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Topics & Standards *Quarter 1*	**I. The Study of Matter** **A. Classification of Matter** 1. Solutions are homogeneous mixtures of a solute dissolved in solvent [homogeneous vs heterogeneous solution]. a) solubility increases as the temperature increases since the particles have more kinetic energy to overcome the attractive forces between them, also affected by surface area and stirring b) water is a universal solvent since so many substances will dissolve in water 2. Properties of matter are physical and chemical. a) physical properties include color, solubility, odor, hardness, density, melting point, boiling point, viscosity, malleability 1) physical properties can be used to separate substances of mixtures, including solutions 2) physical properties can be altered during chemical change 3) 3. Changes in states of matter involve temperature and the absorption and release of energy. A) data for phase change(s) can be graphed as temperature of the sample vs. the time it has been heated; the following are important observations: 1) investigations should involve collecting data during heating, cooling and solid-liquid-solid phase changes 2) at times, temperature changes steadily - - indicating a change in the motion of the particles and the kinetic energy of the substance 3) at times, the temperature of the substance does not change, indicating there is no change in the kinetic energy; students should wonder where the energy goes 4) since the substance continues to gain or lose energy during phase changes, these changes in energy are potential and indicate a change in the position of the particles 5) when a substance is heated, a phase change will occur when the kinetic energy of the particles is great enough to overcome the attractive forces between the particles; the substance then melts or boils 6) when a substance is cooled, a phase change will occur when the kinetic energy of the particles is no longer great enough to overcome the attractive forces between the particles; the substance then condenses or freezes 4. When thermal energy is added to a solid, liquid or gas, most substances increase in volume because the increased kinetic energy of the particles causes and increased distance between the particles. a) this results in a change in density of the material; solids have greater density than liquids, which have greater density than gases - - all due to the spacing between the particles

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b) density of a substance can be calculated from the slope of a mass vs. volume graph
c) differences in densities can be determined by interpreting mass vs. volume graphs of the substances

B. Atoms

1. The atom consists of specific structures and electrical charges surrounding empty space.
a) the atom is composed of protons, neutrons, and electrons that have measurable properties, including mass; protons and electrons contain a characteristic charge b. discovery of p+ (Au foil experiment): when bombarding thin gold foil with atomic-sized, positively charged, high-speed particles, the following occurs:
1) a few of the particles are deflected slightly from their straight-line path; even fewer bounce back toward the source
2) most of an atom is empty space with a very small, positively charged nucleus
3) the nucleus is composed of protons and neutrons

II. The Study of Matter
C. Classification of Matter

2. Properties of matter are physical and chemical.
b. chemical properties are mainly about reactivity
3. Changes in states of matter involve temperature and the absorption and release of energy.
b. phase changes are examples of changes that can occur when energy is absorbed from the surroundings (endothermic) or released into the surroundings (exothermic)

D. Atoms
2. Ions (cations and anions) are among the signature structures associated with atoms.
a. atoms may gain or lose electrons to become anions or cations
b. atomic number, mass number, charge, and identity of the element can be determined from the number of protons, neutrons, and electrons
c. each element has a unique atomic spectrum that can be observed and used to identify it
3. Isotopes are the variations in the atom of an element due to different numbers of neutrons; all atoms of a particular element have the same atomic number, but the isotopes of an element have different mass numbers.

C. Periodic Trends of the Elements
1. In Periodic Law, atoms are listed in order of increasing atomic number; the sequence of properties repeat.

