NECAP Science GE and DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 9-10**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK Level	Science Concepts	Examples/Practice Items
Enduring Knowledge: All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.			
DOK 2 **PS1(9-11)INQ** **PS1(9-11)MAS** **+NOS-2** **DOK 2**	**S9-12:9** **(DOK 2)** **Students demonstrate their understanding of the Properties of Matter by…** • Distinguishing one substance from another through examination of physical properties (such as density**,** melting point, **conductivity**), chemical properties (such as **pH, reactivity**—with O_2 or acid or water), and nuclear properties (such as changes in **atomic mass, isotopes** and **half-life**). **(Extension)** • Explaining the states of a substance in terms of the particulate nature of matter and the forces of interaction between particles.	Science Concepts: a. Substances (elements, compounds) differ from one another based on their physical, chemical and nuclear properties. Extension: a. Substances (elements, compounds) differ from one another based on their physical, chemical and nuclear properties.	**(DOK 1)** • What is radioactive decay? • What is an isotope of an element? **(DOK 2)** • Compare the characteristics of the 3 isotopes of Hydrogen
DOK 2 **PS1(9-11)MAS +** **NOS-2** **DOK 2** **PS1(9-11)MAS +** **FAF-4** **DOK 3** **PS1(9-11)MAS +** **FAF-4**	**S79-12:10** **(DOK 3)** **Students demonstrate their understanding of the Properties of Matter by…** • Citing evidence of the change in our understanding of the atom and the development of **atomic theory** **AND** • Comparing the characteristics of three major components of all atoms **(protons, electrons, neutrons**) their location within an atom, their relative size and their charge. **AND** • Writing formulae for compounds and Developing models using electron structure (e.g., Lewis dot).	Science Concepts: a. Atoms have a dense nucleus containing positively charged **protons** and neutral **neutrons**. The number of protons in the nucleus determines the identity of an element. b. The nucleus of an atom is surrounded by much lighter negatively-charged **electrons** in .mostly empty space. c. In neutral atoms the number of protons and electrons is equal. d**.** The arrangement of electrons of an atom determines what kinds of bonds are formed to produce molecules (compounds).	

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 11-12**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK Level	Science Concepts	Examples/Practice Items
Enduring Knowledge: All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.			
DOK 2 PS1(9-12)MAS + NOS-2 PS1(9-11)POC-3 PS1(9-11)MAS + FAF-4 **DOK 2** PS1(9-11)INQ-1 PS1(9-11)MAS + FAF-4 **DOK 2** PS1(9-11)INQ-1 PS1(9-11)POC-3	**S9-12:11** **(DOK 2)** **Students demonstrate their understanding of the Properties of Matter by…** • Identifying and explaining the basis for the arrangement of elements within the Periodic Table (e.g., **trends, valence, reactivity, electronegativity, ionization**). **AND** • Determining **valence** electrons of selected elements. **AND** • Predicting the relative physical and chemical properties of an element based on its location within the Periodic Table	Science Concepts: a. Elements (substances composed of a single type of atom) are arranged in repeating patterns within the Periodic Table. b. The arrangement of **electrons** of an atom determines placement in the Periodic Table.	**(DOK 2)** • Using the Periodic Table identify the following elements as metals, non-metals or metalloids: (teacher selection of unknowns) • An element has the following properties: brittle, solid, non-conductive. Classify this element as a metal or non-metal. • Using the Periodic Table determine the valence for each of the following elements. (teacher choice)
Enduring Knowledge: All living and non-living things are composed of matter having characteristic properties that distinguish one substance from another.			
DOK 3 PS1(9-11)MAS + FAF--4	**S9-12:12** **(DOK 3)** **Students demonstrate their understanding of the States of Matter by…** • Investigating and explaining the interactions between atoms or molecules within a system (e.g., **hydrogen bonding**, van der Waals forces, fluorescent light, stars).	Science Concepts (Extension): a. Solids, liquids and gases differ in distance and angles between atoms or molecules and the energy that binds them. b. Plasma is another state of matter composed of electrons and positive ions that have been separated by collisions at very high temperatures.	

