational Motion** **• Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion** **• Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity** **• Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse** **• Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum** **• Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions** **• Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge**

		• Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force • Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers
STRAND	**NGSS.HS-PS.**	**PHYSICAL SCIENCE**
TITLE	**HS-PS2.**	**Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:**
PERFORMANCE EXPECTATION / FOUNDATION	**HS-PS2.CNS.**	**Connections to Nature of Science**
ELEMENT	**HS-PS2.CNS.1.**	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**
INDICATOR	**HS-PS2.CNS.1.1.**	**Theories and laws provide explanations in science. (HS-PS2-1), (HS-PS2-4)** Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem
INDICATOR	**HS-PS2.CNS.1.2.**	**Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1), (HS-PS2-4)** Open Stax_TEA Physics • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.1 Force • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.2 Newton's First Law of Motion: Inertia • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.4 Newton's Third Law of Motion • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law

		• Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power • Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.DCI.	Disciplinary Core Ideas
ELEMENT	PS2.A:	Forces and Motion
INDICATOR	PS2.A:1.	Newton’s second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) Open Stax_TEA Physics • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse
INDICATOR	PS2.A:2.	Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved. (HS-PS2-2) Open Stax_TEA Physics • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
INDICATOR	PS2.A:3.	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. (HS-PS2-2), (HS-PS2-3) Open Stax_TEA Physics • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE

TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.DCI.	Disciplinary Core Ideas
ELEMENT	PS2.B:	Types of Interactions
INDICATOR	PS2.B:1.	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. (HS-PS2-4) Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential
INDICATOR	PS2.B:2.	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. (HS-PS2-4), (HS-PS2-5) Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force • Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers
INDICATOR	PS2.B:3.	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6), (secondary to HS-PS1-1), (secondary to HS-PS1-3) Open Stax_TEA Physics • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.DCI.	Disciplinary Core Ideas

ELEMENT	PS3.A:	Definitions of Energy
INDICATOR	PS3.A:1.	…and "electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5) Open Stax_TEA Physics • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.A:	Defining and Delimiting Engineering Problems
INDICATOR	ETS1.A:1.	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.C:	Optimizing the Design Solution
INDICATOR	ETS1.C:1.	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. (secondary to HS-PS2-3) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.CC.	Crosscutting Concepts
ELEMENT	HS-PS2.CC.1.	Patterns
INDICATOR	HS-PS2.CC.1.1.	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. (HS-PS2-4) Open Stax_TEA Physics • Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement • Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs • Physics: Chapter 03 Acceleration: Section 3.1 Acceleration • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.1 Force

		• Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.2 Newton's First Law of Motion: Inertia • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.4 Newton's Third Law of Motion • Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.CC.	Crosscutting Concepts
ELEMENT	HS-PS2.CC.2.	Cause and Effect
INDICATOR	HS-PS2.CC.2.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1), (HS-PS2-5) Open Stax_TEA Physics • Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement • Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs • Physics: Chapter 03 Acceleration: Section 3.1 Acceleration • Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields,

		Field Lines, and Force
INDICATOR	HS-PS2.CC.2.2.	Systems can be designed to cause a desired effect. (HS-PS2-3) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.CC.	Crosscutting Concepts
ELEMENT	HS-PS2.CC.3.	Systems and System Models
INDICATOR	HS-PS2.CC.3.1.	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2) Open Stax TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS2.	Motion and Stability: Forces and Interactions - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS2.CC.	Crosscutting Concepts
ELEMENT	HS-PS2.CC.4.	Structure and Function
INDICATOR	HS-PS2.CC.4.1.	Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.1 Temperature and Thermal Energy • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.3 Phase Change and Latent Heat • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics

PERFORMANCE EXPECTATION / FOUNDATION	**HS-PS3-2.**	**Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.** **<u>Open Stax_TEA Physics</u>** **• Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem** **• Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy** **• Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.1 Temperature and Thermal Energy** **• Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work** **• Physics: Chapter 13 Waves and Their Properties: Section 13.1 Types of Waves** **• Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period** **• Physics: Chapter 13 Waves and Their Properties: Section 13.3 Wave Interaction: Superposition and Interference** **• Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength** **• Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level** **• Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms** **• Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance** **• Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential** **• Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics** **• Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law** **• Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits** **• Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits**
PERFORMANCE EXPECTATION / FOUNDATION	**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.*** **<u>Open Stax_TEA Physics</u>** **• Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy** **• Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines** **• Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer** **• Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators** **• Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics** **• Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law** **• Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits** **• Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits** **• Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power** **• Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force** **• Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers**
PERFORMANCE EXPECTATION /	**HS-PS3-4.**	**Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different**

FOUNDATION		temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force • Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.SEP.	Science and Engineering Practices
ELEMENT	HS-PS3.SEP.1.	Developing and Using Models - Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
INDICATOR	HS-PS3.SEP.1.1.	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2), (HS-PS3-5) Open Stax_TEA Physics • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.SEP.	Science and Engineering Practices
ELEMENT	HS-PS3.SEP.2.	Planning and Carrying Out Investigations - Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
INDICATOR	HS-PS3.SEP.2.1.	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. (HS-PS3-4) Open Stax_TEA Physics • Physics: Chapter 01 What is Physics?: Section 1.2 The Scientific Methods • Physics: Chapter 02 Motion in One Dimension: Section 2.1 Relative Motion, Distance, and Displacement • Physics: Chapter 02 Motion in One Dimension: Section 2.3 Position vs. Time Graphs • Physics: Chapter 03 Acceleration: Section 3.1 Acceleration • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 05 Motion in Two Dimensions: Section 5.4 Inclined Planes • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 06 Circular and Rotational Motion: Section 6.1 Angle of Rotation and Angular Velocity • Physics: Chapter 06 Circular and Rotational Motion: Section 6.2 Uniform Circular Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.SEP.	Science and Engineering Practices
ELEMENT	HS-PS3.SEP.3.	Using Mathematics and Computational Thinking - Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical

		analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-PS3.SEP.3.1.	Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1) <u>Open Stax_TEA Physics</u> • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.1 Temperature and Thermal Energy • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.3 Phase Change and Latent Heat • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.SEP.	Science and Engineering Practices
ELEMENT	HS-PS3.SEP.4.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-PS3.SEP.4.1.	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. (HS-PS3-3) <u>Open Stax_TEA Physics</u> • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.A:	Definitions of Energy
INDICATOR	PS3.A:1.	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. (HS-PS3-1), (HS-PS3-2) Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
INDICATOR	PS3.A:2.	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3) Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.1 Temperature and Thermal Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics
INDICATOR	PS3.A:3.	These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as either motions of particles or energy stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.B:	Conservation of Energy and Energy Transfer
INDICATOR	PS3.B:1.	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. (HS-PS3-1) Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
INDICATOR	PS3.B:2.	Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4)

