NM Public Education Department

SCIENCE:
PHYSICAL SCIENCE

END-OF-COURSE EXAM | GRADE 9–12 | YEAR 18–19

ASSESSMENT BLUEPRINT

Purpose Statement
Physical Science

The Physical Science End-of-Course (EOC) exam is intended to measure student proficiency of the New Mexico STEM Ready! Science Standards. This course-level exam is provided to all students who have completed Physical Science or related courses. This exam can be given for the following STARS course code:

1703 - Physical Science

Intended as a final exam for the course, this is a summative exam covering a range of content, skills, and applications. Scores are reported to the teacher, school, district, and state levels for the purposes of student grades, curriculum review, student graduation requirements, and NMTeach summative reports.

Materials Required for Testing:
NM PED Physical Science Reference Sheet/Periodic Table and a Scientific or Graphing Calculator

"The EOCs are exams written by New Mexico Teachers for New Mexico Students."
During the 2018 summer, teachers were brought together in person or online as part of the blueprint and exam revision process. The NM PED extends our gratitude to all those who contributed to this improvement process. Although we were unable to implement every suggestion due to conflicting viewpoints at times, this blueprint reflects the best collaborative effort among dedicated peers.

The NM PED would like to especially recognize the following people who led the revision of this blueprint:

- *Christy Krenek, Santa Fe Public Schools, Content Lead*
- *Anastacia Cadena, Alamogordo Public Schools*
- *Dana Cantrell, Alamogordo Public Schools*
- *Irina Cislaru, Santa Fe Public Schools*
- *Joy Rosario, Central Consolidated Schools*
- *Larie Laudato, Gallup-McKinley County Schools*
- *Emily Clauss, Albuquerque Public Schools*

Explanation of Blueprint Layout & Test Specifications Table

Topics	Clarifications on Test Item Specifications:
The performance expectations (PEs) identified in this portion of the blueprint are aligned to the New Mexico STEM Ready! Science Standards. *The PEs have been deconstructed to highlight the three dimensionality. Consult your NM STEM Ready! Standards for the full PE:* *https://webnew.ped.state.nm.us/bureaus/math-science/nm-STEM Ready-science/nm-STEM Ready-science-standards/* *and High School Recommended Discipline-Specific Course Map:* *https://webnew.ped.state.nm.us/bureaus/math-science/nm-STEM Ready-science/nm-STEM Ready-science-standards/recommended-secondary-course-maps/* *New Mexico Teachers identified the PEs to be measured on the EOC exam using the following criteria: 1) a great deal of instructional time is spent on the PE as identified in the curriculum and/or; 2) the PE is important to subsequent learning.* *It is important to note that the PEs in the blueprint are only a **subset** of PEs to be measured with the understanding that teachers cover more PEs during the course of instruction than what has been selected to be measured.*	● *This portion of the blueprint identifies the disciplinary core idea (DCI) that students will have to demonstrate knowledge of during the exam. These items are not fully aligned to the science and engineering practices (SEP) and crosscutting concepts (CCC).* ● *Although the PE measures other dimensions, the item specifications may place constraints on portions of the DCI in order to provide more transparency as to what specifically will be measured relative to the PE.* ● *Items on this year's NM STEM Ready! transition EOC are content aligned and are items from the existing EOC and/or SBA item banks. PED will be field testing NM STEM Ready! cluster items for EOCs, which are optional for school participation.*
	Item Types: *The item types for this EOC exam are limited to:* *MC = multiple choice with or without stimulus (e.g., picture, graph, chart)*
	Sample Question: *Sample questions have been provided for some PEs to assist teachers to correlate the questions with the performance standards and the test item specification, when applicable. Sample questions could not be provided for all PEs due to the limitations in the existing EOC and SBA item bank.* ● *An * denotes the correct answer* ● *DOK = Depth of Knowledge* ● *Some sample questions may be items released items from prior EOC exams*