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	2. The elements are clustered into “periods” and “families.” a. elements are identified by their horizontal position on the Periodic Table as “periods:” metals, nonmetals, and metalloids b. elements are identified by their vertical position on the Periodic Table as “families:” alkali metals, alkaline earth metals, halogens, and noble gases c. in a “family,” elements have similar chemical and physical properties; metalloids have some properties of metals and some of nonmetals d. elements in groups 1, 2, and 17 have characteristic ionic charges that are used to predict formulas of compounds D. Bonding and Compounds 1. Bonding (ionic and covalent) is the formation of molecules by gaining, losing, or sharing electrons. a. an ionic bond is the attraction of two oppositely charge ions, typically a metal cation and a nonmetal anion; they are formed by transfer of electrons between atoms; ions attract oppositely charged ions from every direction, forming a 3-D lattice b. covalent bond is the sharing electrons between two atoms - - usually nonmetals; structures formed range from small individual molecules to 3-D lattices (e.g., a diamond) 2. Formulas for predicting ionic compounds use ionic charge (groups 1, 2, 17, H, O). 3. The ionic and covalent names of substances are used in writing formulas. 4. Given a chemical formula, the nomenclature (or how to name compounds), uses Prefixes and Suffixes. 5. electrons move about in the empty space that surrounds the nucleus (elocation; e- cloud) **Vision to Practice:** Visually compare the inside structure of various balls (tennis ball, golf ball, baseball, basketball/kickball and soccer ball). Determine what makes the ball bounce the highest (and/or travel farthest), compare, analyze the data, draw conclusions and present findings in multiple formats. • Explore the benefits of radiation and how it can be used as a tool to sustain life (sterilization and food irradiation processes, nuclear medicine). Include details about how the radiation works to accomplish the benefit and the extent (limit or range) that the benefit will continue as opposed to becoming harm to life (plants, animals or human beings) on Earth. Draw conclusions and present an argument based on supporting data as to when radiation poses a threat as opposed to being beneficial. Present findings in multiple formats.

Time Frame	*Curriculum Units/ Assessment (Evidence)*	*Opportunities for Integration*	*Resources (Curriculum /Textbook)*	*Instructional Practices/ Differentiation*

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Week 1-3	**Unit:**	***ELA/Literacy***	**Introduction to Unit**	**Intervention**
The Study of Matter *Part I*	 **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **Mathematics**	**Preview the Unit** **STEM Unit Projects** **McGraw-Hill** *Chapter 15, Pages 460-485* Section 1: Composition of Matter Section 2: Properties of Matter Lab 1 Lab 2 Science and Technology Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	♦ Re-visit the chem4kids website for more assistance with classification of matter: www.chem4kids.com/matter **Extension** ♦ Have students classify 20 different objects from home. Objects can be household items, food, chemicals etc.

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		Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.		
Week 4-5 *Matter*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may*	**ELA/Literacy** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.	**McGraw-Hill** *Chapter 14, Pages 430-459* Section 1: Matter and Thermal Energy Lab 1 Section 2: Properties of Fluids Section 3: Behavior of Gases Lab 2 How Science Works Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	**Intervention** ♦ Re-visit the chem4kids website for more assistance with classification of matter: www.chem4kids.com/matter **Extension** ♦ Have students classify 20 different objects from home. Objects can be household items, food, chemicals etc.

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	be at the **emergent** level.			
Weeks 6-8 *Atoms*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	**ELA/Literacy** Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address	**McGraw-Hill** *Chapters 16 & 17, Pages 486-547* ***Chapter 16*** Section 1: Structure of the Atom Section 2: Masses of Atoms Section 3: The Periodic Table Lab 1 Lab 2 How Science Works Study Guide Assessment ***Chapter 17*** Section 1: Metals Section 2: Nonmetals Lab 1 Section 3: Mixed Groups Lab 2 How Science Works Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in	**Intervention** ♦ This website is a great resource for all chemistry questions: www.chem4kids.com ♦ Use Phet through University of Colorado for more help with Atoms: http://phet.colorado.edu/en/simulation/build-an-atom ♦ Atom Family Math Challenge: http://sciencespot.net/Media/atomicmath.pdf ♦ A website from Annenberg on the Atoms/Subatomic Particles/& Periodic Table offers a nice review: https://www.learner.org/interactives/periodic/basics_2_the_atom.html **Extension** ♦ Use this website to further your understanding of atoms and elements. Click on View after typing in the web address: http://thinktv.pbslearningmedia.org/resource/lsps07.sci.phys.matter.theatom/the-atom/ ♦ A website to describe the latest elements that are being synthesized:

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			Gizmos https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	http://www.popsci.com/science/article/2 013-04/making-new-elements

Topic & Standard ***Quarter 2***	**III. The Study of Matter** **E. Reactions of Matter** 1. Chemical reactions are about changes in the electrons. a. balancing equations and writing balanced equations requires being given either formulas of reactants and products or a word description of the reaction 2. Nuclear reactions are about changes in the nucleus and involve much larger energies than chemical reactions. a. the nuclear force binds protons with neutrons, and the electrical force repulses the protons b. the nuclear force is extremely weak at distances, but over the short distance in the nucleus, it is greater than the electrical force 3. An unstable nucleus (i.e., if forces are unbalanced) emits radiation through radioactive decay. a. the products of radioactive decay are fast-moving particles, energy, or a new nucleus; the identity of the element changes b. radioisotopes have medical applications (e.g., used to kill undesired cells); when introduced into the body, they show the flow of materials in biological processes

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c. for radioisotopes, the half-life is the time required for the isotope to lose half of its radioactivity; half-life values are unique and constant, and are used in radioactive dating.

4. Fission and fusion involve the splitting and combining the nucleus to release large quantities of energy.

a. fission is splitting a large nucleus into smaller nuclei, releasing large quantities of energy

b. fusion is joining smaller nuclei into a larger nucleus, releasing large quantities of energy

c. fission and fusion are responsible for the formation of all elements in the universe beyond helium and the energy of the sun and stars.

II. ENERGY AND WAVES

A. Conservation of energy

1. Kinetic energy can be quantified.

a. energy has no direction; it is measured in units of Joules (J)

b. Ek = ½ mv2

2. Quantifying gravitational potential energy is displayed by Eg = mgh

3. Energy is relative. a. an object's energy is measured relative to a reference (point of zero energy)

1) reference may change in different situations

2) only the change in amount of energy can be measured absolutely

b. use conservation of energy and equations for kinetic and gravitational potential energy –

(1) to calculate values associated with energy (i.e., height, speed, mass)

(2) for situations involving energy transfer and transformations

(3) to quantify energy from data collected in experimental situations (e.g., swinging pendulum, a car traveling down incline)

B. Transfer and transformation of energy (including work)

1. If the force = F, and displacement = Δx, and they are in the same direction, work can be displayed as W = FΔx.

2. Use pie graphs or bar graphs to represent energy transformations.

3. Solve problems by combining equations for work, kinetic energy, and potential energy with the law of conservation of energy.

4. When energy is transferred from one system to another, some energy is transformed to thermal energy, but it is less organized and unavailable for doing useful work, and the total amount of energy remains constant.

D. Thermal energy

1. Transfer of thermal energy occurs during heating, cooling, and phase changes.

2. Thermal energy transfer occurs until thermal equilibrium is reached.

3. Thermal conductivity is the rate at which thermal energy is transferred from one material to another (i.e., conductors vs. insulators).

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	4. Whether there is absorption or emission of thermal energy depends on temperature, color, texture, exposed surface area (i.e., black, rough vs. white, smooth). 5. Objects or systems continually absorb and emit thermal radiation. a. if they absorb more than they emit, there is no phase change, and the temperature increases b. if they emit more than they absorb, there is no phase change, and the temperature decreases c. if the amount absorbed equals the amount emitted, thermal equilibrium results, and the temperature is constant			
Time Frame	***Curriculum Units with Assessment (Evidence)***	***Opportunities for Integration***	***Resources (Curriculum /Textbook)***	***Instructional Practices/ Differentiation***
Weeks 9-10 *Trends*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may*	**ELA/Literacy** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. Follow precisely a complex multistep procedure when carrying out experiments, taking	**McGraw-Hill** *Chapter 17, Pages 502-547* ***Chapter 17*** Section 1: Metals Section 2: Nonmetals Lab 1 Section 3: Mixed Groups Lab 2 How Science Works Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	

