KUTZTOWN AREA SCHOOL DISTRICT
Maximize potential, embrace change, create the future

Kutztown Area School District Curriculum (Unit Map)

Physical Science
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Course Description: This course will follow a discovery lab program that develops an understanding of the fundamental natural laws concerning motion, energy, and chemistry, with an emphasis on physical and chemical laws. The course is designed to develop experimentation and problem solving skills. Whenever possible, problems are chosen that demonstrate the application of scientific understandings to the real world. Experiments will be conducted, data will be analyzed, conclusions will be made, and formal lab reports will be written in this course. Students are required to keep work assignments in a laboratory notebook.

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Unit #/Title	1/Scientific Method and Measurement	Time Frame	3-4 Weeks

Standards	
2.1.A1.D. Use exponential, scientific, and calculator notation to represent any rational number . **2.5.A1.B.** Use symbols, mathematical terminology, standard notation, mathematical rules, graphing, and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas, and results.	
Big Ideas	**Essential Questions**
• Science is the attempt to understand and explain the natural world. • Preparation is important when carrying out scientific investigations.	• How does science attempt to explain the natural world? • What is a standard of measurement? • How can data be analyzed, interpreted, and represented?
Content	**Skills**
• Scientists use measurements based on the Metric System. • The difference in using the Metric System versus the English System. • Identifying and implementing the steps of the Scientific Method. • Conducting a laboratory experiment within a safe environment.	• Create and interpret graphs • Relate steps of scientific method to real life situations • Convert metric to metric, English to metric, English to English • Perform calculations (basic mathematical operations) using numbers in scientific notation • Convert between proper scientific notation and standard form

Unit #/Title	2/Properties of Matter	Time Frame	3-4 Weeks

Standards	
3.2.C.A1. Differentiate between physical properties and chemical properties. **3.1.10.B6.** Identify questions and concepts that guide scientific investigations.	
Big Ideas	**Essential Questions**
• All objects and substances in the world are made of matter. • All kinds of matter can be identified based on their physical and chemical properties. • Solids, liquids, and gases all have mass, volume and density, each of which can be measured or calculated.	• Are changes in matter related to changes in energy? • How can characteristic properties be used to distinguish one form of matter from another? • How can things float and sink?

Content	Skills
• Irregularly shaped objects require the use of water displacement and/or an overflow can to assist in determining their density. • Density is a characteristic property that can be used to identify an object and is calculated by mass divided by volume. • Objects will float or sink based on their densities.	• Determine if an object floats or sinks based on its density • Determine density using water displacement and an overflow can • Identify substances based on their densities • Distinguish between mass, volume, and density

Unit #/Title	3/Motion and Forces	Time Frame	5-6 Weeks

Standards
3.2.10.B1. Analyze the relationships among the net forces acting on a body, the mass of the body and the resulting acceleration using Newton's Second Law of Motion. **3.2.10.B1.**Use Newton's Third Law to explain forces as interactions between bodies. **3.2.P.B1**. Differentiate among translational motion, simple harmonic motion and rotational motion in terms of position, velocity and acceleration. **3.2.P.B1.** Use force and mass to explain translational motion or simple harmonic motion of objects. **3.2.8.B1**. Explain how inertia is a measure of an object's mass.

Big Ideas	Essential Questions
• Newton's three laws are applied to understand motion in the real world. • A relationship exists between forces and motion. • Everything in the universe is in motion relative to some reference point.	• How do Newton's three laws attempt to explain the natural world? • Why do objects move the way that they do? • What is the relationship between motion and forces? • In what ways do forces occur?

Content	Skills
• Everything in the universe is in motion relative to some reference point. • Inertia is a body's resistance to any change in motion. • How a body accelerates is determined by its mass and the force exerted on it. • Free Body Diagrams identify the forces acting on an object. • All forces occur in pairs called action/reaction forces, which are equal and opposite. • Understand motion as it relates to velocity, speed, acceleration, force, and Newton's 3 Laws.	• Solve variable algebraic equations • Distinguish between weight and mass • Explain how forces change the motion of matter • Predict an object's motion • Identify forces acting on an object

Unit #/Title	4/Work, Power, and Energy	Time Frame	4-5 Weeks

Standards	
3.2.10.B2. Explain how the overall energy flowing through a system remains constant. **3.2.10.B2**. Describe the work-energy theorem. **3.2.10.B2.** Explain the relationships between work and power. **3.2.10.B3.** Describe the law of conservation of energy.	
Big Ideas	**Essential Questions**
• Energy can be transferred between objects and/or can be converted into different forms. • The amount of energy before a transformation is equal to the amount of energy after the transformation. • Work is the change in energy. • Power is a described in terms of work and time.	• How is energy transferred between objects and converted into different forms? • How do objects interact with each other? • Where does energy come from and where does it go? • How do we know things have energy?
Content	**Skills**
• The energy of an object is related to its mass, velocity, and height. • Various forms of energy exist and behavior differently. • Mechanical energy of an object is the sum of its kinetic energy and its potential energy at any point in time. • Energy can be changed and conserved.	• Solve variable algebraic equations • Differentiate kinetic and potential energy • Calculate kinetic and potential energy • Design and carry out investigations to determine how changing the mass of an object or changing its speed changes its kinetic energy • Identify the mechanical energy of objects in different circumstances and identify whether the mechanical energy consists of KE, PE or both • Calculate work and power

