Mendon High School Science Curriculum Map

Time Frame: September – January <u>Chemistry</u>

Unit 1: Structure and Properties of Matter

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
Students who demonstrate understanding can: **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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [*Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.*] **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. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on	**PS1.A: Structure and Properties of Matter** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) 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. (HS-PS1-1) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6) **PS1.C: Nuclear Processes**	How can one explain the structure, properties, and interactions of matter? What is the most useful type of information obtained by the organization of the periodic table? How is energy related to fusion, fission and radioactive decay?	**<u>Before</u>:** KWL – Students will list what they know and what they want to know about atoms. This will be repeated with each concept throughout the unit. (periodic table, fusion, decay, etc) Quick Writes – Before each lesson students will be asked to write their thoughts and questions for the day pertaining to the objectives. Pretest – Students will be given an assessment to understand their knowledge on the unit before instruction is given. **<u>During</u>:** Think/Pair/Share – Students will work in pairs to practice and reinforce rules as they are introduced.	Absorbance spectrum Actual mass Atomic bonding principles Atomic mass Atomic motion Atomic nucleus Atomic number Atomic theory Atomic weight Avogadro's hypothesis Avogadro's number Binary Binary compound Bond energy Bright line spectrum Carbon atom Carbon atom Carbon dioxide Charged object Chemical bond Chemical properties of elements Covalent bond Crystalline solid Decay rate Double bond Earth's elements Electric force Electrical conductivity Electrically neutral Electromagnetic field Electromagnetic radiation Electromagnetic spectra

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naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [*Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.*] **HS-PS1-8** Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy release during the processes of fission, fusion, and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [*Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.*] **HS-PS2-6** Communicate scientific and technical information about why the	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. (HS-PS1-8) **PS2.B: Types of Interactions** 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	How do the properties of the atomic particles affect the interactions of those atoms?	Conferences – Check for understanding by meeting with students during work time. Lab Investigations – Students will be responsible for developing and implementing one or more lab investigation(s) exploring the periodic table, nuclear processes, and properties of elements. **<u>After</u>:** Posttest: Students will be given a test after the unit has been completed and the Presentations have been given. Project: Students will create a presentation using multi-media (as a group) of this unit. This will include various concepts, experimental data, vocabulary, and applications in the "real world" and will focus on predictions of an imaginary element. Assessed by teacher created rubric.	Electromagnetic wave Electron Electron cloud Electron configuration Electron sharing Electron transfer Electro-negativity Element family Elementary particle Elements of matter Emission spectra Empirical formula Endothermic process Energy level Energy sublevels Enthalpy Excited state Exothermic process Fossil fuel Ground state Hydrocarbons Intermolecular force Ion Ionic bond Ionization energy Isomers Isotope Kernel Lewis structures Main energy level Main group elements Metallic bond Metalloids Mole Molecular formula Monomer Moving electric charge Neutron mass to energy conversion

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
molecular-level structure is important in the functioning of designed materials. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [*Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.*] **HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.				Nuclear reaction Orbital shape Orbitals Organic matter Outer electron Periodic table of the elements Polarity Potential energy Probability Protein Proton Quantum energy Quantum numbers Radioactive dating Radioactive decay Radioactive isotope Relative mass Release of energy Single bond Stable Strong force Sublevel Synthetic polymer Thermal conductivity Transforming matter and/or energy Valence electrons Wave amplitude Wavelength Weight of subatomic particles

Mendon High School Curriculum Map

Time Frame: January – April
Chemistry
Unit 2: Chemical Reactions

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
Students who demonstrate understanding can: **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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [*Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.*] **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. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models	**PS1.A: Structure and Properties of Matter** 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. (HS-PS1-2) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.) 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. (HS-PS1-4) **PS1.B: Chemical Reactions** Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules	How can one explain the structure, properties, and interactions of matter? How can one explain and predict interactions between objects and within systems of objects? How can you determine if a chemical reaction will occur?	**Before:** KWL – Students will list what they know and what they want to know about atoms. This will be repeated with each concept throughout the unit. (periodic table, fusion, decay, etc) Quick Writes – Before each lesson students will be asked to write their thoughts and questions for the day pertaining to the objectives. Pretest – Students will be given an assessment to understand their knowledge on the unit before instruction is given. **During:** Think/Pair/Share – Students will work in pairs to practice and reinforce rules as they are introduced.	Acid rain Acid/base reaction Acidic Alkaline Atomic weight Basic Boiling point Bronsted-lowry Carboxyl group Chemical bond Delta (meaning change) Dipole-dipole bond Dispersion forces Endothermic process Endothermic reaction Exothermic process Exothermic reaction Hydrogen bonding Hydrogen ion Hydronium ion Hydroxide Ion Ionic solid (crystal) Kw Limiting reagent Melting point Metal Molar volume Network solid Neutral Neutralize Oxidation