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	be at the **emergent** level.	measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.		
Weeks 11-14 *Bonding*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	**ELA/Literacy** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	**McGraw-Hill** **Preview the Unit** **STEM Unit Projects** *Chapter 18, Pages 550-579* Section 1: Stability in Bonding Lab 1 Section 2: Types of Bonds Section 3: Writing Formulas and Naming Compounds Lab 2 Science and Technology Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	**Intervention** A basic worksheet to show Covalent Bonding: http://colinamiddle.net/dmatras/Chapter%205/pages/Covalent%20Bonding%20Wor ksheet1.pdf ♦ A basic worksheet to show Ionic Bonding: http://colinamiddle.net/dmatras/Chapter%205/pages/Ionic%20Bonding%20Worksh eet-1.pdf

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Weeks 15-16 *Reactions*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g.,	**McGraw-Hill** *Chapter 19, Pages 580-613* *Chapter 20 certain sections if needed* Section 1: Chemical Changes Section 2: Classifying Chemical Reactions Section 3: Chemical Reactions and Energy Section 4: Reaction Rates and Equilibrium Lab 1 Lab 2 Science and History Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	**Intervention** ♦ This Bill Nye video clip provides a variety of examples of Chemical Reactions (23min): http://www.youtube.com/watch?v=PlwuxpMh8n k ♦ This video clip explains how radioactive elements decay over time. http://educationportal.com/academy/lesson/half-life-calculatingradioactive-decay-and-interpreting-decaygraphs.html ♦ Happy/ Sad balls in Heat/Ice Bath MSB polymers p.32 ♦ This web address discusses the basics of Heat transfer in and out of the system. http://www.wisconline.com/Objects/ViewObject.aspx?ID=sce304 **Extension** ♦ Use the University of Colorado website for a variety of Phet simulations and activities (focus on Chemical Reactions and Nuclear Energy). http://phet.colorado.edu ♦ This link provides a worksheet for students who require more challenging practice with Phase Diagrams. https://www.myhaikuclass.com/c/6479862/file/show/85630710

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		force, friction, reaction force, energy).		
Weeks 17-18 *Forces*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments**	**ELA/Literacy** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **Mathematics** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information	**McGraw-Hill** *Chapter 3, Pages 70-101* Section 1: Forces Section 2: Newton's Laws of Motion Section 3: Using Newton's Laws Lab 1 Lab 2 Science and History Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos**	**Intervention** ♦ Phet simulation on Magnetic Forces: http://phet.colorado.edu/en/simulation/faraday **Extension** ♦ Use this website for extra work with all types of forces: http://www.physicsclassroom.com/Class/newtlaw s/u2l2b.cfm

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	• At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	expressed visually or mathematically (e.g., in an equation) into words.	https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	

Topics & Standards	**FORCES AND MOTION (3.5 weeks)** **A. Forces** 1. Force diagrams are used to determine net force and direction. a. in one-dimension (positive and negative) forces, net force can be determined by one-dimensional vector addition

