8th grade Physical Science
Program of Studies Description

Physical Science is a year-long exploration of the principles that govern matter and energy. Students will engage in scientific inquiry and hands-on investigations to build a strong foundation in motion, forces, energy, waves, electricity, and magnetism, as well as the structure, properties, and interactions of matter. Key areas of study include describing and measuring motion, applying Newton's laws, analyzing design process, and forces in fluids, and examining various forms of energy such as thermal, light, and sound. Students will also investigate the nature of matter through the study of states of matter, atomic structure, the periodic table, elements, bonding, and chemical reactions. Additional topics include mixtures, solutions, the periodic table, as well as wave behavior and the interactions of gravity, electricity and magnetism. Throughout the course, students will apply the metric system, practice laboratory safety, and use engineering and problem-solving skills to analyze patterns, design experiments, and connect physical science concepts to real-world applications.

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Course Description: Physical Science is a year-long exploration of the principles that govern matter and energy. Students will engage in scientific inquiry and hands-on investigations to build a strong foundation in motion, forces, energy, waves, electricity, and magnetism, as well as the structure, properties, and interactions of matter. Key areas of study include describing and measuring motion, applying Newton's laws, analyzing design process, and forces in fluids, and examining various forms of energy such as thermal, light, and sound. Students will also investigate the nature of matter through the study of states of matter, atomic structure, the periodic table, elements, bonding, and chemical reactions. Additional topics include mixtures, solutions, the periodic table, as well as wave behavior and the interactions of gravity, electricity and magnetism. Throughout the course, students will apply the metric system, practice laboratory safety, and use engineering and problem-solving skills to analyze patterns, design experiments, and connect physical science concepts to real-world applications.

REQUIRED TOPICS OF STUDY	SUGGESTED INSTRUCTIONAL TIME	STANDARDS/ ELIGIBLE CONTENT	COMMON ASSESSMENT
Nature of Science / Safety Inquiry and Engineering Process ● Scientific method vs. engineering design process ● Lab safety & proper equipment use ● Measurement (metric system) ● Variables, controls, and fair testing	5 weeks	**3.5.6-8.N – Asking Questions & Defining Problems** **3.5.6-8.O – Developing & Using Models** **3.5.6-8.P – Planning & Carrying Out Investigations** **3.5.6-8.W – Engaging in Argument from Evidence**	**Calculator Check-In** **Metric Labs - mass, length, volume** **Marble Race Exp Lab** **NOS Unit 1/2 Quiz** **NOS Metric Quiz** **NOS Vocabulary Assessment** **Tower Lab** **Inquiry Activity**
Describing Motion - speed and acceleration ● Speed, velocity, acceleration ● Distance vs. displacement ● Graphing motion (position-time graphs)	2-4 weeks	**MS-PS2-2 – Motion and stability** **MS-ETS1-4 – Data analysis from testing models**	**Motion Sensor Lab - describing motion** **Describing Motion Vocabulary Assessment**
Forces and Laws of Motion ● Newton's 3 Laws ● Net force and unbalanced forces ● Friction and gravity	2-4 weeks	**MS-PS2-1 – Newton's Laws** **MS-PS2-2 – Forces and motion**	**Newton's Laws Lab** **Force Diagram Analysis** **Unit Quiz**

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Work and Simple Machines/Forces and Fluids ● Work and mechanical advantage ● Simple machines ● Buoyancy and fluid forces	2 weeks	**MS-PS2-2** **MS-ETS1-2 – Design solutions**	Simple Machine Build Lab Fluid Density Lab CER (Claim-Evidence-Reasoning) Task Unit Quiz
Energy and Energy Resources ● Kinetic vs. potential energy ● Energy transformations ● Renewable vs. nonrenewable energy	2 weeks	**MS-PS3-1 – Energy transfer** **MS-PS3-2 – Conservation of energy**	Energy Transfer Lab Roller Coaster Investigation Energy Quiz KE PE Lab Unit Quiz
Thermal Energy ● Heat vs. temperature ● Conduction, convection, radiation ● Insulation and energy efficiency	2 weeks	**MS-PS3-3 – Thermal energy transfer**	Heat Transfer Lab Insulation Challenge Unit Assessment
Foundations of Chemistry ● Atoms, molecules, compounds ● Physical vs. chemical properties	2 weeks	**MS-PS1-1 – Structure of matter**	Classification Lab Properties Investigation Vocabulary Assessment Build-A-Phase Unit Quiz
States of Matter/Understanding the Atom ● Solid, liquid, gas ● Atomic structure (protons, neutrons, electrons) ● Phase changes	2 weeks	**MS-PS1-4 – Particle motion and states**	States of Matter Lab Unit Quiz
The Periodic Table	3 weeks	**MS-PS1-1**	Element Research Project