		<u>Open Stax_TEA Physics</u> • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
INDICATOR	PS3.B:3.	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. (HS-PS3-1) <u>Open Stax_TEA Physics</u> • Physics: Chapter 05 Motion in Two Dimensions: Section 5.5 Simple Harmonic Motion • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.2 Coulomb's Law • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits
INDICATOR	PS3.B:4.	The availability of energy limits what can occur in any system. (HS-PS3-1) <u>Open Stax_TEA Physics</u> • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
INDICATOR	PS3.B:5.	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). (HS-PS3-4) <u>Open Stax_TEA Physics</u> • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:

PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.C:	Relationship Between Energy and Forces
INDICATOR	PS3.C:1.	When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.D:	Energy in Chemical Processes
INDICATOR	PS3.D:1.	Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3), (HS-PS3-4) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.A:	Defining and Delimiting Engineering Problems
INDICATOR	ETS1.A:1.	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS3-3) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.CC.	Crosscutting Concepts
ELEMENT	HS-PS3.CC.1.	Cause and Effect
INDICATOR	HS-PS3.CC.1.1.	Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5) Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE

TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.CC.	Crosscutting Concepts
ELEMENT	HS-PS3.CC.2.	Systems and System Models
INDICATOR	HS-PS3.CC.2.1.	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-PS3-4) Open Stax_TEA Physics • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power
INDICATOR	HS-PS3.CC.2.2.	Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1) Open Stax_TEA Physics • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge • Physics: Chapter 18 Static Electricity: Section 18.3 Electric Field • Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS3.	Energy - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS3.CC.	Crosscutting Concepts
ELEMENT	HS-PS3.CC.3.	Energy and Matter
INDICATOR	HS-PS3.CC.3.1.	Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS3-3) Open Stax_TEA Physics • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.1 Force • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.2 Newton's First Law of Motion: Inertia • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.3 Newton's Second Law of Motion • Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.4 Newton's Third Law of Motion

		• Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 08 Momentum: Section 8.2 Conservation of Momentum • Physics: Chapter 08 Momentum: Section 8.3 Elastic and Inelastic Collisions • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.1 Temperature and Thermal Energy • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.3 Phase Change and Latent Heat • Physics: Chapter 12 Thermodynamics: Section 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.3 Second Law of Thermodynamics: Entropy • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators • Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law • Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power
INDICATOR	**HS-PS3.CC.3.2.**	**Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)** Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.2 Mechanical Energy and Conservation of Energy • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
STRAND	**NGSS.HS-PS.**	**PHYSICAL SCIENCE**
TITLE	**HS-PS3.**	**Energy - Students who demonstrate understanding can:**
PERFORMANCE EXPECTATION / FOUNDATION	**HS-PS3.CETS.**	**Connections to Engineering, Technology, and Applications of Science**
ELEMENT	**HS-PS3.CETS.1.**	**Influence of Science, Engineering, and Technology on Society and the Natural World**
INDICATOR	**HS-PS3.CETS.1.1.**	**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. (HS-PS3-3)** Open Stax_TEA Physics • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem • Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity

		• Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer • Physics: Chapter 12 Thermodynamics: Section 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium • Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators • Physics: Chapter 19 Electrical Circuits: Section 19.4 Electric Power • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion • Physics: Chapter 22 The Atom: Section 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
STRAND	**NGSS.HS-PS.**	**PHYSICAL SCIENCE**
TITLE	**HS-PS3.**	**Energy - Students who demonstrate understanding can:**
PERFORMANCE EXPECTATION / FOUNDATION	**HS-PS3.CNS.**	**Connections to Nature of Science**
ELEMENT	**HS-PS3.CNS.1.**	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**
INDICATOR	**HS-PS3.CNS.1.1.**	**Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)** **No Correlations**
STRAND	**NGSS.HS-PS.**	**PHYSICAL SCIENCE**
TITLE	**HS-PS4.**	**Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:**
PERFORMANCE EXPECTATION / FOUNDATION	**HS-PS4-1.**	**Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 21 The Quantum Nature of Light: Section 21.1 Planck and Quantum Nature of Light
PERFORMANCE EXPECTATION /	**HS-PS4-2.**	**Evaluate questions about the advantages of using a digital transmission and storage of information.**

FOUNDATION		Open Stax_TEA Physics • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 01 What is Physics?: Section 1.1 Physics: Definitions and Applications • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential • Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION /	HS-PS4.SEP.	Science and Engineering Practices

FOUNDATION		
ELEMENT	HS-PS4.SEP.1.	Asking Questions and Defining Problems - Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
INDICATOR	HS-PS4.SEP.1.1.	Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HS-PS4-2) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.SEP.	Science and Engineering Practices
ELEMENT	HS-PS4.SEP.2.	Using Mathematics and Computational Thinking - Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-PS4.SEP.2.1.	Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1) Open Stax TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 21 The Quantum Nature of Light: Section 21.1 Planck and Quantum Nature of Light
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.SEP.	Science and Engineering Practices
ELEMENT	HS-PS4.SEP.3.	Engaging in Argument from Evidence - Engaging in argument from

		evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.
INDICATOR	HS-PS4.SEP.3.1.	Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.SEP.	Science and Engineering Practices
ELEMENT	HS-PS4.SEP.4.	Obtaining, Evaluating, and Communicating Information - Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.
INDICATOR	HS-PS4.SEP.4.1.	Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4) No Correlations
INDICATOR	HS-PS4.SEP.4.2.	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). (HS-PS4-5) Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.1 Types of Waves • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 13 Waves and Their Properties: Section 13.3 Wave Interaction: Superposition and Interference • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information

		Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.CNS.	Connections to Nature of Science
ELEMENT	HS-PS4.CNS.1.	Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
INDICATOR	HS-PS4.CNS.1.1.	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. (HS-PS4-3) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.D:	Energy in Chemical Processes
INDICATOR	PS3.D:1.	Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5) Open Stax_TEA Physics • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.DCI.	Disciplinary Core Ideas
ELEMENT	PS4.A:	Wave Properties
INDICATOR	PS4.A:1.	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. (HS-PS4-1) Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.1 Types of Waves • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 13 Waves and Their Properties: Section 13.3 Wave Interaction: Superposition and Interference • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection

		• Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 21 The Quantum Nature of Light: Section 21.1 Planck and Quantum Nature of Light
INDICATOR	PS4.A:2.	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. (HS-PS4-2), (HS-PS4-5) No Correlations
INDICATOR	PS4.A:3.	[From the 3–5 grade band endpoints] 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.) (HS-PS4-3) Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.1 Types of Waves • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 13 Waves and Their Properties: Section 13.3 Wave Interaction: Superposition and Interference • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.DCI.	Disciplinary Core Ideas
ELEMENT	PS4.B:	Electromagnetic Radiation
INDICATOR	PS4.B:1.	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. (HS-PS4-3)

		Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 21 The Quantum Nature of Light: Section 21.1 Planck and Quantum Nature of Light • Physics: Chapter 21 The Quantum Nature of Light: Section 21.2 Einstein and the Photoelectric Effect • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
INDICATOR	PS4.B:2.	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. (HS-PS4-4) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
INDICATOR	PS4.B:3.	Photovoltaic materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) Open Stax_TEA Physics • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 21 The Quantum Nature of Light: Section 21.2 Einstein and the Photoelectric Effect • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.DCI.	Disciplinary Core Ideas
ELEMENT	PS4.C:	Information Technologies and Instrumentation
INDICATOR	PS4.C:1.	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. (HS-PS4-5) Open Stax_TEA Physics • Physics: Chapter 01 What is Physics?: Section 1.1 Physics: Definitions and Applications • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential

		• Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.CC.	Crosscutting Concepts
ELEMENT	HS-PS4.CC.1.	Cause and Effect
INDICATOR	HS-PS4.CC.1.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1) Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
INDICATOR	HS-PS4.CC.1.2.	Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS4-4) Open Stax_TEA Physics • Physics: Chapter 10 Special Relativity: Section 10.1 Postulates of Special Relativity • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 14 Sound: Section 14.1 Speed of Sound, Frequency, and Wavelength • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
INDICATOR	HS-PS4.CC.1.3.	Systems can be designed to cause a desired effect. (HS-PS4-5) Open Stax_TEA Physics • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.CC.	Crosscutting Concepts
ELEMENT	HS-PS4.CC.2.	Systems and System Models

INDICATOR	HS-PS4.CC.2.1.	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. (HS-PS4-3) Open Stax_TEA Physics • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.1 Understanding Diffraction and Interference
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.CC.	Crosscutting Concepts
ELEMENT	HS-PS4.CC.3.	Stability and Change
INDICATOR	HS-PS4.CC.3.1.	Systems can be designed for greater or lesser stability. (HS-PS4-2) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.CETS.	Connections to Engineering, Technology, and Applications of Science
ELEMENT	HS-PS4.CETS.1.	Interdependence of Science, Engineering, and Technology
INDICATOR	HS-PS4.CETS.1.1.	Science and engineering complement each other in the cycle known as research and development (R&D). (HS-PS4-5) No Correlations
STRAND	NGSS.HS-PS.	PHYSICAL SCIENCE
TITLE	HS-PS4.	Waves and Their Applications in Technologies for Information Transfer - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-PS4.CETS.	Connections to Engineering, Technology, and Applications of Science
ELEMENT	HS-PS4.CETS.2.	Influence of Engineering, Technology, and Science on Society and the Natural World
INDICATOR	HS-PS4.CETS.2.1.	Modern civilization depends on major technological systems. (HS-PS4-2), (HS-PS4-5) Open Stax_TEA Physics • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
INDICATOR	HS-	Engineers continuously modify these technological systems by

	PS4.CETS.2.2.	applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS4-2) Open Stax_TEA Physics • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-1.	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-2.	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. Open Stax_TEA Physics • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-3.	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-4.	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-5.	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-6.	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1-7.	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.SEP.	Science and Engineering Practices
ELEMENT	HS-LS1.SEP.1.	Developing and Using Models - Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
INDICATOR	HS-LS1.SEP.1.1.	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

		(HS-LS1-2) No Correlations
INDICATOR	HS-LS1.SEP.1.2.	Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4), (HS-LS1-5), (HS-LS1-7) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.SEP.	Science and Engineering Practices
ELEMENT	HS-LS1.SEP.2.	Planning and Carrying Out Investigations - Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
INDICATOR	HS-LS1.SEP.2.1.	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. (HS-LS1-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.SEP.	Science and Engineering Practices
ELEMENT	HS-LS1.SEP.3.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-LS1.SEP.3.1.	Construct and revise 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. (HS-LS1-6) No Correlations
INDICATOR	HS-LS1.SEP.3.2.	Construct and revise 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. (HS-LS1-6) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.CNS.	Connections to Nature of Science
ELEMENT	HS-LS1.CNS.1.	Scientific Investigations Use a Variety of Methods

INDICATOR	HS-LS1.CNS.1.1.	Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (HS-LS1-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.DCI.	Disciplinary Core Ideas
ELEMENT	LS1.A:	Structure and Function
INDICATOR	LS1.A:1.	Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) No Correlations
INDICATOR	LS1.A:2.	All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.) No Correlations
INDICATOR	LS1.A:3.	Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) No Correlations
INDICATOR	LS1.A:4.	Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.DCI.	Disciplinary Core Ideas
ELEMENT	LS1.B:	Growth and Development of Organisms
INDICATOR	LS1.B:1.	In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION /	HS-LS1.DCI.	Disciplinary Core Ideas