NECAP Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 13-14**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK Level	Science Concepts	Examples/Practice Items
DOK 2 **DOK 2**	**S9-12:13** **(DOK 2)** **Students demonstrate their understanding of the Properties of a Gas by…** • Determining the pressure of a given volume of gas when the temperature changes incrementally (doubles, triples, etc.). **(Extension)** • Quantitatively determining how volume, pressure, temperature and amount of gas affect each other (PV=nRT) in a system**.**	Science Concepts: a. There are specific proportional relationships that exist among volume, pressure, temperature and amount of gas (mass) in a system. Science Concepts (Extension): a. There are specific relationships that exist among volume, pressure, temperature and amount of gas (moles).	
Enduring Knowledge: A transfer of energy can result in the physical change of state of a substance.			
DOK 3 PS2(9-11)POC+ SAE-5	**S9-12:14** **(DOK 3)** **Students demonstrate their understanding of Physical Change by…** • Experimenting, graphing, and explaining the effect of heat energy on the phase changes of water from a solid state to a liquid state to a gaseous state, comparing that data to other substances, and using evidence to draw conclusions based upon these data.	Science Concepts: a. Different compounds require different amounts of energy for phase change due to their unique molecular structure.	

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 15-16**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK Level	Science Concepts	Examples/Practice Items
Enduring Knowledge: When matter undergoes a chemical change it turns into a new and different substance whose properties are different from the original. No matter how substances interact with one another, the total mass of the system remains the same.			
DOK 2 PS1(9-11)MAS + FAF--4 **DOK 2** PS1(9-11)MAS +FAF--4 PS2 (9-11)INQ + SAE -6 **DOK 2**	**S9-12:15** **(DOK 2)** **Students demonstrate their understanding of Chemical Change by…** • Writing simple **balanced chemical equations** to represent chemical reactions and illustrate the conservation of matter (atoms). **AND** • Qualitatively predicting **reactants** and **products** in a prescribed investigation (e.g. **oxidation, reduction, acid/base reactions**). **(Extension)** • Using chemical equations and Information about molar masses to predict quantitatively the masses of **reactants** and **products** in chemical reactions.	Science Concepts: a. The total mass of reactants of any chemical reaction is the same as the total mass of the products of that chemical reaction (**Conservation of Mass**). b. **Bonds** between atoms are created when electrons are paired by being transferred or shared. Many important reactions involve the transfer of either electrons or hydrogen ions between reacting **ions**, molecules or atoms. Extension: a. The numbers of atoms of the **reactants** of any chemical reaction are the same as the numbers of atoms of the **products** of that chemical reaction.	**(DOK 1)** • Balance this equation: $Mg + O_2 = MgO$ **(DOK 2)** • Predict the products of a reaction between magnesium and oxygen and write a balanced equation to represent this reaction. **(DOK 3)** • Perform a reaction that burns magnesium metal. Use qualitative and quantitative evidence of reactants and products from your observations to justify whether a chemical change has occurred.
DOK 3 PS2 (9-11)INQ + SAE -6	**S9-12:16** **(DOK 3)** **Students demonstrate their understanding of Chemical Change by…** • Performing an experiment and using evidence to explain how the increase or decrease in temperature of the substances in a chemical reaction causes a transfer of heat energy from that reaction. (e.g., **exothermic** and **endothermic** reactions**).**	Science Concepts: a. During a chemical change, energy is absorbed or released (e.g., AMP, ADP, ATP or burning wood).	