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• Organization of elements • Groups, periods, trends • Metals, nonmetals, metalloids			Periodic Table Create the table Unit Test Hunting the Elements Activity
Elements and Chemical Bonds • Ionic vs. covalent bonds • Valence electrons • Molecule formation	2 weeks	**MS-PS1-2 – Chemical bonding**	Bonding Models Lab Lewis Dot Structures Quiz
Chemical Reactions and Equations • Types of reactions • Balancing equations • Evidence of chemical change	2 weeks	**MS-PS1-2** **MS-PS1-5 – Conservation of mass**	Reaction Lab (Open/Closed System) Balancing Equations Practice Unit Test
Mixtures, Solubility and Acid Base Chemistry • Homogeneous vs. heterogeneous mixtures • Solubility • pH scale	1 weeks	**MS-PS1-2**	Mixtures Lab pH Testing Activity Unit Test
Waves – Sound and Light • Wave properties (frequency, wavelength) • Sound vs. light waves • Reflection and refraction	2 weeks	**MS-PS4-1 – Wave properties** **MS-PS4-2 – Wave interactions**	Wave Simulation Activity Light Investigation Unit Quiz
Electricity and Magnetism • Circuits (series vs. parallel) • Current and voltage • Magnetism and electromagnetism	2 weeks	**MS-PS2-3 – Electromagnetic forces**	Circuit Build Lab Electromagnet Demo Unit Test

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Unit 1	**Nature of Science - Integration of Knowledge, Technologies, and Practices**
Big Idea	● Scientists and engineers use systematic investigations, precise measurements, and controlled variables to understand patterns, test designs, and solve real-world problems. ● Cause and effect relationships can be investigated through controlled experiments and precise measurements, forming the basis for scientific knowledge and engineering design.
Unit Essential Questions:	1. Why do scientists and engineers need to design fair tests when investigating a problem? 2. How do independent and dependent variables help us understand cause and effect in the natural world? 3. Why is using the metric system important in science and engineering? 4. How does accurate measurement influence the reliability of experimental results? 5. In what ways do scientists and engineers use data to design, test, and improve solutions to real-world problems? 6. How can changing one variable at a time reveal patterns and relationships in science and engineering? 7. What makes an investigation or design “scientific”?

Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
2 weeks	**3.5.6-8.W (ETS)** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	constant Control Group critical thinking	Unit 1 Resources and lessons	Unit 1 Assessments Assessments Vocab Quiz Lesson 1-2 Quiz Metric Lesson Quiz Mass, Volume,	Collaborative Communicative Problem solver

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1 week	**3.5.6-8.N (ETS):** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved	dependent variable experimental group hypothesis independent variable		Length Lab Marble Maze Lab Concrete Lab and Drop Activity Tower Lab	Creative Critical thinker Communicative Adaptable Collaborative Problem solver
1 week	**3.5.6-8.O (ETS):** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each	International System of Units (SI) qualitative data quantitative data		IXL A2, A1, A3, B1, B3, B4, B7	
1 week	**3.5.6-8.P (ETS):** Evaluate competing design solutions using a systematic process to determine how well they meet criteria and constraints.	science scientific law scientific theory variable			

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Unit 4	**Forces and Motion**
Big Idea	**A change in motion of interacting objects can be explained and predicted by forces.**
Unit Essential Questions:	• **How can one predict an object's continued motion, changes in motion, or stability?** • **How can we describe the motion of an object using speed, direction, and time?** • **What factors affect how fast an object moves or changes direction?** • **How are speed, velocity, and acceleration related?** • **What happens to an object's motion when balanced and unbalanced forces act on it?** • **How do Newton's Laws explain real-world motion and collisions?** • **How can momentum be used to predict the outcome of interactions between moving objects?**

