DRAFT ALTERNATE CONTENT STANDARDS FOR PHYSICAL SCIENCE – HIGH SCHOOL (GRADES 9-12)

Topic Bundle 1: Structure and Properties of Matter

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS1-1: Use models to observe and describe properties of elements involved in real-world situations (such as, their location in the Periodic Table, the number of electrons, their relative size, their components, and how they are classified).	**EE.HS-PS1-H.1:** Use models to observe and describe properties of elements involved in real-world situations (such as, their location in the Periodic Table, the number of electrons, their relative size, their components, and how they are classified).	**EE.HS-PS1-M.1:** Use illustrations or models to identify common elements from the periodic table or describe how they are used in real-world situations.	**EE.HS-PS1-L.1:** Given a description of a familiar element involved in real-world situations, identify the element (limited to: oxygen, helium, sodium, aluminum, calcium, iron, lead, silver, gold, tin, nickel, copper)

Topic Bundle 1: Structure and Properties of Matter

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS1-3: Use an investigation to describe the relationship between the melting and/or boiling points of a common substance and/or identify that as the temperature increases, so does the spacing and motion of the particles of the substance.	**EE.HS-PS1-H.3:** Use an investigation to describe the relationship between the melting and/or boiling points of a common substance and/or identify that as the temperature increases, so does the spacing and motion of the particles of the substance.	**EE.HS-PS1-M.3:** Use an investigation to identify the melting point and/or boiling point of a familiar substance.	**EE.HS-PS1-L.3:** Identify a familiar substance as boiling or melting.

Topic Bundle 1: Structure and Properties of Matter

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
Not appropriate	Not appropriate	Not appropriate	Not appropriate

Topic Bundle 1: Structure and Properties of Matter

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.			
EE.HS-PS2-6: Use evidence to describe the relationship between the structure (properties) and function of natural or man-made materials.	**EE.HS-PS2-H.6:** Use evidence to describe the relationship between the structure (properties) and function of natural or man-made materials.	**EE.HS-PS2-M.6:** Use evidence to identify one or more structure properties (such as strength, weight, heat conductivity, durability, flexibility, magnetism, or buoyancy, etc.) of a given natural or man-made material.	**EE.HS-PS2-L.6:** Observe and identify a material (such as metals, plastics or plant materials) used to make a familiar product.

Topic Bundle 2: Chemical Reactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standards: HS-PS1-2, HS-PS1-4, and HS-PS1-7 **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.** **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.** **HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.**			
EE.HS-PS1-2: Use models, simulations, or illustrations, to explain patterns of chemical properties that occur in a substance during a common chemical reaction (i.e. baking soda and vinegar).	**EE.HS-PS1-H.2:** Use models, simulations, or illustrations, to explain patterns of chemical properties that occur in a substance during a common chemical reaction (i.e. baking soda and vinegar).	**EE.HS-PS1-M.2:** Use illustrations, models or simulations to identify the changes that occur during a chemical reaction.	**EE.HS-PS1-L.2:** After observing a familiar real-life chemical reaction, identify a result of the chemical reaction.

Topic Bundle 2: Chemical Reactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS1-5: Develop or complete a model showing how changes in temperature or concentration can affect the rate of reactions.	**EE.HS-PS1-H.5:** Use evidence to explain how changing conditions (temperature and/or concentration of the reacting particles) affects the reaction rate.	**EE.HS-PS1-M.5:** While observing a chemical reaction or creation of a mixture, identify that increasing the temperature makes the reaction faster.	**EE.HS-PS1-L.5:** While observing a chemical reaction or creation of a mixture, identify the source of change (i.e., heat).

Topic Bundle 2: Chemical Reactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
Not appropriate	Not appropriate	Not appropriate	Not appropriate

Topic Bundle 3: Forces and Interactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS2-1: Use data to describe how the net force acting on an object, or the mass of the objects impacts its acceleration (as increasing, decreasing or staying the same) or the direction of the object.	**EE.HS-PS2-H.1:** Use data to describe how the net force acting on an object, or the mass of the objects impacts its acceleration (as increasing, decreasing or staying the same) or the direction of the object.	**EE.HS-PS2-M.1:** Use data or simulations to determine how a force (e.g., push, pull, gravity, friction, or mass) acting on an object changes the speed of an object. (e.g., faster, slower, stays same, or stops).	**EE.HS-PS2-L.1:** Given an object that has a push/pull force applied and an object without a force applied, identify which of the 2 objects goes faster as it moves down a ramp or along a flat surface.

Topic Bundle 3: Forces and Interactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS2-2: Use mathematical models to indicate trends of the total momentum of a system of objects being conserved when there is no net force on the system.	**EE.HS-PS2-H.2:** Using models. Illustrations or simulations, show the change in momentum of each object after two objects collide or show that momentum remains the same as before the collision.	**EE.HS-PS2-M.2:** Using models, illustrations, or simulations, describe that, after a collision between two objects, the force of movement (momentum) for each object is in the opposite direction of the original movement.	**EE.HS-PS2-L.2:** Given objects with and without momentum, identify the object that is moving.