Blueprint Table – Physical Science

Topic: Engineering Design	DCI with Test Item Specifications:
HS-ETS1-1 **SEP**: Analyze a major global challenge **DCI**: to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. **CCC**: for societal needs and wants. **Clarification Statement**: None **Assessment Boundary:** None	**<u>ETS1.A: Defining and Delimiting Engineering Problems</u>** 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. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **Essential Questions:** **What is design for?** **What are the criteria and constraints of a successful solution?**
	Item Types: *MC = multiple choice with or without stimulus*

Topic: Engineering Design	DCI with Test Item Specifications:
HS-ETS1-2 **SEP**: Design a solution to a complex real-world problem **DCI**: by breaking it down into smaller, more manageable problems that can be solved through engineering. **CCC**: None **Clarification Statement:** None **Assessment Boundary:** None	**<u>ETS1.C: Optimizing the Design Solution</u>** 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) may be needed. **Essential Questions:** **How can the various proposed design solutions be compared and improved?** **What are the criteria and constraints of a successful solution?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Engineering Design	DCI with Test Item Specifications:
HS-ETS1-3 **SEP**: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs **DCI**: that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. **CCC**: as well as possible social, cultural, and environmental impacts. **Clarification Statement:** None **Assessment Boundary:** None	**<u>ETS1.B: Developing Possible Solutions</u>** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. **Essential Question:** **What is the process for developing potential design solutions?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Engineering Design	DCI with Test Item Specifications:
HS-ETS1-4 **SEP**: Use a **DCI**: computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on **CCC**: interactions within and between systems relevant to the problem. **Clarification Statement:** None **Assessment Boundary:** None	**<u>ETS1.B: Developing Possible Solutions</u>** Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. **Essential Question:** **What is the process for developing potential design solutions?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Matter and interactions	DCI with Test Item Specifications:
HS-PS1-1 **SEP**: Use the periodic table as a model to predict **DCI**: the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. **CCC**: properties of elements based on the patterns of electrons **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**.**	**<u>PS1.A: Structure and Properties of Matter</u>** 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. **Essential Question:** **How do particles combine to form the variety of matter one observes?**
	Item Types: *MC = multiple choice with or without stimulus*
	Sample Question: Which of the following statements about subatomic particles is correct? (A) Electrons have considerably less mass than protons or neutrons. * (B) Protons, neutrons, and electrons all have about the same mass. (C) Protons and neutrons have mass, electrons have no mass. (D) Neutrons have less mass than protons and electrons.

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-2 **SEP**: Construct and revise an explanation **DCI**: 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. **CCC**: 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.	**<u>PS1.A: Structure and Properties of Matter</u>** 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. **<u>PS1.B: Chemical Reactions</u>** 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. **Essential Questions:** **How do particles combine to form the variety of matter one observes?** **How do substances combine to change (react) to make new substances?** **How does one characterize and explain the reactions and name predictions about them?**
	Item Types: *MC = multiple choice with or without stimulus*
	Sample Question: What type of reaction occurs when two elements/compounds are combined into one compound? (A) synthesis * (B) decomposition (C) single displacement (D) double displacement