NECAP Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 17-18**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK Level	Science Concepts	Examples/Practice Items
Enduring Knowledge: The nucleus of some atoms is unstable and may spontaneously decay.			
DOK 2 **DOK 2** **DOK 2** **PS2(9-11)POC + SAE-5** **ESS3(9-11)POC +SAE-8** **DOK 2**	**S9-12:17** **(DOK 2)** **Students demonstrate their understanding of Nuclear Change by…** • Explaining the organization of an **atomic nucleus** and identifying the universal forces from strongest to weakest. **AND** • Explaining how alpha and beta emissions create changes in the nucleus of an atom, resulting in a completely different element. **AND** • Distinguishing between the **reactants** and **products** of a chemical reaction and those of a nuclear decay reaction and comparing the relative energies produced by each. **(Extension)** • Comparing the transmission and Penetration effects of alpha, beta, and gamma radiation.	Science Concepts: a. The number of neutrons in the nucleus can vary and gives rise to different **isotopes** of an element. b. Certain nuclear configurations lead to radioactive decay, producing alpha and beta particles, and ultimately a different element. c Nuclear forces, which exist only within the nucleus of an atom, are the forces that hold the nucleus of an atom together and are much stronger than either gravitational or electrical forces. Science Concepts: a. Gamma radiation may also be produced.	
DOK 2 **ESS1(9-11)INQ + POC + MAS-4** **ESS3(9-11)POC +SAE-8**	**S9-12:18** **(DOK 2)** **Students demonstrate their understanding of Nuclear Change by…** • Explaining the concept of **half-life** and using the **half-life** principle to predict the approximate age of a material.	Science Concepts: a. Radioactive decay occurs at a predictable rate (**half-life**) which allows radioactivity to be used for estimating the age of materials that contain radioactive substances.	

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 19-20**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK Level	Science Concepts	Examples/Practice Items
Enduring Knowledge: Everything is constantly moving; motion is relative, but the motion of an object can be described and predicted by tracing and measuring its position over time.			
DOK 3 **PS3(9-11)INQ + POC-8** **PS3(9-11)POC-9** **DOK 2** **PS3(9-11)POC-9** **DOK 3** **PS3(9-11)POC-9** **DOK 2** **DOK 2**	**S9-12:19** **(DOK 3)** **Students demonstrate their understanding of Motion by…** • Predicting the path of an object in different reference planes and explaining how and why this occurs. **AND** • Using modeling and illustrating, to explain how distance and velocity change over time for a free falling object. **AND** • Modeling, illustrating, and explaining the path of an object which has horizontal and free fall motion (i.e., football, bullet). **(Extension)** o Using quantitative representation of how distance and velocity change over time for a free falling object. **AND** o Using quantitative representation of the path of an object which has horizontal and free fall motion (i.e., football, bullet).	Science Concept: a. Motion is relative. The motion of an object is observed and measured relative to a given frame of reference (point of view) (e.g. trees flashing by when sitting in a moving vehicle). b. Acceleration occurs when an object undergoes a change in velocity over time (speed up, slow down, change direction). c. .Motion is predictable; a falling object increases speed in a predictable pattern as it falls. d. Motion is predictable; projectile motion combines a uniform horizontal motion and free-fall motion simultaneously	
DOK 2 **PS3(9-11)POC-9**	**S9-12:20** **(DOK 2)** **Students demonstrate their understanding of Motion by…** • Explaining how inertia affects the outcome in each of a series of situations (i.e., kicking a sand-filled football, moving a bowl of soup quickly across the table).	Science Concept: a. An object at rest or moving uniformly (in a straight line) will remain so unless acted upon by an external unbalanced (net) force (**Newton's First Law, The Law of Inertia**). (e.g., We wear seatbelts because our body has a tendency to keep moving when the vehicle stops.)	**(DOK 1)** • Define inertia, net force, 'rest' (an object at rest), and uniform motion **(DOK 2)** • Using a diagram and scientific terminology, explain why you will be ejected from a moving car, that stops suddenly, if you are not wearing a seatbelt.