Dates/weeks	PA Standards/ Eligible Content	Vocabulary	Instructional Materials	Common Assessments	Link to Profile of a Zephyr
1 week	3.2.6-8.G (PS) Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.	force net force balanced unbalanced Newton's 1st law Newton's 2nd law Newton's 3rd law		Force Diagrams Egg Drop	Adaptable Collaborative Creative Critical thinker Communicative Problem solver
1 week	3.2.6-8.H (PS)	reference			

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	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	point force mass acceleration motion			
2 weeks	3.2.8.A1: Plan and carry out investigations to describe and graph the motion of an object in terms of position, direction, and speed.	Motion Speed Velocity Acceleration Momentum Force Inertia Friction Gravity Mass Distance Time Direction Newton's Laws Unbalanced Forces Balanced Forces Reference Point Displacement Energy Collision			
1 week	3.2.8.A2: Construct and interpret data to show relationships among speed, velocity, and acceleration.				

	3.2.8.A3: Apply Newton's laws to explain how changes in force and mass affect motion. 3.2.8.A4: Use mathematical representations to describe and predict changes in momentum and energy in systems of colliding objects.				

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Unit 2	**Structure and Properties of Matter**				
Big Idea	**All forms of matter exist as a result of the combination or rearrangement of atoms.**				
Unit Essential Questions:	**How do particles combine to form the variety of matter one observes?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
2 weeks	3.2.6-8.A(PS) Develop models to describe the atomic composition of simple molecules and extended structures.	atoms molecules bonding compounds elements			Adaptable Collaborative Creative Critical thinker Communicative Problem solver
2 weeks	3.2.6-8.B(PS) Develop a model that predicts and describes changes in the particle motion, temperature and state of a pure substance when thermal energy is added or removed.	gas liquid solid molecular motion temperature thermal energy heat			

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Unit 3	**Chemical Reactions**				
Big Idea	**The atoms of some substances combine or rearrange to form new substances that have different properties.**				
Unit Essential Questions:	**How do substances combine or change (react) to make new substances?** **How does one characterize and explain these reactions and make predictions about them?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
2	3.2.6-8.C (PS) Gather and make sense of information to describe how synthetic materials come from natural resources and impact society.	reactants molecules substance synthetic material natural resource	Reaction Lab (open/closed); **Reactivity Lab**; pH Lab	Unit Test Lab Check ins	Adaptable Collaborative Creative Critical thinker Communicative Problem solver
1	3.2.6-8.D(PS) Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	reactants products precipitate chemical change mixture compounds yields physical properties chemical properties	Chemical reaction powders lab		
0.5	3.2.6-8.E(PS)	chemical			

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	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	equation conservation of mass open vs. close system yields reactants products			
0.5	3.2.6-8.F(PS) Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	electrical endothermic exothermic			

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Unit 5	**Types of Interactions**				
Big Idea	**All forces between objects, regardless of size or direction, arise from only a few types of interactions.**				
Unit Essential Questions:	**What underlying forces explain the variety of interactions observed?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
1 week	3.2.6-8.I (PS) Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	magnetic force electric current electromagnetic	Motion Sensor Lab; Newton's Laws Lab; Cement Puck Drop Lab (impact & force);		Adaptable Collaborative Creative Critical thinker Communicative Problem solver
1 week	3.2.6-8.J (PS) Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	gravitational forces law of universal gravity mass weight	Gravity Webquest		
0.5 week	3.2.6-8.K (PS) Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	electric force magnetic force gravitational	EM Spectrum Demo		

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Unit 6	**Definitions of Energy**				
Big Idea	**Energy can be modeled as either motions of particles or as being stored in force fields.**				
Unit Essential Questions:	**What is energy?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
2-4 weeks	3.2.6-8.L (PS) Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object.	speed velocity acceleration kinetic energy mass	KE/PE Lab Car Lab Sensor Lab Force Disagrams	Energy Quiz Unit Test KE/PE Lab Car Lab Sensor Lab Force Disagrams	Adaptable Collaborative Creative Critical thinker Communicative Problem solver
	3.2.6-8.M Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	speed velocity acceleration kinetic energy mass	KE/PE Lab Car Lab Sensor Lab Force Disagrams	Energy Quiz Unit Test KE/PE Lab Car Lab Sensor Lab Force Disagrams	Adaptable Collaborative Creative Critical thinker Communicative Problem solver