Unit #/Title	5/Simple Machines	Time Frame	1-2 Weeks

Standards	
3.2.10.B2. Explain how the overall energy flowing through a system remains constant.	
Big Ideas	**Essential Questions**
• A relationship exists between work and energy. • Energy has many forms and can be transferred through work. • Simple machines make doing work easier.	• How do simple machines make doing work easier? • Where is the law of conservation of energy demonstrated in the world around you? • How is the word energy commonly used?

Content	Skills
• Understanding of why no system is 100% efficient. • Machines make doing work easier. • Understanding of the methods used to classify simple machines.	• Identify examples of simple machines • Calculate mechanical advantage and machine efficiency • Demonstrate knowledge of the usefulness of simple machines • Analyze and describe the relationship among work, power, and efficiency

Unit #/Title	6/Temperature & Thermal Energy	Time Frame	3 Weeks

Standards
3.2.10.A3 Describe phases of matter according to the kinetic molecular theory. **3.2.C.A3** Describe the three normal states of matter in terms of energy, particle motion and phase transitions. **3.2.12.B3** Describe the relationship between the average kinetic molecular energy, temperature and phase changes. **ALGEBRA I 2.6.A1.C**. Construct a line of best fit and calculate its equation for linear and nonlinear two variable data.

Big Ideas	Essential Questions
• Matter is conserved during a change of state. • The Kinetic-Molecular Model of matter explains and predicts phase changes of matter relative to changes in thermal energy. • Thermal energy is a form of energy that can be transferred as well as converted into other forms of energy.	• How is energy transferred and transformed? • How is energy stored in food? • Why do objects store and transfer heat differently? • How are the laws of thermodynamics related?

Content	Skills
• States of matter are classified based on motion of particles. • Compare and contrast temperature and thermal energy. • The relationship between converting degrees Fahrenheit, degrees Celsius, and Kelvin. • Charles' Law and Boyle's Law are used to describe the relationship between temperature, pressure, and volume in gases.	• Distinguish between the different states of matter • Identify phase changes • Identify and distinguish between the gas laws • Identify the graphical relationships of the gas laws • Distinguish between the three types of temperature scales • Convert values using the three temperature scales • Describe the relationship between thermal energy and temperature

Unit #/Title	7/Heat	Time Frame	3 Weeks

Standards
3.2.10.B3 Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached. **3.2.10.B3** Analyze the processes of convection, conduction and radiation between objects or regions that are at different temperatures. **3.2.10.A4**. Explain the difference between an endothermic process and an exothermic process. **3.2.8.B3** Explain how changes in temperature are accompanied by changes in kinetic energy.

Big Ideas	Essential Questions
• Energy can be transferred or transformed through a variety of mechanisms, and in any change energy is lost through transformation into heat.	• How is heat transferred? • How does heat affect our world? • How is heat used in common, everyday systems?
Content	**Skills**
• Thermal energy is transferred through heat. • What classifies a reaction as being endothermic vs. exothermic. • Specific heat capacity is the amount of energy needed to change the temperature of 1g of a substance by 1°C. • Latent heat/Enthalpy is the heat required for a phase change. • The melting point and freezing point for a substance occur at the same temperature.	• Explain the relationship among different forms of energy transfer (radiation, conduction, convection) • Compare and contrast thermal conductors from thermal insulators • Calculate the amount of heat gained or lost • Construction of heating curves and cooling curves • Identify melting and freezing points • Calculate the latent heats of vaporization and fusion for substances • Convert between Joules and calories

Unit #/Title	8/Modern Atomic Theory	Time Frame	2 Weeks

Standards
3.2.C.A2. Draw Lewis dot structures for simple molecules and ionic compounds. **3.2.C.A2.** Explain how atoms combine to form compounds through both ionic and covalent bonding. **3.2.10.A1**. Predict properties of elements using trends of the periodic table.

