

HCPs Integrated Physics and Chemistry (IPC) Course

Unit & Title	MSDE/NGSS Science Standards	Lesson Topic	
Unit 1 – Introduction to Energy <i>9 Class Periods</i>	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.	Experience 1	Types of 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).	Experience 2	Conservation of Energy
	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.	Experience 3	Mathematical Representations of Energy Conservation

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Unit 2 – Waves and Energy <i>9 Class Periods</i>	HS-PS4-1 : Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	Experience 1	Energy Transfer
	HS-ESS2-3 : Develop a model based on evidence of Earth's interior to	Experience 2	Wave Interference

	describe the cycling of matter by thermal convection.	Experience 3	Resonance and Standing Waves
		Experience 4	Earthquakes and Waves

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Unit 3 – The Periodic Table and Atomic Structure <i>9 Class Periods</i>	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.	Experience 1	Elements, Compounds and Mixtures
		Experience 2	The Periodic Table
		Experience 3	Metals, Nonmetals, and Metalloids
		Experience 4	Subatomic Particles

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Unit 4 – Chemical Reactions <i>9 Class Periods</i>	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.	Experience 1	Chemical Reactions
	HS-PS1-7 : Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	Experience 2	Balancing Chemical Equations
	HS-ESS2-7 : Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.	Experience 3	Conservation of Mass
		Experience 4	Composition of the Atmosphere

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Unit 5 – Newton’s and Kepler’s Laws <i>5 Class Periods</i>	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.	Experience 1	Newton’s First Law
	HS-PS2-4 : Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the	Experience 2	Newton’s Second Law
		Experience 3	Newton’s Law of Universal Gravitation

	gravitational and electrostatic forces between objects. HS-ESS1-4 : Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	Experience 4	Kepler's Laws
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Unit 6 – Conservation of Momentum <i>5 Class Periods</i>	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.	Experience 1	Momentum and Conservation of Momentum
		Experience 2	Conservation of Momentum
		Experience 3	Impulse
		Experience 4	Engineering Design Egg Helmet

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Unit 7 – Electricity 5 Class Periods	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.	Experience 1	Electrostatics
	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.	Experience 2	Coulomb’s Law and Electric Fields
	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.	Experience 3	Circuits
		Experience 4	Circuitry Challenge

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Unit 8 – Periodic Trends and Chemical Bonding I 5 Class Periods	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.	Experience 1	Periodic Trends
		Experience 2	Reactivity Series
		Experience 3	Ionic and Covalent Bonding

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Unit 9 – Chemical Bonding II and Properties of Compounds <i>5 Class Periods</i>	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-PS2-6 : Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	Experience 1	Polarity and Intermolecular Forces
		Experience 2	Intermolecular Forces and Phase Changes
		Experience 3	Intermolecular Forces and Freezing Point Depression
		Experience 4	Materials and Design Polymers

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<p>Unit 10 – Magnetism and Motors 4 Class Periods</p>	<p>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.</p>	Experience 1	Magnetic Fields
	<p>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.</p>	Experience 2	Electromagnetism and Motors
	<p>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.</p> <p>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.</p> <p>HS-ESS2-3: Develop a model based on evidence of Earth’s interior to describe the cycling of matter by thermal convection.</p>	Experience 3	Earth’s Magnetic Field

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<p>Unit 11 – Light and the Electromagnetic Spectrum 4 Class Periods</p>	<p>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.</p>	Experience 1	Wave Particle Duality and the Photoelectric Effect
	<p>HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.</p> <p>HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.</p>	Experience 2	The Electromagnetic Spectrum
	<p>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.</p>	Experience 3	Technology and Waves for Data Transmission
	<p>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.</p> <p>HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to</p>	Experience 4	Light Spectra and the Big Bang Theory

	<p>transmit and capture information and energy.</p> <p>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.</p> <p>HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.</p>		
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Unit 12 – Nuclear <i>3 Class Periods</i>	<p>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.</p> <p>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 in the form of radiation.</p> <p>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.</p>	Experience 1	Fission, Fusion, and Radioactive Decay
	<p>HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.</p> <p>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.</p>	Experience 2	Life Cycle of the Sun

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<p>Unit 13 – Thermodynamics and Equilibrium <i>weeks</i></p>	<p>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.</p>	Experience 1	Temperature Changes and Chemical Reactions
	<p>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.</p>	Experience 2	Collision Theory
	<p>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.</p>	Experience 3	Equilibrium and Conservation of Energy
	<p>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.</p> <p>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).</p>	Experience 4	Entropy and the 2 nd Law of Thermodynamics

	<p>HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).</p> <p>HS-ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.</p>	Experience 5	Convection Currents and the Earth
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