EAST PENN SCHOOL DISTRICT

Chemistry Matters
DATE OF APPROVAL

Unit 1 - Structure and Properties of Matter

<table>
<tr><th colspan="3">STAGE 1 | DESIRED RESULTS</th></tr>
<tr><th>Standards</th><th colspan="2">Transfer</th></tr>
<tr><td rowspan="5">3.2.9-12.A 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.

3.2.9-12.B 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.

3.2.9-12.N Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials.

3.2.9-12.P 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).</td><td colspan="2">Students will be able to independently use their learning to...
❑ Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
❑ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
❑ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
❑ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
❑ Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ All forms of matter exist as a result of the combination or rearrangement of atoms.
❑ All forces between objects, regardless of size or direction, arise from only a few types of interactions.
❑ Energy can be modeled as either motions of particles or as being stored in force fields.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ How do particles combine to form the variety of matter one observes?
❑ What underlying forces explain the variety of interactions observed?
❑ What is energy?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know...
❑ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
❑ The periodic table orders elements horizontally by the number of protons in the</td><td>Students will be skilled at...
❑ Developing and using models to explain why lightning happens and why some places are safer than others when it strikes.
❑ Planning and carrying out investigations with various materials to</td></tr>
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	atom's nucleus and places those with similar chemical properties in columns. ❑ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ❑ Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. ❑ Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. ❑ That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. ❑ At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles).	produce and analyze static interactions. ❑ Using simulations and other methods to model subatomic particles: electrons, protons, neutrons, as well as electrostatic forces. ❑ Using the periodic table to determine the names and chemical symbols of elements ❑ Using atomic mass and atomic number from the periodic table to determine the subatomic structure of atoms and ions. ❑ Modeling the transfer of electrons in ionic bonds. ❑ Using periodic patterns to name and write the chemical formulas for ionic compounds ❑ Carrying out investigations to determine how increasing the concentration of aqueous ionic solutions affects the rate of charges flowing through it ❑ Comparing and contrasting the physical and chemical properties of metals, nonmetals, and metalloids. ❑ Modeling how polarity in molecular structures results from an unequal distribution of charges. ❑ Modeling how energy cannot be created nor destroyed–only moved between systems.

Unit 2 - Molecular Processes

<table>
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<tr><td rowspan="6">3.2.9-12.A 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.

3.2.9-12.C 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.

3.2.9-12.G Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td>
<td colspan="2">Students will be able to independently use their learning to...
❑ Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
❑ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
❑ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
❑ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
❑ Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that...
❑ All forms of matter exist as a result of the combination or rearrangement of atoms.
❑ The atoms of some substances combine or rearrange to form new substances that have different properties.</td>
<td>ESSENTIAL QUESTIONS
Students will keep considering...
❑ How do particles combine to form the variety of matter one observes?
❑ How do substances combine or change (react) to make new substances?
❑ How does one characterize and explain these reactions and make predictions about them?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know...
❑ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
❑ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.</td>
<td>Students will be skilled at...
• Determining the electron configuration of an atom
• Modeling atomic structure using Lewis Dot Diagrams
• Using Lewis Structures to model covalent bonding
• Modeling the transfer of electrons in an ionic bonding
• Comparing and contrasting physical and chemical changes
• Using electronegativities to determine bond type.</td></tr>
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	❑ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	• Using "Like Dissolves Like" as a simple rule to explain how non-polar solvents dissolve non-polar substances and polar solvents dissolve both polar and ionic substances. • Modeling and writing balanced chemical equations.

Unit 3 - Chemical and Nuclear Energy

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<tr><td rowspan="3">3.2.9-12.D 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.

3.2.9-12.H 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.

3.2.9-12.P 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</td><td colspan="2">Students will be able to independently use their learning to…
❑ Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
❑ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
❑ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.
❑ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
❑ Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…
❑ All forms of matter exist as a result of the combination or rearrangement of atoms.
❑ Phenomena involving nuclei explain the formation of the elements, radioactivity, and the release of energy.</td><td>ESSENTIAL QUESTIONS
Students will keep considering…
❑ How do particles combine to form the variety of matter one observes?
❑ What forces hold nuclei together and mediate nuclear processes?
❑ What is energy?</td></tr>
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associated with the relative positions of particles (objects).	❑ Energy can be modeled as either motions of particles or as being stored in force fields.	
	Acquisition	
	Students will know... ❑ A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. ❑ Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. ❑ Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. ❑ The total number of neutrons plus protons does not change in any nuclear process. ❑ Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. ❑ That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.	*Students will be skilled at...* ❑ Systematically using lenses of matter, energy, and forces to help explain the mechanisms behind different fuels providing energy to vehicles. ❑ Evaluating different fuels ❑ Supporting arguments and design decisions with data from a variety of sources. ❑ Determining the energy and matter flows into and out of a chemical reaction while analyzing the role of activation energy in the reaction process. ❑ Planning and conducting an experiment to compare and contrast the characteristics of endothermic and exothermic reactions ❑ Model nuclear fission and fusion reactions to illustrate and explain the energy released during these processes. ❑ Writing nuclear equations to model radioactive decay. ❑ Using atomic mass and mass number to determine the subatomic structure of isotopes. ❑ Solving problems involving half-life calculations using real-world isotopes, and representing decay processes graphically. ❑ Identifing and classifying the characteristics of alpha, beta, and gamma radiation, including their charge, mass, penetration power, and methods of detection. ❑ Determining changes in pressure, volume, and temperature using the gas laws.