FOUNDATION		
ELEMENT	LS1.C:	Organization for Matter and Energy Flow in Organisms
INDICATOR	LS1.C:1.	The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5) No Correlations
INDICATOR	LS1.C:2.	The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) No Correlations
INDICATOR	LS1.C:3.	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7) No Correlations
INDICATOR	LS1.C:4.	As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (HS-LS1-7) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.CC.	Crosscutting Concepts
ELEMENT	HS-LS1.CC.1.	Systems and System Models
INDICATOR	HS-LS1.CC.1.1.	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. (HS-LS1-2), (HS-LS1-4) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.CC.	Crosscutting Concepts
ELEMENT	HS-LS1.CC.2.	Energy and Matter
INDICATOR	HS-LS1.CC.2.1.	Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
INDICATOR	HS-LS1.CC.2.2.	Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.(HS-LS1-7)

		Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.CC.	Crosscutting Concepts
ELEMENT	HS-LS1.CC.3.	Structure and Function
INDICATOR	HS-LS1.CC.3.1.	Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1) Open Stax_TEA Physics • Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses • Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS1.	From Molecules to Organisms: Structures and Processes - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS1.CC.	Crosscutting Concepts
ELEMENT	HS-LS1.CC.4.	Stability and Change
INDICATOR	HS-LS1.CC.4.1.	Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-1.	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-2.	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-3.	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-4.	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of

		Themodynamics: Thermal Energy and Work
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-5.	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-6.	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-7.	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2-8.	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.SEP.	Science and Engineering Practices
ELEMENT	HS-LS2.SEP.1.	Developing and Using Models - Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed worlds.
INDICATOR	HS-LS2.SEP.1.1.	Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.SEP.	Science and Engineering Practices
ELEMENT	HS-LS2.SEP.2.	Using Mathematics and Computational Thinking - Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-LS2.SEP.2.1.	Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1) No Correlations
INDICATOR	HS-LS2.SEP.2.2.	Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2) No Correlations
INDICATOR	HS-LS2.SEP.2.3.	Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

		No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.SEP.	Science and Engineering Practices
ELEMENT	HS-LS2.SEP.3.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-LS2.SEP.3.1.	Construct and revise 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. (HS-LS2-3) No Correlations
INDICATOR	HS-LS2.SEP.3.2.	Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.SEP.	Science and Engineering Practices
ELEMENT	HS-LS2.SEP.4.	Engaging in Argument from Evidence - Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
INDICATOR	HS-LS2.SEP.4.1.	Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) No Correlations
INDICATOR	HS-LS2.SEP.4.2.	Evaluate the evidence behind currently accepted explanations to determine the merits of arguments. (HS-LS2-8) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.CNS.	Connections to Nature of Science
ELEMENT	HS-LS2.CNS.1.	Scientific Knowledge is Open to Revision in Light of New Evidence
INDICATOR	HS-LS2.CNS.1.1.	Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-2), (HS-LS2-3)

		No Correlations
INDICATOR	HS-LS2.CNS.1.2.	Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6), (HS-LS2-8) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	LS2.A:	Interdependent Relationships in Ecosystems
INDICATOR	LS2.A:1.	Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1), (HS-LS2-2) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	LS2.B:	Cycles of Matter and Energy Transfer in Ecosystems
INDICATOR	LS2.B:1.	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) No Correlations
INDICATOR	LS2.B:2.	Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
INDICATOR	LS2.B:3.	Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:

PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	LS2.C:	Ecosystem Dynamics, Functioning, and Resilience
INDICATOR	LS2.C:1.	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2), (HS-LS2-6) No Correlations
INDICATOR	LS2.C:2.	Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	LS2.D:	Social Interactions and Group Behavior
INDICATOR	LS2.D:1.	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	LS4.D:	Biodiversity and Humans
INDICATOR	LS4.D:1.	Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7) No Correlations
INDICATOR	LS4.D:2.	Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who

		demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.D:	Energy in Chemical Processes
INDICATOR	PS3.D:1.	The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.B:	Developing Possible Solutions
INDICATOR	ETS1.B:1.	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. (secondary to HS-LS2-7) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.CC.	Crosscutting Concepts
ELEMENT	HS-LS2.CC.1.	Cause and Effect
INDICATOR	HS-LS2.CC.1.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.CC.	Crosscutting Concepts
ELEMENT	HS-LS2.CC.2.	Scale, Proportion, and Quantity
INDICATOR	HS-LS2.CC.2.1.	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1) No Correlations
INDICATOR	HS-LS2.CC.2.2.	Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.CC.	Crosscutting Concepts
ELEMENT	HS-LS2.CC.3.	Systems and System Models

INDICATOR	HS-LS2.CC.3.1.	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. (HS-LS2-5) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.CC.	Crosscutting Concepts
ELEMENT	HS-LS2.CC.4.	Energy and Matter
INDICATOR	HS-LS2.CC.4.1.	Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS2-4) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
INDICATOR	HS-LS2.CC.4.2.	Energy drives the cycling of matter within and between systems. (HS-LS2-3) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS2.	Ecosystems: Interactions, Energy, and Dynamics - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS2.CC.	Crosscutting Concepts
ELEMENT	HS-LS2.CC.5.	Stability and Change
INDICATOR	HS-LS2.CC.5.1.	Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6), (HS-LS2-7) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3-1.	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3-2.	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3-3.	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE	HS-LS3.SEP.	Science and Engineering Practices

EXPECTATION / FOUNDATION		
ELEMENT	HS-LS3.SEP.1.	Asking Questions and Defining Problems - Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
INDICATOR	HS-LS3.SEP.1.1.	Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.SEP.	Science and Engineering Practices
ELEMENT	HS-LS3.SEP.2.	Analyzing and Interpreting Data - Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
INDICATOR	HS-LS3.SEP.2.1.	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.SEP.	Science and Engineering Practices
ELEMENT	HS-LS3.SEP.3.	Engaging in Argument from Evidence - Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
INDICATOR	HS-LS3.SEP.3.1.	Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.DCI.	Disciplinary Core Ideas
ELEMENT	LS1.A:	Structure and Function
INDICATOR	LS1.A:1.	All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:

PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.DCI.	Disciplinary Core Ideas
ELEMENT	LS3.A:	Inheritance of Traits
INDICATOR	LS3.A:1.	Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.DCI.	Disciplinary Core Ideas
ELEMENT	LS3.B:	Variation of Traits
INDICATOR	LS3.B:1.	In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2) No Correlations
INDICATOR	LS3.B:2.	Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2), (HS-LS3-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.CC.	Crosscutting Concepts
ELEMENT	HS-LS3.CC.1.	Cause and Effect
INDICATOR	HS-LS3.CC.1.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1), (HS-LS3-2) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.CC.	Crosscutting Concepts
ELEMENT	HS-LS3.CC.2.	Scale, Proportion, and Quantity
INDICATOR	HS-LS3.CC.2.1.	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-LS3-3)

		No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS3.	Heredity: Inheritance and Variation of Traits - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS3.CNS.	Connections to Nature of Science
ELEMENT	HS-LS3.CNS.1.	Science is a Human Endeavor
INDICATOR	HS-LS3.CNS.1.1.	Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3) No Correlations
INDICATOR	HS-LS3.CNS.1.2.	Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4-1.	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4-2.	Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4-3.	Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4-4.	Construct an explanation based on evidence for how natural selection leads to adaptation of populations. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4-5.	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4-6.	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.SEP.	Science and Engineering Practices
ELEMENT	HS-LS4.SEP.1.	Analyzing and Interpreting Data - Analyzing data in 9–12 builds on

		K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
INDICATOR	HS-LS4.SEP.1.1.	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS4-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.SEP.	Science and Engineering Practices
ELEMENT	HS-LS4.SEP.2.	Using Mathematics and Computational Thinking - Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-LS4.SEP.2.1.	Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.SEP.	Science and Engineering Practices
ELEMENT	HS-LS4.SEP.3.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-LS4.SEP.3.1.	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. (HS-LS4-2), (HS-LS4-4) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.SEP.	Science and Engineering Practices
ELEMENT	HS-LS4.SEP.4.	Engaging in Argument from Evidence - Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science.
INDICATOR	HS-LS4.SEP.4.1.	Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)

		No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.SEP.	Science and Engineering Practices
ELEMENT	HS-LS4.SEP.5.	Obtaining, Evaluating, and Communicating Information - Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.
INDICATOR	HS-LS4.SEP.5.1.	Communicate scientific information (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). (HS-LS4-1) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.DCI.	Disciplinary Core Ideas
ELEMENT	LS4.A:	Evidence of Common Ancestry and Diversity
INDICATOR	LS4.A:1.	Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1) Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.3 Half Life and Radiometric Dating
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.DCI.	Disciplinary Core Ideas
ELEMENT	LS4.B:	Natural Selection
INDICATOR	LS4.B:1.	Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2), (HS-LS4-3) No Correlations
INDICATOR	LS4.B:2.	The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE	HS-LS4.DCI.	Disciplinary Core Ideas

EXPECTATION / FOUNDATION		
ELEMENT	LS4.C:	Adaptation
INDICATOR	LS4.C:1.	Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) No Correlations
INDICATOR	LS4.C:2.	Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3), (HS-LS4-4) No Correlations
INDICATOR	LS4.C:3.	Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) No Correlations
INDICATOR	LS4.C:4.	Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5), (HS-LS4-6) No Correlations
INDICATOR	LS4.C:5.	Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.DCI.	Disciplinary Core Ideas
ELEMENT	LS4.D:	Biodiversity and Humans
INDICATOR	LS4.D:1.	Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6) (Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who

		demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.B:	Developing Possible Solutions
INDICATOR	ETS1.B:1.	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. (secondary to HS-LS4-6) No Correlations
INDICATOR	ETS1.B:2.	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. (secondary to HS-LS4-6) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.CC.	Crosscutting Concepts
ELEMENT	HS-LS4.CC.1.	Patterns
INDICATOR	HS-LS4.CC.1.1.	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. (HS-LS4-1), (HS-LS4-3) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.CC.	Crosscutting Concepts
ELEMENT	HS-LS4.CC.2.	Cause and Effect
INDICATOR	HS-LS4.CC.2.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2), (HS-LS4-4), (HS-LS4-5), (HS-LS4-6) No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.CNS.	Connections to Nature of Science
ELEMENT	HS-LS4.CNS.1.	Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
INDICATOR	HS-LS4.CNS.1.1.	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. (HS-LS4-1)

		No Correlations
STRAND	NGSS.HS-LS.	LIFE SCIENCE
TITLE	HS-LS4.	Biological Evolution: Unity and Diversity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-LS4.CNS.	Connections to Nature of Science
ELEMENT	HS-LS4.CNS.2.	Scientific Knowledge Assumes an Order and Consistency in Natural Systems
INDICATOR	HS-LS4.CNS.2.1.	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. (HS-LS4-1), (HS-LS4-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1-1.	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 23 Particle Physics: Section 23.3 The Unification of Forces
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1-3.	Communicate scientific ideas about the way stars, over their life cycle, produce elements. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1-4.	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1-5.	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1-6.	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

		No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS1.SEP.1.	Developing and Using Models - Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
INDICATOR	HS-ESS1.SEP.1.1.	Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS1-1) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS1.SEP.2.	Using Mathematical and Computational Thinking - Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-ESS1.SEP.2.1.	Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4) Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS1.SEP.3.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
INDICATOR	HS-ESS1.SEP.3.1.	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, 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. (HS-ESS1-2) No Correlations
INDICATOR	HS-ESS1.SEP.3.2.	Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (MS-ESS1-6)

		No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS1.SEP.4.	Engaging in Argument from Evidence - Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
INDICATOR	HS-ESS1.SEP.4.1.	Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS1.SEP.5.	Obtaining, Evaluating, and Communicating Information - Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.
INDICATOR	HS-ESS1.SEP.5.1.	Communicate scientific 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). (HS-ESS1-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	ESS1.A:	The Universe and Its Stars
INDICATOR	ESS1.A:1.	The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) <u>Open Stax_TEA Physics</u> • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
INDICATOR	ESS1.A:2.	The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2), (HS-ESS1-3) <u>Open Stax_TEA Physics</u> • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
INDICATOR	ESS1.A:3.	The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the

		primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) Open Stax_TEA Physics • Physics: Chapter 23 Particle Physics: Section 23.3 The Unification of Forces
INDICATOR	ESS1.A:4.	Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	ESS1.B:	Earth and the Solar System
INDICATOR	ESS1.B:1.	Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	ESS1.C:	The History of Planet Earth
INDICATOR	ESS1.C:1.	Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (HS-ESS1-5) No Correlations
INDICATOR	ESS1.C:2.	Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.B:	Plate Tectonics and Large-Scale System Interactions
INDICATOR	ESS2.B:1.	Plate tectonics is the unifying theory that explains the past and