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Quarter 3	b. a force is an interaction between two objects; both objects experience an equal amount of force, but in opposite directions. (1) interacting force pairs are often confused with balanced forces; interacting force pairs can never cancel each other out because they always act on different objects (2) naming the force (e.g., gravity, friction) does not identify the two objects involved in the interacting force pair 2. Types of forces include gravity, normal, field, and tension; friction is "resistance" to motion [note: the standards document refers to friction as a type of "force"] a. force is a vector quantity, having magnitude and direction; a unit of force is a Newton; (1) 1 Newton of net force will cause a 1 kg object to experience an acceleration of 1m/s2 or 1 N = kg ·m/s2 (2) measure force in lab with a spring scale or a force probe b. gravitational force can be calculated from mass, but all other forces are quantified only from force diagrams c. friction is resistance to motion that opposes "sliding" between two surfaces d. the force on an object always points in a direction opposite to the relative motion of the object e. normal force is distinguishable from tension force f. normal force exists between two solid objects when their surfaces are pressed together due to other forces actin on one or both objects (e.g., a solid sitting on or sliding across a table, a magnet attached to a refrigerator); normal force is always a push directed at right angles from the surfaces of the interacting objects. g. tension force occurs when a non-slack rope, wire, cord, or similar device pulls on another object; it always points in the direction of the pull 3. Field models are used to describe forces at a distance. a) the stronger the field, the greater the force exerted on objects placed in the field; the field of an object is always there - - even if the object is not interacting with anything else b) gravitational force (weight) of an object is proportional to its mass (i.e., Weight , Fg, can be calculated from the equation Fg = m g, where g is the gravitational field strength of an object which is equal to 9.8 N/kg (m/s2) on the surface of the Earth. **B. Motion (5.5 weeks)** 1. "One-dimensional vectors" describe forces and motion acting in one direction. a. Moving from qualitative understanding of motion to quantitative, including graphing to describe motion phenomena b. (In Physical Science) all motion is limited to objects moving in a straight line (e.g., horizontally, vertically, up/down incline), that can be characterized in a single step (e.g., at rest, constant velocity, constant acceleration) c. motion of two objects may be compared or addressed simultaneously (e.g., when or where they would meet) d. motion depends on the observer's frame of reference; it is described in terms of distance, position, displacement, speed, velocity acceleration, time; there is no motionless frame from which to judge all motion e. vector properties (magnitude and direction) impact position, displacement, velocity, and acceleration 2. Displacement, velocity (constant, average, and instantaneous) and acceleration can be measured or calculated.

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	a. displacement is calculated by subtracting initial position from final position (Δx = xf – xi) (1) can be positive or negative depending on direction of motion (2) is not always equal to distance traveled; give examples where distance is not same as displacement b. velocity is speed in a given direction [v avg = (xf – xi)/(tf -ti)] (1) divide displacement (change in position) by elapsed time (2) may be positive or negative depending on direction of motion (3) is not always equal to speed; provide examples when average speed is not same as average velocity (4) constant velocity = the object has same displacement for each successive time interval (5) velocity of object changes continuously while speeding up, slowing down, and/or changing direction (6) speed of object at any instant is its instantaneous speed; the object does not travel at this speed for any period of time or cover any distance if the speed is continually changing c) acceleration is the rate at which velocity changes (1) average acceleration = change in velocity divided by elapsed time; aavg = (vf – vi) / (tf – ti) (2) can be positive or negative (but not the specific motions responsible for producing them (3) objects with no acceleration can be standing still or moving with constant velocity (4) constant acceleration = when change in object's instantaneous velocity is same for equal successive time intervals 3. Position vs. time and velocity vs. time can be interpreted in graphic form. a. Interpret graphs to determine specifics about speed, direction and change in motion are limited to positive x-values and show only uniform motion involving constant velocity or constant acceleration b. motion is investigated by collecting and analyzing data in lab (1) objects that move with constant velocity and have no acceleration form a straight line (not necessarily horizontal) on a position time graph (2) objects at rest form a straight horizontal line on a position-time graph (3) objects accelerating show a curved line on a position-time graph (4) velocity is calculated by determining slope of position-time graph; positive slopes indicate motion in a positive direction; negative slopes indicate motion in a negative direction (5) constant acceleration is represented by a straight line (not necessarily horizontal) on a velocity-time graph (6) objects that have no acceleration (at rest or moving at constant velocity) have a straight horizontal line for a velocity-time graph (7) average acceleration can be determined by the slope of a velocity-time graph. c. technology is used to enhance motion exploration and investigation; e.g., video analysis; motion detectors; and computer graphing programs or graphing calculators can be used for data analysis d. make interpretations from motion graph data and develop generalizations **B. Forces**