Big Ideas	Essential Questions

• Atomic structure is related to the properties of elements, and their position on the periodic table.	• How does the structure of matter affect the properties and uses of materials? • How does the arrangement of the Periodic Table describe the properties of an element? • What gives an element its properties?
Content	**Skills**
• Physical and chemical changes • Atomic theory has changed throughout the years as technology has progressed. • Indirect evidence was initially used to predict structure of atom. • Atoms are made up of protons, neutrons, and electrons. • Correct spelling and recognition of the symbol for 30 common elements.	• Identify differences between chemical and physical changes • Identify signs of a chemical reaction • Identify major contributions from various scientists to atomic theory • Determine number of protons, neutrons, and electrons using the periodic table • Determine atomic mass of any element

Unit #/Title	9/Ionic & Covalent Bonding	**Time Frame**	2-3 Weeks

Standards	
3.2.C.A2. Draw Lewis dot structures for simple molecules and ionic compounds. **3.2.10.A2.** Compare and contrast different bond types that result in the formation of molecules and compounds. **3.2.C.A2**. Predict the chemical formulas for simple ionic and molecular compounds. **3.2.C.A2**. Predict chemical formulas based on the number of valence electrons.	
Big Ideas	**Essential Questions**
• All elements have isotopes. • Ionic bonds are formed by the gaining and losing of electrons. • Covalent bonds are formed by the sharing of electrons.	• How can the nuclei of the same element differ? • How can some nuclei change? • How do atoms form a covalent bond? • Why do atoms bond together? • How do atoms form an ionic bond?
Content	**Skills**
• Properties of compounds differ from the properties of the elements from which they are composed and the type of bond between them. • Bonding occurs when elements share, lose or gain electrons to achieve stability.	• Identify metals, nonmetals, and metalloids on the periodic table • Draw an ionic bond • Identify types of ions formed • Draw a covalent molecule

Unit #/Title	10/Periodic Table Trends	Time Frame	1.5-2 Weeks

Standards

3.2.C.A1. Explain the relationship of an element's position on the periodic table to its atomic number, ionization, energy, electronegativity, atomic size and classification of elements.

Big Ideas	Essential Questions
• Periodic trends in the properties of atoms allow for the prediction of physical and chemical properties. • Elements are substances that cannot be broken down into simpler forms of matter, and they are the primary constituents of all matter. • The elements are the basis of all chemical interactions, and the implications of the ways in which atoms interact are relevant to every aspect of our lives, from health to technology, energy, and the environment.	• What are periodic table trends, and how are periodic trends related to the structure of atoms? • How does understanding periodic trends allow us to predict properties of different elements? What properties can be predicted by understanding trends?
Content	**Skills**
• Each element has distinct characteristic properties. • Some elements are classified as metals because they have similar properties, and some are classified as nonmetals. • Each element has properties that affect its behavior and interaction with its environment. These properties can be predicted using the periodic table as a model. • Periodic trends include Atomic Number and Atomic Weight, Atomic Radius and Metallic Properties, and Electron Affinity, Electronegativity, and Ionization Energy. • Understanding the periodic trends allows scientists to make predictions about the properties of individual elements based on their position on the periodic table. • There are some exceptions to the rules of periodic trends.	• Explain why periodic trends occur. • Make predictions about the relative properties of elements using the periodic table as a model. • Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Unit #/Title	11/Chemical Reactions & Balancing Equations	Time Frame	2-3 Weeks

Standards

3.2.C.A4. Balance chemical equations by the laws of conservation of mass.
3.2.C.A4. Classify chemical reactions, as synthesis (combination), decomposition, single displacement (replacement), double displacement and combustion.

Big Ideas	Essential Questions
• A chemical reaction involves the breaking and reforming of chemical bonds to create new substances. • Every reaction involves energy and must express the conservation of mass.	• How do the Law of conservation of mass and chemical equations explain the interactions of atoms and molecules both conceptually and mathematically? • How are chemical reactions balanced? • How are reaction products predicted? • What is conserved in a chemical reaction? • Why do chemical reactions need to be balanced?
Content	**Skills**
• A chemical reaction is the breaking and forming of chemical bonds to produce new substances. • Chemical reactions can be expressed as equations. • Chemical reactions demonstrate the law of conservation of mass by showing an equal number of atoms of each element in the reactants and products. • Reactions can also be classified by energy loss or gain. • Chemical equilibrium is reached when the rate of a forward reaction equals the rate of a reverse reaction. • The equilibrium of a chemical reaction can be manipulated to maximize the amount of products made.	• Identify different types of reactions. • Predict products of reactions. • Write word equations and chemical equations balance chemical equations. • Use the type of reaction and the periodic table to predict the products of reactions. • Create and use models of particles to demonstrate balanced equations. • Identify four signs of a chemical reaction.

Unit #/Title	12/Classification of Matter	Time Frame	1.5 Weeks

Standards

3.2.C.A1. Differentiate between pure substances and mixtures; differentiate between heterogeneous and homogeneous mixtures.

Big Ideas	Essential Questions
• All matter can be classified as either a pure substance or a mixture. • Both mixtures and pure substances can be broken down into subcategories. • There are techniques chemists use to determine in which category a sample of matter belongs.	• How is matter classified? • How does the structure of matter affect the properties and uses of materials? • How are the properties of elements different from the properties of compounds?
Content	**Skills**
• Compounds have different properties than the individual elements of which they are made. • Vocabulary: element, compound, mixture, homogeneous mixture, heterogeneous mixture, Tyndall effect, colloid	• Distinguish between a homogenous mixture and a heterogenous mixture. • Interpret and construct solubility curves. • Define solute, solvent, and solubility. • Calculate solution concentration.