		current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. (ESS2.B Grade 8 GBE) (secondary to HS-ESS1-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	PS1.C:	Nuclear Processes
INDICATOR	PS1.C:1.	Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5), (secondary to HS-ESS1-6) Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.3 Half Life and Radiometric Dating
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	PS3.D:	Energy in Chemical Processes and Everyday Life
INDICATOR	PS3.D:1.	Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1) Open Stax_TEA Physics • Physics: Chapter 12 Thermodynamics: Section 12.2 First Law of Themodynamics: Thermal Energy and Work • Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.DCI.	Disciplinary Core Ideas
ELEMENT	PS4.B:	Electromagnetic Radiation
INDICATOR	PS4.B:1.	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. (secondary to HS-ESS1-2) Open Stax_TEA Physics • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE	HS-ESS1.CC.	Crosscutting Concepts

EXPECTATION / FOUNDATION		
ELEMENT	HS-ESS1.CC.1.	Patterns
INDICATOR	HS-ESS1.CC.1.1.	Empirical evidence is needed to identify patterns. (HS-ESS1-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.CC.	Crosscutting Concepts
ELEMENT	HS-ESS1.CC.2.	Scale, Proportion, and Quantity
INDICATOR	HS-ESS1.CC.2.1.	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1) No Correlations
INDICATOR	HS-ESS1.CC.2.2.	Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-ESS1-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.CC.	Crosscutting Concepts
ELEMENT	HS-ESS1.CC.3.	Energy and Matter
INDICATOR	HS-ESS1.CC.3.1.	Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. (HS-ESS1-2) No Correlations
INDICATOR	HS-ESS1.CC.3.2.	In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.CC.	Crosscutting Concepts
ELEMENT	HS-ESS1.CC.4.	Stability and Change
INDICATOR	HS-ESS1.CC.4.1.	Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.CETS.	Connections to Engineering, Technology, and Applications of Science
ELEMENT	HS-ESS1.CETS.1.	Interdependence of Science, Engineering, and Technology

INDICATOR	HS-ESS1.CETS.1.1.	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. (HS-ESS1-2), (HS-ESS1-4) Open Stax_TEA Physics • Physics: Chapter 01 What is Physics?: Section 1.1 Physics: Definitions and Applications • Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation • Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection • Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS1.CNS.1.	Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
INDICATOR	HS-ESS1.CNS.1.1.	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. (HS-ESS1-2), (HS-ESS1-6) No Correlations
INDICATOR	HS-ESS1.CNS.1.2.	Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS1.	Earth's Place in the Universe - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS1.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS1.CNS.2.	Scientific Knowledge Assumes an Order and Consistency in Natural Systems
INDICATOR	HS-ESS1.CNS.2.1.	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. (HS-ESS1-2) No Correlations
INDICATOR	HS-ESS1.CNS.2.2.	Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-1.	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. Open Stax_TEA Physics

		• Physics: Chapter 04 Forces and Newton's Laws of Motion: Section 4.2 Newton's First Law of Motion: Inertia • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-2.	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-3.	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-4.	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-5.	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-6.	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2-7.	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS2.SEP.1.	Developing and Using Models - Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
INDICATOR	HS-ESS2.SEP.1.1.	Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1), (HS-ESS2-3), (HS-ESS2-6) No Correlations
INDICATOR	HS-ESS2.SEP.1.2.	Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS2.SEP.2.	Planning and Carrying Out Investigations - Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
INDICATOR	HS-ESS2.SEP.2.1.	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. (HS-ESS2-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth’s Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS2.SEP.3.	Analyzing and Interpreting Data - Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
INDICATOR	HS-ESS2.SEP.3.1.	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. (HS-ESS2-2) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth’s Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS2.SEP.4.	Engaging in Argument from Evidence - Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
INDICATOR	HS-ESS2.SEP.4.1.	Construct an oral and written argument or counter-arguments based on data and evidence. (HS-ESS2-7) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth’s Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS2.CNS.1.	Scientific Knowledge is Based on Empirical Evidence
INDICATOR	HS-ESS2.CNS.1.1.	Science knowledge is based on empirical evidence. (HS-ESS2-3) No Correlations
INDICATOR	HS-ESS2.CNS.1.2.	Science disciplines share common rules of evidence used to evaluate explanations about natural systems. (HS-ESS2-3) No Correlations
INDICATOR	HS-ESS2.CNS.1.3.	Science includes the process of coordinating patterns of evidence with current theory. (HS-ESS2-3) No Correlations
INDICATOR	HS-ESS2.CNS.1.4.	Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth’s Systems - Students who demonstrate understanding can:

PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.DCI.	Disciplinary Core Ideas
ELEMENT	ESS1.B:	Earth and the Solar System
INDICATOR	ESS1.B:1.	Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.A:	Earth Materials and Systems
INDICATOR	ESS2.A:1.	Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1), (HS-ESS2-2) No Correlations
INDICATOR	ESS2.A:2.	Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3) Open Stax_TEA Physics • Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation
INDICATOR	ESS2.A:3.	The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.B:	Plate Tectonics and Large-Scale System Interactions
INDICATOR	ESS2.B:1.	The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3) No Correlations
INDICATOR	ESS2.B:2.	Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a

		framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (ESS2.B Grade 8 GBE) (HS-ESS2-1) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.C:	The Roles of Water in Earth's Surface Processes
INDICATOR	ESS2.C:1.	The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.D:	Weather and Climate
INDICATOR	ESS2.D:1.	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-4) No Correlations
INDICATOR	ESS2.D:2.	Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6), (HS-ESS2-7) No Correlations
INDICATOR	ESS2.D:3.	Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6), (HS-ESS2-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.E:	Biogeology
INDICATOR	ESS2.E:1.	The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE	HS-ESS2.DCI.	Disciplinary Core Ideas