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	1. Force diagrams are used to determine net force and direction b. a force is an interaction between two objects; both objects experience an equal amount of force, but in opposite directions. (3) objects involved in an interacting force pair can be identified by using the form " A acts on B so B acts on A." (e.g., truck hits sign therefore the sign hits the truck with an equal force in the opposite direction; Earth pulls book down so the book pulls Earth up with an equal force. c. the laws of motion explain and predict changes 2. Types of forces include gravity, normal, and tension; friction is "resistance" to motion [note: the standards document refers to friction as a type of "force"] a. force is a vector quantity, having magnitude and direction; a unit of force is a Newton; (1) 1 Newton of net force will cause a 1 kg object to experience an acceleration of 1m/s2 or 1 N = kg ·m/s2 **C. Dynamics (how forces affect motion)** 1. Objects at rest tend to remain at rest. a. an object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced net force acts on it. b. when the vector sum of the forces (net force) acting on an object is zero, the object does not accelerate. c. an object that is not moving will continue to remain stationary 2. Objects moving with constant velocity tend to move at a constant velocity in the same direction. a. when the vector sum of the forces (net force) acting on an object is zero, the object does not accelerate b. an object that is moving will remain moving without changing its speed or direction 3. The rate at which an object changes its speed or direction (acceleration) is proportional to the vector sum of the applied forces (net force, Fnet) and inversely proportional to the mass (a = Fnet/m) **Vision to Practice:** Research the ranges of human reaction time and braking accelerations. Design a traffic light pattern (e.g., how long the light should stay yellow) for a particular intersection, given the speed limits. Present the design and rationale to the class. Compare the results for different speed limits. Explain any patterns and trends observed. • Investigate the relationship between position and time for a cart that rolls down a ramp from rest. Graph the results. Make a claim about how position and time are related and use evidence to support the claim. Present the findings to the class. Based on the presentations of other investigations, propose sources of error and provide suggestions for how the experiments can be improved.

Time Frame	*Curriculum Units with Assessment*	*Opportunities for Integration*	*Resources (Curriculum /Textbook)*	*Instructional Practices/ Differentiation*

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	(Evidence)			
Week 19-21 *Motion*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP • *Students' level of understanding *may* be at the **emergent** level.	**ELA/Literacy** RST.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). Visually demonstrate the relationships among concepts in text: force-friction **Writing** WHST.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences **Mathematics** Translate quantitative or technical	**McGraw-Hill** **Preview the Unit** **STEM Unit Projects** *Chapter 2, Pages 43-69* Section 1:Describing Motion Section 2: Velocity and Momentum Section 3:Acceleration Lab 1 Lab 2 In the Field Study Guide Assessment	**Intervention** ♦ Making Accelerometers Activity. This will help students understand the concept of increasing and decreasing acceleration of an object: http://sciencespot.net/Media/phys_accellab.pdf **Extension** ♦ The Universe & More website address: http://www.theuniverseandmore.com ♦ Use the Phet Simulation from University of Colorado http://phet.colorado.edu/en/simulations/category/new

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		information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.		
Week 20 *Forces*	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	**ELA/ Literacy** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **Mathematics** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	**McGraw-Hill** Chapter 3, Pages 70-101 Section 1: Forces Section 2: Newton's Laws of Motion Section 3: Using Newton's Laws Lab 1 Lab 2 Science and History Study Guide Assessment	**Intervention** ♦ Phet simulation on Magnetic Forces: http://phet.colorado.edu/en/simulation/faraday **Extension** ♦ Use this website for extra work with all types of forces

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Weeks 21-22	**Unit:**	**ELA/ Literacy**	**McGraw-Hill**	**Intervention**
Dynamics	 **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP • *Students' level of understanding *may* be at the **emergent** level.	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **Mathematics** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	Chapter 3, Pages 70-101 Section 1: Forces Section 2: Newton's Laws of Motion Section 3: Using Newton's Laws Lab 1 Lab 2 Science and History Study Guide Assessment	♦ This website offers a complete description of Newton's 3rd Law, complete with diagrams and comprehensive questions: http://www.physicsclassroom.com/class/newtlaws/Lesson-4/Newton-s-Third-Law **Extension** ♦ Students can work with a partner on this computer based activity to draw a variety of free body diagrams. http://www.physicsclassroom.com/shwave/fbd.cfm

