Smart Science® Lessons and High School Next Generation Science Standards

You have chosen the right place to find great science learning and, **beyond learning**, **how to think**. The NGSS emphasize thinking and inquiry, which sit front and center in every Smart Science® lesson. These lessons improve student test scores because the students come to understand the material and, importantly, the **nature of science.**

High school students benefit greatly in their understanding by doing real experiments and taking their own data in a hands-on fashion, the hallmarks of Smart Science® lessons.

These web-delivered lessons use HTML5 to ensure that your students can use them on any modern device from desktops to smart phones. Furthermore, you will see the software and content constantly improving to provide the best in online and virtual learning tools you can find anywhere and to do so always. We look forward to welcoming you to the Smart Science® family of educators.

PHONE: 855-4SCIENCE | **E-MAIL:** SALES@SMARTSCIENCE.NET | **WEB:** SMARTSCIENCE.NET

Next Generation Science Standards
Physical Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Matter and Its Interactions	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.	• Periodic Table Introduction • Periodic Table Exercise • Flame Test
Matter and Its Interactions	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.	• Chemical Periodicity
Matter and Its Interactions	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.	
Matter and Its Interactions	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.	• Enthalpy of Neutralization • Enthalpy of Solution
Matter and Its Interactions	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.	• Iron-Tin Reaction • Crystal Violet Bleaching • Reaction Rate Wet Lab
Matter and Its Interactions	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.*	• Equilibrium Constant • Buffers
Matter and Its Interactions	HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Matter and Its Interactions	HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	• Radioactive Decay

Next Generation Science Standards
Physical Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Motion and Stability: Forces and Interactions	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.	• Atwood Machine • Mass of Falling Objects • Gravity and Speed • Ramp and Mass • Inertial Balance
Motion and Stability: Forces and Interactions	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.	• Inelastic Collisions • Inelastic Collisions/Varying Mass • Elastic Collisions • Elastic Collisions/Varying Mass
Motion and Stability: Forces and Interactions	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.*	• Inelastic Collisions • Inelastic Collisions/Varying Mass • Elastic Collisions • Elastic Collisions/Varying Mass
Motion and Stability: Forces and Interactions	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.	• Moons of Jupiter
Motion and Stability: Forces and Interactions	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.	
Motion and Stability: Forces and Interactions	HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*	
Energy	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.	• Elastic Collisions • Elastic Collisions/Varying Mass • Projectile Motion, Energy • Pendulums & Energy • Springs & Energy

Next Generation Science Standards
Physical Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Energy	HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).	• Projectile Motion & Energy • Pendulums & Energy • Springs & Energy • Ramp & Speed
Energy	HS-PS3-3	Use evidence to construct an explanation relating the speed of an object to the energy of that object.	• Work-Energy Theorem • Gravity & Speed
Energy	HS-PS3-4	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*	• Magnet Cannon • Voltaic Cell
Energy	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.	• Magnet Cannon
Waves and Their Applications in Technologies for Information Transfer	HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	• Speed of Sound • Direct Speed of Sound • Wavelength & Speed
Waves and Their Applications in Technologies for Information Transfer	HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.	• Noise
Waves and Their Applications in Technologies for Information Transfer	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.	• Wave Diffraction • Wave Interference

Next Generation Science Standards
Physical Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Waves and Their Applications in Technologies for Information Transfer	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.	
Waves and Their Applications in Technologies for Information Transfer	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.*	• Noise

Next Generation Science Standards
Life Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
From Molecules to Organisms: Structures and Processes	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.	• Genetic Code • Gel Electrophoresis
From Molecules to Organisms: Structures and Processes	HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	• Animal Behavior • Cardiac Physiology • Stem Structure
From Molecules to Organisms: Structures and Processes	HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	• Onion Osmosis • Osmosis • Membrane Diffusion • Plants & Water • Cardiac Physiology
From Molecules to Organisms: Structures and Processes	HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	• Mitosis
From Molecules to Organisms: Structures and Processes	HS-LS1-5	Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	• Photosynthesis & Light • Food Webs
From Molecules to Organisms: Structures and Processes	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.	• Enzymes • Enzymes & Temperature
From Molecules to Organisms: Structures and Processes	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.	• Cell Respiration • Yeast Metabolism

Next Generation Science Standards
Life Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Ecosystems: Interactions, Energy, and Dynamics	HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	• Biomes
Ecosystems: Interactions, Energy, and Dynamics	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.	• Biomes • Diversity of Species
Ecosystems: Interactions, Energy, and Dynamics	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.	• Cell Respiration
Ecosystems: Interactions, Energy, and Dynamics	HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	• Food Webs
Ecosystems: Interactions, Energy, and Dynamics	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.	• Cell Respiration • Photosynthesis & Light • Food Webs • Yeast Metabolism
Ecosystems: Interactions, Energy, and Dynamics	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.	
Ecosystems: Interactions, Energy, and Dynamics	HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*	• Seed Pollution • Acid Rain • Air Pollution • Non-Renewable Energy Resources
Ecosystems: Interactions, Energy, and Dynamics	HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	

Next Generation Science Standards
Life Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Heredity: Inheritance and Variation of Traits	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.	• Genetic Code • Corn Genetics • Corn Genetics 2
Heredity: Inheritance and Variation of Traits	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.	• Meiosis
Heredity: Inheritance and Variation of Traits	HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	• Corn Genetics • Corn Genetics 2
Biological Evolution: Unity and Diversity	HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	
Biological Evolution: Unity and Diversity	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.	• Natural Selection
Biological Evolution: Unity and Diversity	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.	• Natural Selection

Next Generation Science Standards
Life Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Biological Evolution: Unity and Diversity	HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	• Natural Selection
Biological Evolution: Unity and Diversity	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.	
Biological Evolution: Unity and Diversity	HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*	• Species Diversity • Biodiversity

Next Generation Science Standards
Earth and Space Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Earth's Place in the Universe	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.	
Earth's Place in the Universe	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.	
Earth's Place in the Universe	HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.	
Earth's Place in the Universe	HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	• Moons of Jupiter
Earth's Place in the Universe	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.	• Basic Rock Identification • Basic Rock Patterns • Minerals • Minerals Exercise
Earth's Place in the Universe	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.	
Earth's Systems	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.	• Erosion & Flow • Acid Rain
Earth's Systems	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 systems.	

Next Generation Science Standards
Earth and Space Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Earth's Systems	HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	
Earth's Systems	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.	
Earth's Systems	HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	• Erosion and Slope • Phase Changes • Porosity
Earth's Systems	HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	• Photosynthesis & Light • Acid Rain
Earth's Systems	HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	• Photosynthesis & Light • Acid Rain
Earth and Human Activity	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.	• Erosion & Flow • Erosion & Slope • Acid Rain • Seed Pollution
Earth and Human Activity	HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*	• Non-Renewable Energy • Renewable Energy
Earth and Human Activity	HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	• Species Diversity • Non-Renewable Energy

Next Generation Science Standards
Earth and Space Science

Disciplinary Core Idea	Performance Expectation	Students who demonstrate understanding can:	Smart Science® Lessons
Earth and Human Activity	HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*	• Renewable Energy • Air Pollution
Earth and Human Activity	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.	
Earth and Human Activity	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.	