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-3 **SEP**: Plan and conduct an investigation to gather evidence **DCI** to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. **CCC**: to compare the structure of substances at the bulk scale to infer **Clarification Statement:** Emphasis is on understanding the strengths of forces between particles, not on 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.	**PS1.A: Structure and Properties of Matter** The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. **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 material objects. (secondary) **Essential Question:** **How do particles combine to form the variety of matter one observes?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-4 **SEP**: Develop a model to illustrate that **DCI**: the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. **CCC**: the release or absorption of energy from a chemical reaction system **Clarification Statement:** Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models 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.	**PS1.A: Structure and Properties of Matter** 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. **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 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. **Essential Questions:** **How do particles combine to form the variety of matter one observes?** **How do substances combine to change (react) to make new substances?** **How does one characterize and explain the reactions and name predictions about them?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-5 **SEP**: Apply scientific principles and evidence to provide an explanation about **DCI**: the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. **CCC**: the effects of changing the temperature or concentration **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.	**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 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. **Essential Questions:** **How do substances combine to change (react) to make new substances?** **How does one characterize and explain the reactions and name predictions about them?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-6 **SEP**: Refine the design of a chemical system by specifying a change **DCI**: in conditions that would produce increased amounts of products at equilibrium. **CCC**: by specifying a change in conditions…at 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.	**PS1.B: Chemical Reactions** 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. **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) may be needed. *(secondary)* **Essential Questions:** **What is design for?** **How do substances combine to change (react) to make new substances?** **How does one characterize and explain the reactions and name predictions about them?** **How can the various proposed designed solutions be compared and improved?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-7 **SEP**: Use mathematical representations to support the claim…and therefore mass, **DCI**: that atoms are conserved during a chemical reaction. **CCC**: that atoms, and therefore mass, are conserved **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 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.	**PS1.B: Chemical Reactions** 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. **Essential Questions:** **How do substances combine to change (react) to make new substances?** **How does one characterize and explain the reactions and name predictions about them?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Matter and Interactions	DCI with Test Item Specifications:
HS-PS1-8 **SEP:** Develop models to illustrate **DCI**: the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. **CCC**: the changes in the composition of the nucleus of the atom… 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.	**<u>PS1.C: Nuclear Processes</u>** 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. **Essential Question:** **What forces hold nuclei together and mediate nuclear processes?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Motion and Stability	DCI with Test Item Specifications:
HS-PS2-1 **SEP:** Analyze data to support the claim **DCI**: that Newton's second law of motion describes…the net force on a macroscopic object, its mass, and its acceleration **CCC**: the mathematical relationship among **Clarification Statement:** Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force. **Assessment Boundary:** Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speed.	**<u>PS2.A: Forces and Motion</u>** Newton's second law accurately predicts changes in the motion of macroscopic objects. **Essential Question:** **How can one predict an object's continued motion, changes in motion, or stability?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Motion and Stability	DCI with Test Item Specifications:
HS-PS2-2 **SEP:** Use mathematical representations to support the claim that **DCI**: the total momentum of a system of objects is conserved when there is no net force on the system. **CCC**: a system of objects… there is no net force on the system **Clarification Statement:** Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. **Assessment Boundary:** Assessment is limited to systems of two macroscopic bodies moving in one dimension.	**PS2.A: Forces and Motion** Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. **Essential Question:** **How can one predict an object's continued motion, changes in motion, or stability?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Motion and Stability	DCI with Test Item Specifications:
HS-PS2-3 **SEP:** Apply science and engineering ideas to design, evaluate, and refine a device **DCI**: that minimizes the force on a macroscopic object during a collision. **CCC**: that minimizes the force **Clarification Statement:** Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. **Assessment Boundary:** Assessment is limited to qualitative evaluations and/or algebraic manipulations.	**PS2.A: Forces and Motion** If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. **ETS1.A: Defining and Delimiting an Engineering Problem** 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)* **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) may be needed. *(secondary)* **Essential Questions:** **How can one predict an object's continued motion, changes in motion, or stability?** **What is design for?** **What are the criteria and constraints of a successful solution?** **How can the various proposed design solutions be compared and improved?**
	Item Types: *MC = multiple choice with or without stimulus*

Topic: Motion and Stability	DCI with Test Item Specifications:
HS-PS2-4 **SEP:** Use mathematical representations…to describe and predict **DCI**: Newton's Law of Gravitation and Coulomb's Law…the gravitational and electrostatic forces between objects. **CCC**: to describe and predict **Clarification Statement:** Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields. **Assessment Boundary:** Assessment is limited to systems with two objects.	**PS2.B: Types of Interactions** Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields **Essential Question:** **What underlying forces explain the variety of interactions observed?**
	Item Types: *MC = multiple choice with or without stimulus*
	Sample Question: Which of the following correctly identifies the four fundamental forces in nature? (A) gravity, momentum, electronic, strong nuclear force (B) electromagnetic, gravity, acceleration, strong nuclear force (C) strong nuclear force, weak nuclear force, electromagnetic, gravity * (D) weak nuclear force, gravity, electromagnetic, momentum