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 21-22**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge (Force): Force is an influence that can change the motion of an object.			
DOK 3 **PS3(9-11)INQ + POC-8** **PS3(9-11)POC-9** **DOK 2** **PS3(9-11)INQ + POC-8** **PS3(9-11)POC-9** **DOK 2**	**S9-12:21** **(DOK 3)** **Students demonstrate their understanding of Force by…** • Investigating (predict, model, illustrate, explain) whether the acceleration is greater or less as either the **mass of the system** or **the force accelerating the mass** is changed and using data to support your conclusion (e.g., cart with variable weights on horizontal table attached to a string with weights). **AND** • Demonstrating action force/reaction force in one of three different ways--describing in words, demonstrating physically, and modeling the occurrence of opposing actions. **(Extension)** o Investigating quantitatively the acceleration as either the mass of the system or the force accelerating the mass is changed (e.g., cart with variable weights on horizontal table attached to a string with weights.)	Science Concept: a. Every body continues in its state of rest or in a straight line, unless it is compelled to change that state by forces impressed upon it (**Newton's First Law).** b. If an unbalanced force acts on an object it will accelerate; the acceleration is proportional to the net force and inversely proportional to the mass of the object (**Newton's Second Law F=ma**). (e.g. A vehicle accelerates more slowly when it's full of passengers.) c. Whenever one object exerts a force on a second object, a force equal in magnitude but opposite in direction is exerted on the first object. Forces always arise in pairs (**Newton's Third Law**). (e.g., When you lean against a wall, the wall pushes back at you.)	**(DOK 1)** • Describe an example for each- an object at rest, one in uniform motion and one in accelerated motion. **(DOK 2)** • Explain, how these three conditions are similar and how they are different: an object at rest, an object in uniform motion and an object in accelerated motion. **(DOK 3)** • Design and carry out an investigation to compare the frictional forces produced by various types (brands) of basketball shoes and use the data collected to justify a selection.
DOK 2 **PS3(9-11)INQ + POC-8** **PS3(9-11)POC-9** **DOK 2**	**S9-12:22** **(DOK 2)** **Students demonstrate their understanding of Gravitational force by…** • Predicting in a variety of situations how gravitational force changes when mass changes or when distance changes. **(Extension)** o Determining quantitatively how gravitational force changes when mass changes or when distance changes.	Science Concept: a. The force of gravity is a universal force of attraction between ANY two objects and is proportional to the masses of those two objects and weakens rapidly with the distance between the objects (e.g., More mass produces more force; less distance produces more force, such as bodies in the solar system). Science Concept (Extension): a. The force of gravity is a universal force of attraction between two objects and is proportional to the product of the masses of those two objects and inversely proportional to the square of the distance between objects.(i.e. $F = Gm_1 m_2/d^2$).	**(DOK 2)** • Determine the acceleration of gravity on top of Mt. Everest.

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 23-24**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: Energy is necessary for change to occur. It is the ability of matter to bring about change. ***There are many forms of energy.** ***The total energy in the universe is constant.** ***Energy can be transformed and transferred, but not destroyed (Conservation of Energy).** ***Energy transfers and transformations exhibit the characteristics of systems with inputs, processes and outputs, as well as connections to other systems.**			
DOK 2 PS2 (9-11)INQ + SAE -6 PS2(9-11)SAE-7 ESS1(9-11)INQ + POC + MAS-4 **DOK 3** PS2(9-11)POC + SAE-5 PS2 (9-11)INQ + SAE -6	**S9-12:23** **(DOK 3)** **Students demonstrate their understanding of Heat Energy by…** • Comparing and contrasting characteristics of the different forms of energy, particularly within chemical reactions. **AND** • Explaining the changes in energy (transformation) that occur in different reactions (e.g., chemical, biological, physical) through analysis of the **input and output energies** in the system (e.g., calorimetry, **entropy**) and using evidence to justify the explanation.	Science Concepts: a. Different energy levels are associated with different configurations within atoms and molecules (firework explosions). b. The total energy in an isolated system remains constant regardless of transformation. (Whenever the amount of energy in one place or form diminishes, the amount in other places or forms increases by an equivalent amount.) c. Whenever energy is transformed from one form to another, some energy becomes less available and is transformed into heat energy, such as from engines, electrical wires, hot-water tanks, our bodies, and stereo systems (**ENTROPY**).	
DOK 2 PS2(9-11)SAE-7 **DOK 2** PS2(9-11)SAE-7	**S9-12:24** **(DOK 2)** **Students demonstrate their understanding of Electrical Energy by…** • Explaining (through words, diagrams, models or electrostatic demonstrations) the principle that like charges repel and unlike charges attract (e.g. **electromagnetic forces**). **AND** • Explaining (through words, charts, diagrams, models or mathematical examples) the effects of distance and the amount of charge on the strength of the electrical force present.	Science Concept: a. Electrical force is a universal force that arises from charge and can be attractive (between different charges) or repulsive (between similar charges). b. The strength of the electrical force is proportional to the amount of charge and weakens rapidly with distance between the charges. c. Mechanical forces such as tension, compression, and friction are manifestations of electrostatic forces between atoms and molecules.	

