The American School in London

Science 9 - High school NGSS aligned integrated science course

Unit 1: We know what stars are made of

Essential Questions	What is the basis of scientific understanding? What can we learn about the universe from what we see? Is everything in the universe made of the same stuff?	
Summary	Students develop a model of the atom while reasoning through the evidence showing that the elements are made in stars.	
Standards Assessed	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.
	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.
	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.
	HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.

Unit 2: Everything is made of atoms.

Essential Questions	What are the properties of matter? How do the macroscopic properties of matter relate to particulate structure? How do atoms come together to make new materials?	
Summary	Students analyze evidence for the particulate nature of matter, while using intermolecular and interatomic forces to reason about the properties of matter, the elements, and chemical reactions.	
Standards Assessed	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.
	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.
	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.
	HS-PS1-7.	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Unit 3: Forces and energy determine changes in motion.

Essential Questions	What rules determine the interactions between objects? How are motion and interaction linked?	
Summary	Students analyze the motion of objects and systems to determine the net force on an object, and determine changes and transfers of energy	
Standards Assessed	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.
	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.

	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.
	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.
	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.

Unit 4: The universe is expanding.

Essential Questions	What kind of information do waves carry? What can the rules of interaction and motion tell us about the history of the universe?	
Summary	Students develop an understanding of waves while reasoning through the evidence for a big bang history of the universe.	
Standards Assessed	HS-PS4-1.	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
	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.
	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.
	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.

Unit 5: Earth is formed and shaped by natural processes.

Essential Questions	How do forces above and below the earth's surface change and shape the earth? How do we know how old the earth is? Can we explain all of the features we see on Earth's surface through natural phenomena?	
Summary	Students use evidence to develop a model for the formation of the Earth, its interior makeup, and the development of its surface features.	
Standards Assessed	HS-ESS1-4.	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
	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.
	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.
	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.
	HS-ESS2-3.	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
	HS-ESS2-5.	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Unit 6: Life depends on the environment for matter and energy.

Essential Questions	How do the living things on Earth interact with their natural environment? What cycles of matter and energy support the existence of life on Earth?

Summary	Students use and evaluate evidence to trace the flow of energy and cycling of matter through an ecosystem, and the interdependence of life and the environment.
Standards Assessed	HS-LS1-5. Use a model to show how photosynthesis transforms light energy into stored chemical energy. 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. 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. 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. HS-LS2-4. Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. 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. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.