Topic: Motion and Stability	DCI with Test Item Specifications:
HS-PS2-5 **SEP:** Plan and conduct an investigation to provide evidence that **DCI**: an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. **CCC**: can produce…can produce **Clarification Statement:** none **Assessment Boundary:** Assessment is limited to designing and conducting investigations with provided materials and tools.	**PS2.B: Types of Interactions** Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **PS3.A: Definitions of Energy** "Electrical energy" may mean energy stored in a batter or energy transmitted by electric currents. *(secondary)* **Essential Questions:** **What underlying forces explain the variety of interactions observed?** **What is energy?**
	Item Types: *MC = multiple choice with or without stimulus*

Topic: Motion and Stability	DCI with Test Item Specifications:
HS-PS2-6 **SEP:** Communicate scientific and technical information about why…the functioning of designed materials **DCI**: the molecular-level structure is important in **CCC**: 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.	**PS2.B: Types of Interactions** Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations for matter, as well as the contact forces between material objects. **Essential Question:** **What underlying forces explain the variety of interactions observed?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Energy	DCI with Test Item Specifications:
HS-PS3-1 **SEP:** Create a computational model **DCI**: 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, **CCC**: to calculate the change…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.	**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. **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. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. Mathematical expressions, 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. The availability of energy limits what can occur in any system. **Essential Question:** **What is energy?**
	Item Types: *MC = multiple choice with or without stimulus*

Topic: Energy	DCI with Test Item Specifications:
HS-PS3-2 **SEP:** Develop and use models to illustrate **DCI**: energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects). **CCC**: can be accounted for **Clarification Statement:** Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations. **Assessment Boundary:** None	**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. 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). 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. **Essential Question:** **What is energy?**
	Item Types: *MC = multiple choice with or without stimulus*
	Sample Question: In which phase of matter do the particles have the least amount of kinetic energy? (A) gas (B liquid (C) solid * (D) plasma

Topic: Energy	DCI with Test Item Specifications:
HS-PS3-3 **SEP:** Design, build, and refine a device **DCI:** that works within given constraints to convert one form of energy into another form of energy. **CCC**: 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 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.	**PS3.A: Definitions of Energy** At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **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. **ETS1.A: Defining and Delimiting an Engineering Problem** 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. **Essential Questions:** **What is energy?** **How do food and fuel provide energy?** **If energy is conserved, why do people say it is produced or used?** **What is a design for?** **What are the criteria and constraints of a successful solution?**
	Item Types: *MC = multiple choice with or without stimulus*

Topic: Energy	DCI with Test Item Specifications:
HS-PS3-4 **SEP**: Plan and conduct an investigation to provide evidence that **DCI**: 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). **CCC**: within a closed system results in a more uniform energy distribution among the components in the system **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.	**PS3.B: Conservation of Energy and Energy Transfer** Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. 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). **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. **Essential Questions:** **What is energy?** **How do food and fuel provide energy?** **If energy is conserved, why do people say it is produced or used?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Energy	DCI with Test Item Specifications:
HS-PS3-5 **SEP**: Develop and use a model of **DCI**: 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. **CCC**: due to the interaction. **Clarification Statement:** Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. **Assessment Boundary:** Assessment is limited to systems containing two objects.	**<u>PS3.C: Relationship Between Energy and Forces</u>** When two objects interacting through a field change relative position, the energy stored in the field is changed. **Essential Question:** **How are forces related to energy?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Waves and their Applications in Technologies for Information Transfer	**DCI with Test Item Specifications:**
HS-PS4-1 **SEP**: Use mathematical representations to support a claim regarding **DCI**: relationships among the frequency, wavelength, and speed of waves traveling in various media. **CCC**: regarding relationships among **Clarification Statement:** Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth **Assessment Boundary:** Assessment is limited to algebraic relationships and describing those relationships qualitatively.	**<u>PS4.A: Wave Properties</u>** The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. **Essential Question:** **What are the characteristic properties and behavior of waves?** **Item Types:** *MC = multiple choice with or without stimulus* **Sample Question:** During a thunderstorm, what explains the time difference between when you see lightning in the distance and when you hear the thunder? (A) The speed of light is equal to the speed of sound. (B) The speed of light is greater than the speed of sound. * (C) The speed of light is less than the speed of sound. (D) There is no relationship between light and sound.