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [*Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.*] **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. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [*Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.*] **HS-PS1-6** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at	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. (HS-PS1-4),(HS-PS1-5) In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6) 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. (HS-PS1-2),(HS-PS1-7) **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically and decisions about the priority of certain criteria over others (trade-offs)	How can you prove that mass is conserved during a chemical reaction?	Lab Investigations – Students will be responsible for developing and implementing one or more lab investigation(s) exploring the periodic table, nuclear processes, and properties of elements. Daily Assignments – Students will be given assignments that will check for understanding. Drawings – Students will be responsible for molecular drawing to show understanding. **<u>After</u>:** Posttest: Students will be given a test after the unit has been completed and the Presentations have been given. Project: Students will create a presentation using multi-media (as a group) of this unit. This will include various concepts, experimental data, vocabulary, chemical equations and applications in the "real	Ph Pressure Product Properties of reactants Reactant Reagent Reduction reactions Relative mass Release of energy Temporary dipole

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
equilibrium.* **[**Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [*Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.*] **HS-PS1-7** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing	may be needed. (secondary to HS-PS1-6)		world" and will focus on predictions of reactions between real and imaginary elements, compounds, and mixtures. Assessed by teacher created rubric.	

*Denotes a traditional science content integrated with engineering through a Practice or Disciplinary Core Idea.

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [*Assessment Boundary: Assessment does not include complex chemical reactions.*] **HS-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **HS-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.				

Mendon High School Science Curriculum Map

Time Frame: April – June **Chemistry**

Unit 3: Energy

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
Students who demonstrate understanding can: **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. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [*Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]* **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	**PS3.A: Definitions of Energy** 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. (HS-PS3-1), (HS-PS3-2) At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3) These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy	How is energy transferred and conserved? How do you determine if a reaction will release or require energy? Where does that energy come from and/or go to?	**<u>Before</u>:** KWL – Students will list what they know and what they want to know about atoms. This will be repeated with each concept throughout the unit. (periodic table, fusion, decay, etc) Quick Writes – Before each lesson students will be asked to write their thoughts and questions for the day pertaining to the objectives. Pretest – Students will be given an assessment to understand their knowledge on the unit before instruction is given. **<u>During</u>:** Think/Pair/Share – Students will work in pairs to practice and reinforce rules as they are introduced. Lab Investigations – Students will be responsible for developing and implementing one or more lab	Activation energy Anode Boiling point elevation Calorie Cathode Cell Change of state Chemical bond Concentration Conduction Convection current Convection heating Crystalline solid Disorder Electrochemical Electrostatic attractions Endothermic reaction Energy Enthalpy Entropy Equilibrium Exothermic reaction Freezing point depression Gibb's free Hess's law Ionic motion Joules Kelvin temperature Keq Kinetic energy Kinetic molecular model Le chatelier

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [*Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]* **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. [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and	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). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4) Mathematical expressions,		investigation(s) exploring the periodic table, nuclear processes, and properties of elements. Daily Assignments – Students will be given assignments that will check for understanding. **<u>After</u>:** Posttest: Students will be given a test after the unit has been completed and the Presentations have been given. Project: Students will create a presentation using multi-media (as a group) of this unit. This will include various concepts, experimental data, vocabulary, and applications in the "real world" and will focus on all aspects of energy transferred during a given chemical reaction. Assessed by teacher created rubric.	Mass to energy conversion Order Oxidation Oxidation-reduction reactions Potential energy Pressure-temperature relationship Pressure-volume relationship Reaction rate Reduction Release of energy Rotational motion Solute Specific heat Spontaneous Temperature-volume relationship Transforming matter and/or energy Translational motion Vibrational motion

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generators. Examples of constraints could include use of renewable energy forms and efficiency.] [*Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]* **HS-LS1-5** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [*Assessment Boundary: Assessment does not include specific biochemical steps.*] **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	which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1) The availability of energy limits what can occur in any system. (HS-PS3-1) Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4) **PS3.C: Relationship Between Energy and Forces** When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)			

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
carbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [*Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.*] **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. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [*Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.*] **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	**PS3.D: Energy in Chemical Processes** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4) **ETS1.A: Defining and Delimiting Engineering Problems** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS3-3)			

Next Generation Science Standards	Disciplinary Core Ideas	Essential Questions	Assessments	Vocabulary
energy in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [*Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.*] **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. [Clarification Statement: Examples of models could include simulations and mathematical models.] [*Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and*				

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respiration.] **HS-PS4-5** Communicate technical information about how some technological devices use the principles of wave behavior and wave interaction with matter to transmit and capture information and energy. [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [*Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.*] **HS-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **HS-ETS1-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.				

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