Topic Bundle 3: Forces and Interactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: HS-PS2-3. Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the forces on a macroscopic object during a collision.			
Not appropriate	Not appropriate	Not appropriate	Not appropriate

Topic Bundle 3: Forces and Interactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS2-4: Use models, illustrations or simulations to show how factors, such as relative size, charge of particles, relative quantity of charges, relative distance between objects affect the gravitational or electrostatic force between objects.	**EE.HS-PS2-H.4:** Use models, illustrations or simulations to show how factors, such as relative size, charge of particles, relative quantity of charges, relative distance between objects affect the gravitational or electrostatic force between objects.	**EE.HS-PS2-M.4:** Using models, illustrations or simulations, show how factors, such as relative size and/or relative distance between objects) affect the electrostatic force between the objects.	**EE.HS-PS2-L.4:** Identify the objects that attract (stick together) or repel (push apart) due to electrostatic forces.

Topic Bundle 3: Forces and Interactions

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
EE.HS-PS2-5: Use an investigation to identify evidence that an electric current produces a magnetic field and/or a changing magnetic field produces an electric current.	**EE.HS-PS2-H.5:** Use an investigation to identify evidence that an electric current produces a magnetic field and/or a changing magnetic field produces an electric current.	**EE.HS-PS2-M.5:** Use evidence to identify when a magnetic field and/or an electric current are produced.	**EE.HS-PS2-L.5:** Given a simple electric circuit, identify when an electric current is produced (such as, when an appliance or device is on.)

Topic Bundle 4: Energy

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
Not appropriate	Not appropriate	Not appropriate	Not appropriate

Topic Bundle 4: Energy

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standards: HS-PS3-2 and HS-PS3-3 **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 position of particles (objects).** **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.**			
EE.HS-PS3-2-3: Use evidence to describe devices that convert one form of energy into another form of energy.	**EE.HS-PS3-H.2-3:** Use evidence to describe devices that convert one form of energy into another form of energy.	**EE.HS-PS3-M.2-3:** Given evidence, identify one or more forms of energy used by a device.	**EE.HS-PS3-L.2-3:** Given demonstrations or models of energy, identify form of energy.

Topic Bundle 4: Energy

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standards: 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).			
EE.HS-PS3-4: Participate in an investigation to provide evidence that heat transfers between substances until energy is uniformly distributed.	**EE.HS-PS3-H.4:** Use an investigation to provide evidence that heat transfers between substances until energy is uniformly distributed.	**EE.HS-PS3-M.4:** Use evidence to compare the temperatures of two substances of different temperatures before and after combining.	**EE.HS-PS3-L.4:** Given two materials with different temperatures, identify which is hotter or cooler (before or after) a transfer of thermal energy.

Topic Bundle 4: Energy

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standards: 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. **Caution – Do not use magnets in the vicinity of a student with a Vagus Nerve Stimulator (VNS).**			
EE.HS-PS3-5: Use a model to describe the magnetic or electric forces and fields of two interacting objects and/or the resulting change in the motion of the objects.	**EE.HS-PS3-H.5:** Use a model to describe the magnetic or electric forces and fields of two interacting objects and/or the resulting change in the motion of the objects.	**EE.HS-PS3-M.5:** Use a magnet to demonstrate that objects with opposite charges attract and objects with like charges repel.	**EE.HS-PS3-L.5:** Use the results of an experiment to identify materials that are attracted to a magnet.

Topic Bundle 5: Waves and Electromagnetic Radiation

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standards: HS-PS4-1 and HS-PS4-5 **HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** **HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.**			
EE.HS-PS4-1-5: Use evidence or a wave model to describe/identify a wave property (vibration, speed, wavelength, frequency) or how a device uses waves to transmit information.	**EE.HS-PS4-H.1-5:** Use evidence or a wave model to describe/identify a wave property (vibration, speed, wavelength, frequency) or how a device uses waves to transmit information.	**EE.HS-PS4-M.1-5:** Use evidence to compare effects of sound or light traveling through media or recognize that a device uses waves to transmit information.	**EE.HS-PS4-L.1-5:** Use models or demonstration to identify the type of wave (sound, light, etc.) used in devices.

Topic Bundle 5: Waves and Electromagnetic Radiation

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.			
EE.HS-PS4-2: Use evidence to describe advantages and disadvantages of digital devices and digital information storage.	**EE.HS-PS4-H.2:** Use evidence to describe advantages and disadvantages of digital devices and digital storage of information.	**EE.HS-PS4-M.2:** Use evidence to identify how digital devices are beneficial.	**EE.HS-PS4-L.2:** Given a digital device and an analog device, identify the digital device.

Topic Bundle 5: Waves and Electromagnetic Radiation

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: HS-PS4-2. 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.			
Not appropriate	Not appropriate	Not appropriate	Not appropriate

Topic Bundle 5: Waves and Electromagnetic Radiation

Target Alternate Content Standard	Michigan Range of Complexity		
	High Range	Medium Range	Low Range
Michigan K-12 Science Content Standard: 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.			
Not appropriate	Not appropriate	Not appropriate	Not appropriate