Topic: **Waves and their Applications in Technologies for Information Transfer**	**DCI with Test Item Specifications:**
HS-PS4-2 **SEP**: Evaluate questions **DCI**: about the advantages of using digital transmission and storage of information. **CCC**: about the advantages of using **Clarification Statement:** Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft **Assessment Boundary:** None	**<u>PS4.A: Wave Properties</u>** Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses **Essential Question:** **What are the characteristic properties and behavior of waves?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Waves and their Applications in Technologies for Information Transfer	**DCI with Test Item Specifications:**
HS-PS4-3 **SEP**: Evaluate the claims, evidence, and reasoning **DCI**: 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. **CCC**: 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 **Clarification Statement:** Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect. **Assessment Boundary:** Assessment does not include using quantum theory.	**PS4.A: Wave Properties** [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) **PS4.B: Electromagnetic Radiation** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. **Essential Questions:** **What are the characteristic properties and behavior of waves?** **What is light?** **How can one explain the varied effects that involve light?** **What other forms of electromagnetic radiation are there?** **Item Types:** *MC = multiple choice with or without stimulus*

Topic: Waves and their Applications in Technologies for Information Transfer	**DCI with Test Item Specifications:**
HS-PS4-4 **SEP**: Evaluate the validity and reliability of claims in published materials **DCI**: that different frequencies of electromagnetic radiation have when absorbed by matter **CCC**: of the effects **Clarification Statement:** Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. **Assessment Boundary:** Assessment is limited to qualitative descriptions.	**PS4. B: Electromagnetic Radiation** When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. **Essential Questions:** **What is light?** **How can one explain the varied effects that involve light?** **What other forms of electromagnetic radiation are there?** **Item Types:** *MC = multiple choice with or without stimulus* **Sample Question:** When Javier stays outside for 5 hours at a sporting event, he gets sunburned. What type of electromagnetic radiation causes the burn? (A) infrared waves (B visible light (C) gamma rays (D) ultraviolet waves *

Topic: Waves and their Applications in Technologies for Information Transfer	**DCI with Test Item Specifications:**
HS-PS4-5 **SEP**: Communicate technical information about **DCI**: of wave behavior and wave interactions with matter transmit and capture information and energy **CCC**: how some technological devices use the principles **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.	**PS3.D: Energy in the Chemical Processes** Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary) **PS4.A: Wave Properties** Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. **PS4. B: Electromagnetic Radiation** Photoelectric materials emit electrons when they absorb light of a high-enough frequency. **PS4.C: Information Technologies and Instrumentation** Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. **Essential Questions:** **How do food and fuel provide energy?** **If energy is conserved, why do people say it is produced or used?** **What is light?** **How can one explain the varied effects that involve light?** **What other forms of electromagnetic radiation are there?** **How are instruments that transmit and detect waves used to extend human senses?**
	Item Types: *MC = multiple choice with or without stimulus*