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Topics & Standards *Quarter 4*	**ENERGY AND WAVES (3 weeks)** **C. Waves** 1. Refraction, reflection, diffraction, absorption, and superposition occur as a result of a change in wave pattern. a. sound [energy], light, water, seismic energy all travel in waves b. the result of a wave encountering a new material is that the new material may absorb the energy of the wave by transforming it to another form of energy - - usually thermal energy c. waves can be reflected off solid barriers d. waves can be refracted when a wave travels from one medium to another medium e. waves can undergo diffraction around small obstacles or openings f. two waves traveling through the same medium meet, pass through each other, and continue as before g. waves that meet undergo superposition (i.e., constructive or destructive interference). 2. Radiant energy is measured on the electromagnetic spectrum. a. radiant energy travels in waves and does not require a medium

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b. sources of light energy radiate energy continually in all directions

c. the electromagnetic spectrum exhibits the wide range of frequencies, wavelengths, and energies of radiant energy; the continuum of bands is radio (lowest energy); microwaves; infrared; visible light; X-rays; and gamma rays (highest energy) (1) the "bands" have different applications in everyday life (e.g., infra-red lights warming the food at McDonald's; sun burn is caused by ultra-violet rays; etc.) (2) rather than memorizing specific frequencies, students should understand the relative positions of the bands, including the colors of visible light, are important (e.g., ultraviolet has more energy than microwaves)

d. the wave behavior of radiant energy depends on the nature of the medium (i.e., opaque/ transparent; rough/ smooth; and dull/ shiny)

3. The Doppler Shift involves the relative position of wavelengths, frequencies, and the observer.

a. diagrams show how changes in the observed frequency and wavelength of a wave can occur if the wave source and the observer are moving relative to each other (1) toward each other = the wavelength is shorter, and the frequency is higher (2) away from each other = the wavelength is longer, and the frequency is lower

b. explain how the universe was formed and is applied in other sections of the course

ENERGY AND WAVES (3 weeks)

E. Electricity

1. Electricity involves the movement of electrons.

a. circuits are explained by the flow of electrons, current, voltage, and resistance

b. conductors and insulators explain how freely the electrons flow throughout the material due to how firmly electrons are held to the nucleus

c. separation of charges in a battery causes electrons to flow in circuit

2. Current describes the flow of electrons in a circuit.

a. current is the rate at which a positive charge flows in a circuit; in reality, negatively charged electrons actually move

b. current is measured in amperes; (A) = 1 coulomb of charge per second (C/s)

c. current increases as potential difference increases and as resistance decreases

3. Power is measured in electric potential (i.e., voltage).

a. a power source supplies the electrons already in a circuit with electric potential energy by doing work to separate charges (1) in a battery, energy is provided by a chemical reaction that separates charges on positive and negative sides of the battery (2) potential difference (voltage) = one Joule of energy supplied to each coulomb of charge (3) volt (V) = one Joule of energy per coulomb of charge (1 J/C)

b. potential difference across a circuit is a property of the energy source; it does not depend on devices of the circuit

4. Resistors inhibit or increase the transfer of energy.

a. electrons flow and transfer energy to other objects

b. and transform electrical energy into other forms (e.g., heat, light, sound) in resistors

c. resistors oppose the rate of charge flow in the circuit
d. experiments and investigations are useful to test transfer of energy (3-D or the virtual) to construct circuits and to measure and compare potential difference in voltage and current

THE UNIVERSE (3 weeks)

A. History of the Universe

1. The" Big Bang" model is the broadly accepted theory for the origin and evolution of our universe.
   a. The contents of the known universe expanded explosively into existence from a hot, dense state 13.7 billion years ago (NAEP, 2009)
   b. 12 to 14 billion years ago, the portion of the universe seen today was only a few millimeters across (NASA).