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 25-27**

DOK & NECAP Release Item Codes	GE Statement with Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: Energy is necessary for change to occur. It is the ability of matter to bring about change. ***There are many forms of energy.** ***The total energy in the universe is constant.** ***Energy can be transformed and transferred, but not destroyed (Conservation of Energy).** ***Energy transfers and transformations exhibit the characteristics of systems with inputs, processes and outputs, as well as connections to other systems.**			
S7-8:25 Not assessed at this grade level.			
DOK 2 PS3(9-11)SAE-10 **DOK 2** PS3(9-11)SAE-10 ESS3(9-11)SAE-7 **DOK 2**	**S9-12:26** **(DOK 2)** **Students demonstrate their understanding of Electromagnetic Forces by…** • Comparing and contrasting the wave nature of electromagnetic energy to other forms of waves (water, sound, etc.). **AND** • Relating the particle nature of **electromagnetic waves** to their frequencies and to discrete changes in energy levels within atoms (e.g. **red shift, blue shift**, **line spectra**). **(Extension)** o Giving examples and explaining the wave nature of electromagnetic energy (refraction, diffraction, etc.) and describing and explaining the particle nature of electromagnetic energy (photoelectric effect, Compton effect.)	Science Concepts: a. Electromagnetic energy has both wave and particle properties.	
DOK 2 PS3(9-11)SAE-10 **DOK 2** ESS3(9-11)SAE-7 **DOK 2**	**S9-12:27** **(DOK 2)** **Students demonstrate their understanding of Electromagnetic Forces by…** • Describing (through words, models, or diagrams) the presence of electromagnetic forces in an atom. **AND** • Comparing and contrasting the electromagnetic and gravitational forces between the particles that make up an atom. **AND** • Explaining in words, models or diagrams how electric currents produce magnetic fields and how moving fields and moving magnets produce electric currents.	Science Concepts: a. An electromagnetic force is a universal force that acts within and between atoms and is vastly stronger than the gravitational forces between atoms (strength depends upon how much charge is present). b. Electricity and magnetism are two aspects of an electromagnetic force. Moving electrical charges produce magnetic forces and moving magnets produce electrical forces.	

Science GE DOK Alignment Chart **PHYSICAL SCIENCE** **Grades 9-12** **GE 28-29**

DOK & NECAP Release Item Codes	GE Statement and Ceiling DOK	Science Concepts	Examples/Practice Items
Enduring Knowledge: Energy is necessary for change to occur. It is the ability of matter to bring about change. ***There are many forms of energy.** ***The total energy in the universe is constant.** ***Energy can be transformed and transferred, but not destroyed (Conservation of Energy).** ***Energy transfers and transformations exhibit the characteristics of systems with inputs, processes and outputs, as well as connections to other systems.**			
DOK 2 **DOK 2** PS3(9-11)POC-10 ESS3(9-11)SAE-7	**S9-12:28** (DOK 3) **Students demonstrate their understanding of Light Energy by…** • Investigating examples of wave phenomena (e.g., ripples in water, sound waves, seismic waves). **AND** • Comparing and contrasting **electromagnetic waves** to mechanical waves.	Science Concept: a. An electromagnetic force is a universal force that acts within and between atoms and is vastly stronger than the gravitational forces between atoms (strength depends upon how much charge is present). b. Electricity and magnetism are two aspects of an electromagnetic force. Moving electrical charges produce magnetic forces and moving magnets produce electrical forces.	
S9-12:29 Not assessed at this grade level.			