Physical Science EoC Reporting Category Alignment Framework					
Reporting Category	**Performance Expectation**	**DOK (Count by DOK)**			**Grand Total**
		1	**2**	**3**	
Engineering Design (repeat)	HS-ETS1-1				
	HS-ETS1-2				
	HS-ETS1-3				
	HS-ETS1-4				
Forces and Interactions	HS-PS2-1		3	1	**4**
	HS-PS2-2				
	HS-PS2-3				
	HS-PS2-4	1			**1**
	HS-PS2-5				
	HS-PS2-6				
Energy	HS-PS3-1	2	3		**5**
	HS-PS3-2	1			**1**
	HS-PS3-3				
	HS-PS3-4				
	HS-PS3-5				
Waves and Electromagnetic Radiation	HS-PS4-1	4			**4**
	HS-PS4-2				
	HS-PS4-3	3			**3**
	HS-PS4-4	1	2		**3**
	HS-PS4-5				
Chemical Reactions	HS-PS1-2	3	2		**5**
	HS-PS1-4		2		**2**

	HS-PS1-5				
	HS-PS1-6		1		**1**
	HS-PS1-7	4			**4**
Structure and Properties of Matter	HS-PS1-1	3	2		**5**
	HS-PS1-3		1		**1**
	HS-PS1-8				
	Grand Total	**21**	**18**	**1**	**40**

NM PED Reference Sheet

Physical Science

Acceleration = $\frac{\text{final velocity - initial velocity}}{\text{time}}$ $\left(a = \frac{v_f - v_i}{t}\right)$

Speed = $\frac{\text{distance}}{\text{time}}$ $\left(v = \frac{d}{t}\right)$

Density = $\frac{\text{mass}}{\text{volume}}$ $\left(D = \frac{m}{V}\right)$

Force = mass × acceleration ($F = ma$)

Kelvin = ºCelsius + 273 (K = ºC + 273)

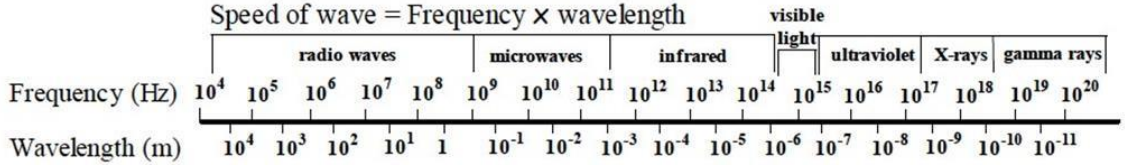
Acceleration of gravity = g ≈ 10 $\frac{\text{m}}{\text{sec}^2}$

Weight = mass × acceleration of gravity ($w = mg$)

Volume of a rectangular solid = length × width × height ($V = lwh$)

Electromagnetic Spectrum

Speed of wave = Frequency × wavelength



Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.180
11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305											13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.631	33 **As** Arsenic 74.922	34 **Se** Selenium 78.971	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.798
37 **Rb** Rubidium 85.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molybdenum 95.95	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.414	49 **In** Indium 114.818	50 **Sn** Tin 118.711	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.294
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.328	57-71	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.085	79 **Au** Gold 196.967	80 **Hg** Mercury 200.592	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [278]	110 **Ds** Darmstadtium [281]	111 **Rg** Roentgenium [280]	112 **Cn** Copernicium [285]	113 **Nh** Nihonium [286]	114 **Fl** Flerovium [289]	115 **Mc** Moscovium [289]	116 **Lv** Livermorium [293]	117 **Ts** Tennessine [294]	118 **Og** Oganesson [294]

Lanthanide Series	57 **La** Lanthanum 138.905	58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.243	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.500	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.259	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.055	71 **Lu** Lutetium 174.967
Actinide Series	89 **Ac** Actinium 227.028	90 **Th** Thorium 232.038	91 **Pa** Protactinium 231.036	92 **U** Uranium 238.029	93 **Np** Neptunium 237.048	94 **Pu** Plutonium 244.064	95 **Am** Americium 243.061	96 **Cm** Curium 247.070	97 **Bk** Berkelium 247.070	98 **Cf** Californium 251.080	99 **Es** Einsteinium [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]