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Unit 7	**Conservation of Energy and Energy Transfer**				
Big Idea	**The total change of energy in any system is always equal to the total energy transferred into or out of the system.**				
Unit Essential Questions:	**What is meant by conservation of energy?** **How is energy transferred between objects or systems?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
2 weeks	3.2.6-8.M (PS) Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	thermal energy temperature heat conductivity energy transfer	Heat Packet	Unit Test Heat Quiz Build-a-phase Project	Adaptable Collaborative Creative Critical thinker Communicative Problem solver
	3.2.6-8.N (PS) Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	thermal energy energy transfer kinetic energy	Heat Lab - heat cold transfer	Heat Transfer	Adaptable Collaborative Creative Critical thinker Communicative Problem solver
	3.2.6-8.O (PS) Construct, use, and present arguments to support the claim that when the kinetic energy of an object	kinetic energy Temperature motion matter	Build-a-Phase		Adaptable Collaborative Creative Critical thinker

	changes, energy is transferred to or from the object.				Communicative Problem solver

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Unit 8	**Relationship Between Energy and Energy Forces**				
Big Idea	**Forces between objects can result in transfer of energy between these objects.**				
Unit Essential Questions:	**How are forces related to energy?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
2 weeks	3.2.6-8.P (PS) Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	potential energy electric force magnetic force gravitational force	Gravity Webquest Space and Gravity Gravity Questions	Model explanation Unit Quiz	Adaptable Collaborative Creative Critical thinker Communicative Problem solver

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Unit 9	**Wave Properties**				
Big Idea	**Waves are repeating patterns of motion that transfer energy and information without transferring matter.**				
Unit Essential Questions:	**What are the characteristic properties and behaviors of waves?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
1-2 weeks	3.2.6-8.Q (PS) Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	amplitude frequency crest trough wavelength	Wave Simulation Sound Lab	Unit Quiz Diagram analysis	Adaptable Collaborative Creative Critical thinker Communicative Problem solver

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Unit 10	**Electromagnetic Radiation**				
Big Idea	**Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave pattern of changing electric and magnetic fields that interact with matter.**				
Unit Essential Questions:	**What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
1-2 weeks	3.2.6-8.R (PS) Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.	frequency color light reflection transmission absorption	Light Investigation Refraction activity	Unit Quiz	Adaptable Collaborative Creative Critical thinker Communicative Problem solver

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Unit 11	**Information Technologies and Instrumentation**				
Big Idea	**Useful modern technologies and instruments have been designed based on an understanding of waves and their interactions with matter.**				
Unit Essential Questions:	**How are instruments that transmit and detect waves used to extend human senses?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
1 week	3.2.6-8.S (PS) Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	waves transmission	Signal comparison activity in various mediums Technology applications	Exit Tickets	Adaptable Collaborative Creative Critical thinker Communicative Problem solver

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Unit 12	**Electricity & Magnetism**				
Big Idea	**Electrical and magnetic interactions arise from the motion and arrangement of charged particles. These interactions can be used to transfer energy, create forces at a distance, and design systems such as circuits and electromagnets that solve real-world problems.**				
Unit Essential Questions:	**How do electric charges create forces and interact with each other?** **How does energy move through a circuit?** **What factors affect the flow of electric current in a system?** **How are electricity and magnetism related?** **How can magnetic fields be created and used to produce motion or force?** **How do engineers design and optimize electrical systems to solve real-world problems?**				
Dates/weeks	**PA Standards/ Eligible Content**	**Vocabulary**	**Instructional Materials**	**Common Assessments**	**Link to Profile of a Zephyr**
1-2 weeks	3.2.6-8.I Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	circuit, current, voltage, resistance	Circuit Demo	Lab Activity	Problem solver Critical thinker
	3.2.6-8.K Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	series/parallel	Circuit Lab	Unit Quiz	Problem solver Critical thinker
	3.2.6-8.M Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	open/closed			Problem solver Critical thinker

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