EXPECTATION / FOUNDATION		
ELEMENT	PS4.A:	Wave Properties
INDICATOR	PS4.A:1.	Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (secondary to HS-ESS2-3) <u>Open Stax_TEA Physics</u> • Physics: Chapter 13 Waves and Their Properties: Section 13.1 Types of Waves • Physics: Chapter 13 Waves and Their Properties: Section 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period • Physics: Chapter 13 Waves and Their Properties: Section 13.3 Wave Interaction: Superposition and Interference
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CC.	Crosscutting Concepts
ELEMENT	HS-ESS2.CC.1.	Cause and Effect
INDICATOR	HS-ESS2.CC.1.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CC.	Crosscutting Concepts
ELEMENT	HS-ESS2.CC.2.	Energy and Matter
INDICATOR	HS-ESS2.CC.2.1.	The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6) No Correlations
INDICATOR	HS-ESS2.CC.2.2.	Energy drives the cycling of matter within and between systems. (HS-ESS2-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CC.	Crosscutting Concepts
ELEMENT	HS-ESS2.CC.3.	Structure and Function
INDICATOR	HS-ESS2.CC.3.1.	The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CC.	Crosscutting Concepts
ELEMENT	HS-ESS2.CC.4.	Stability and Change
INDICATOR	HS-	Much of science deals with constructing explanations of how things

	ESS2.CC.4.1.	change and how they remain stable. (HS-ESS2-7) No Correlations
INDICATOR	HS-ESS2.CC.4.2.	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1) No Correlations
INDICATOR	HS-ESS2.CC.4.3.	Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CETS.	Connections to Engineering, Technology, and Applications of Science
ELEMENT	HS-ESS2.CETS.1.	Interdependence of Science, Engineering, and Technology
INDICATOR	HS-ESS2.CETS.1.1.	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. (HS-ESS2-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS2.	Earth's Systems - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS2.CETS.	Connections to Engineering, Technology, and Applications of Science
ELEMENT	HS-ESS2.CETS.2.	Influence of Engineering, Technology, and Science on Society and the Natural World
INDICATOR	HS-ESS2.CETS.2.1.	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. (HS-ESS2-2) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3-1.	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3-2.	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* Open Stax_TEA Physics • Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers • Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3-3.	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

		No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3-4.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3-5.	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3-6.	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS3.SEP.1.	Analyzing and Interpreting Data - Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
INDICATOR	HS-ESS3.SEP.1.1.	Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS3.SEP.2.	Using Mathematics and Computational Thinking - Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-ESS3.SEP.2.1.	Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3) No Correlations
INDICATOR	HS-ESS3.SEP.2.2.	Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6) Open Stax_TEA Physics • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.1 Kepler's Laws of Planetary Motion • Physics: Chapter 07 Newton's Law of Gravitation: Section 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE

TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS3.SEP.3.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.
INDICATOR	HS-ESS3.SEP.3.1.	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. (HS-ESS3-1) No Correlations
INDICATOR	HS-ESS3.SEP.3.2.	Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.SEP.	Science and Engineering Practices
ELEMENT	HS-ESS3.SEP.4.	Engaging in Argument from Evidence - Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
INDICATOR	HS-ESS3.SEP.4.1.	Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.DCI.	Disciplinary Core Ideas
ELEMENT	ESS2.D:	Weather and Climate
INDICATOR	ESS2.D:1.	Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate

		understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.DCI.	Disciplinary Core Ideas
ELEMENT	ESS3.A:	Natural Resources
INDICATOR	ESS3.A:1.	Resource availability has guided the development of human society. (HS-ESS3-1) No Correlations
INDICATOR	ESS3.A:2.	All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2) Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.DCI.	Disciplinary Core Ideas
ELEMENT	ESS3.B:	Natural Hazards
INDICATOR	ESS3.B:1.	Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1) Open Stax_TEA Physics • Physics: Chapter 06 Circular and Rotational Motion: Section 6.3 Rotational Motion
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.DCI.	Disciplinary Core Ideas
ELEMENT	ESS3.C:	Human Impacts on Earth Systems
INDICATOR	ESS3.C:1.	The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) No Correlations
INDICATOR	ESS3.C:2.	Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.DCI.	Disciplinary Core Ideas
ELEMENT	ESS3.D:	Global Climate Change
INDICATOR	ESS3.D:1.	Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)

		No Correlations
INDICATOR	ESS3.D:2.	Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.B:	Developing Possible Solutions
INDICATOR	ETS1.B:1.	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. (secondary to HS-ESS3-2), (secondary HS-ESS3-4) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CC.	Crosscutting Concepts
ELEMENT	HS-ESS3.CC.1.	Cause and Effect
INDICATOR	HS-ESS3.CC.1.1.	Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CC.	Crosscutting Concepts
ELEMENT	HS-ESS3.CC.2.	Systems and System Models
INDICATOR	HS-ESS3.CC.2.1.	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CC.	Crosscutting Concepts
ELEMENT	HS-ESS3.CC.3.	Stability and Change
INDICATOR	HS-ESS3.CC.3.1.	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3), (HS-ESS3-5) No Correlations
INDICATOR	HS-ESS3.CC.3.2.	Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

		No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CETS.	Connections to Engineering, Technology, and Applications of Science
ELEMENT	HS-ESS3.CETS.1.	Influence of Engineering, Technology, and Science on Society and the Natural World
INDICATOR	HS-ESS3.CETS.1.1.	Modern civilization depends on major technological systems. (HS-ESS3-1), (HS-ESS3-3) No Correlations
INDICATOR	HS-ESS3.CETS.1.2.	Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2), (HS-ESS3-4) No Correlations
INDICATOR	HS-ESS3.CETS.1.3.	New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3) No Correlations
INDICATOR	HS-ESS3.CETS.1.4.	Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS3-2) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS3.CNS.1.	Scientific Investigations Use a Variety of Methods
INDICATOR	HS-ESS3.CNS.1.1.	Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) No Correlations
INDICATOR	HS-ESS3.CNS.1.2.	New technologies advance scientific knowledge. (HS-ESS3-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS3.CNS.2.	Scientific Knowledge is Based on Empirical Evidence
INDICATOR	HS-ESS3.CNS.2.1.	Science knowledge is based on empirical evidence. (HS-ESS3-5) No Correlations
INDICATOR	HS-ESS3.CNS.2.2.	Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS3-5) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE

TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS3.CNS.3.	Science is a Human Endeavor
INDICATOR	HS-ESS3.CNS.3.1.	Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3) No Correlations
STRAND	NGSS.HS-ESS.	EARTH AND SPACE SCIENCE
TITLE	HS-ESS3.	Earth and Human Activity - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ESS3.CNS.	Connections to Nature of Science
ELEMENT	HS-ESS3.CNS.4.	Science Addresses Questions About the Natural and Material World
INDICATOR	HS-ESS3.CNS.4.1.	Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2) No Correlations
INDICATOR	HS-ESS3.CNS.4.2.	Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2) No Correlations
INDICATOR	HS-ESS3.CNS.4.3.	Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	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. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	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. No Correlations
PERFORMANCE EXPECTATION / FOUNDATION	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. Open Stax_TEA Physics • Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse • Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer
PERFORMANCE EXPECTATION / FOUNDATION	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. No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN

TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ETS1.SEP.1.	Asking Questions and Defining Problems - Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
INDICATOR	HS-ETS1.SEP.1.1.	Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ETS1.SEP.2.	Using Mathematics and Computational Thinking - Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
INDICATOR	HS-ETS1.SEP.2.1.	Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.SEP.	Science and Engineering Practices
ELEMENT	HS-ETS1.SEP.3.	Constructing Explanations and Designing Solutions - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.
INDICATOR	HS-ETS1.SEP.3.1.	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2) No Correlations
INDICATOR	HS-ETS1.SEP.3.2.	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.A:	Defining and Delimiting Engineering Problems
INDICATOR	ETS1.A:1.	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. (HS-ETS1-1) No Correlations
INDICATOR	ETS1.A:2.	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. (HS-ETS1-1) Open Stax_TEA Physics • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.B:	Developing Possible Solutions
INDICATOR	ETS1.B:1.	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. (HS-ETS1-3) No Correlations
INDICATOR	ETS1.B:2.	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. (HS-ETS1-4) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.DCI.	Disciplinary Core Ideas
ELEMENT	ETS1.C:	Optimizing the Design Solution
INDICATOR	ETS1.C:1.	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. (HS-ETS1-2) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:
PERFORMANCE EXPECTATION / FOUNDATION	HS-ETS1.CC.	Crosscutting Concepts
ELEMENT	HS-ETS1.CC.1.	Systems and System Models
INDICATOR	HS-ETS1.CC.1.1.	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. HS-ETS1-4) No Correlations
STRAND	NGSS.HS-ETS.	ENGINEERING DESIGN
TITLE	HS-ETS1.	Engineering Design - Students who demonstrate understanding can:

PERFORMANCE EXPECTATION / FOUNDATION	**HS-ETS1.CETS.**	**Connections to Engineering, Technology, and Applications of Science**
ELEMENT	**HS-ETS1.CETS.1.**	**Influence of Science, Engineering, and Technology on Society and the Natural World**
INDICATOR	**HS-ETS1.CETS.1.1.**	**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. (HS-ETS1-1) (HS-ETS1-3)** **Open Stax_TEA Physics** **• Physics: Chapter 01 What is Physics?: Section 1.1 Physics: Definitions and Applications** **• Physics: Chapter 03 Acceleration: Section 3.2 Representing Acceleration with Equations and Graphs** **• Physics: Chapter 08 Momentum: Section 8.1 Linear Momentum, Force, and Impulse** **• Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.1 Work, Power, and the Work-energy Theorem** **• Physics: Chapter 09 Work, Energy, and Simple Machines: Section 9.3 Simple Machines** **• Physics: Chapter 10 Special Relativity: Section 10.2 Consequences of Special Relativity** **• Physics: Chapter 11 Thermal Energy, Heat, and Work: Section 11.2 Heat, Specific Heat, and Heat Transfer** **• Physics: Chapter 12 Thermodynamics: Section 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium** **• Physics: Chapter 12 Thermodynamics: Section 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators** **• Physics: Chapter 14 Sound: Section 14.2 Sound Intensity and Sound Level** **• Physics: Chapter 14 Sound: Section 14.3 Doppler Effect and Sonic Booms** **• Physics: Chapter 14 Sound: Section 14.4 Sound Interference and Resonance** **• Physics: Chapter 15 Light: Section 15.1 The Electromagnetic Spectrum** **• Physics: Chapter 15 Light: Section 15.2 The Behavior of Electromagnetic Radiation** **• Physics: Chapter 16 Mirrors and Lenses: Section 16.1 Reflection** **• Physics: Chapter 16 Mirrors and Lenses: Section 16.2 Refraction** **• Physics: Chapter 16 Mirrors and Lenses: Section 16.3 Lenses** **• Physics: Chapter 17 Diffraction and Interference: Section 17.2 Applications of Diffraction, Interference, and Coherence** **• Physics: Chapter 18 Static Electricity: Section 18.1 Electrical Charges, Conservation of Charge, and Transfer of charge** **• Physics: Chapter 18 Static Electricity: Section 18.4 Electric Potential** **• Physics: Chapter 18 Static Electricity: Section 18.5 Capacitors and Dielectrics** **• Physics: Chapter 19 Electrical Circuits: Section 19.1 Ohm's Law** **• Physics: Chapter 19 Electrical Circuits: Section 19.2 Series Circuits** **• Physics: Chapter 19 Electrical Circuits: Section 19.3 Parallel Circuits** **• Physics: Chapter 20 Magnetism: Section 20.1 Magnetic Fields, Field Lines, and Force** **• Physics: Chapter 20 Magnetism: Section 20.2 Electromagnetic Induction** **• Physics: Chapter 20 Magnetism: Section 20.3 Motors, Generators, and Transformers** **• Physics: Chapter 21 The Quantum Nature of Light: Section 21.2 Einstein and the Photoelectric Effect** **• Physics: Chapter 21 The Quantum Nature of Light: Section 21.3 The Dual Nature of Light**

		• Physics: Chapter 22 The Atom: Section 22.2 Nuclear Forces and Radioactivity • Physics: Chapter 22 The Atom: Section 22.4 Nuclear Fission and Fusion • Physics: Chapter 22 The Atom: Section 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation • Physics: Chapter 23 Particle Physics: Section 23.1 The Four Fundamental Forces