2. Supporting evidence for the "Big Bang" theory include Hubble's law, red shift, or cosmic microwave background radiation. 3. Technology provides the basis for many new discoveries related to space and the universe, including - -
   a. visual radio and x-ray telescopes collect information across the entire electromagnetic spectrum
b. computers are used to manage data and complicated computations
c. space probes send back data and materials from remote parts of the solar system
d. accelerators provide subatomic particle energies that simulate conditions in the stars and in the early history of the universe before stars formed

B. Galaxy Formation

1. After the Big Bang, the universe expanded quickly (and continues to expand) and then cooled down enough for atoms to form; gravity pulled atoms together into gas clouds that became stars, which comprised young galaxies.
2. A galaxy is a group of billions of individual stars, star systems, star clusters, dust and gas bound together by gravity.
3. There are billions of galaxies in the universe, and they are classified by size and shape. a. Milky Way is a spiral galaxy; has more than 100 billion stars and a diameter of more than 100,000 light years b. at the center of the Milky Way is a bulge of stars, from which are spiral arms of gas, dust and most of the young stars c. our solar system is part of the Milky Way galaxy 4. Hubble's law states that galaxies that are farther away have a greater red shift, so the speed at which a galaxy is moving away is proportional to its distance from the Earth.
5. Red shift is a phenomenon due to Doppler shifting, so the shift of light from a galaxy to the red end of the spectrum indicates that the galaxy and the observer are moving farther away from one another.

C. Stars

1. The formation of stars is described as stages of evolution.
   a. early in the formation of the universe, stars coalesced out of clouds of hydrogen and helium and clumped together by gravitational attraction into galaxies
   b. stars are classified by their color, size, luminosity and mass.

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	c. Hertzsprung-Russell diagram are used to estimate the size of stars and predict how stars will evolve (1) most stars fall on the main sequence of the H-R diagram, a diagonal band running from the bright hot stars on the upper left to the dim cool stars on the lower right (2) a star's mass determines the star's place on the main sequence and how long it will stay there d. Patterns of stellar evolution are based on the mass of the star (1) stars begin to collapse as the core energy dissipates (2) nuclear reactions outside the core cause expansion of the star, eventually leading to the collapse of the star 2. Fusion occurs in stars and results in the formation of elements. a. when heated to a sufficiently high temperature by gravitational attraction, stars begin nuclear reactions, which convert matter to energy and fuse the lighter elements into the heavier ones b. these and other fusion processes in stars have led to the formation of all the other elements c. all of the elements, except for hydrogen and helium, originated from the nuclear fusion reactions of stars **Vision to Practice:** Investigate features of a solid planetary body using the World Wide Telescope. Identify features that are oldest verses those that are youngest and draw conclusions about the reasons for the differences using current theory to support the conclusions. • Investigate the relative ages of star clusters by plotting data and analyzing the results of the graph created (creating an H-R diagram). Draw conclusions based on the results of the graph and discuss possible implications of the information learned (see Student Instructions and Star Gauge). • Evaluate data analyzing the penetration ability of Gamma radiation, X-rays, UV, visible light, infrared and radio wavelengths in Earth's atmosphere. Based on the analysis and pertinent wavelength-study considerations (e.g., certain wavelengths of light are blocked from reaching Earth's surface by the atmosphere; how efficiently telescopes work at different wavelengths; telescopes in space are much more expensive to construct than Earth-based telescopes) recommend to a federal funding agency which telescope project should receive funds for construction. The two projects to consider are: **Project 1** – A UV wavelength telescope, placed high atop Mauna Kea in Hawaii at 14,000 ft. above sea level, which will be used to look at distant galaxies. **Project 2** – A visible wavelength telescope, placed on a satellite in orbit around Earth, which will be used to observe a pair of binary stars located in the constellation Ursa Major (Big Dipper). (Prather, Slater, Adams, & Brissenden, 2008) Use real-time data from the NASA Hubble Mission to research and document the history of the mission, marking the time, discoveries and impact to humans. There are links at the NASA site to connect students to astronauts and scientists to allow for primary and secondary resources in the research. Present a final product (can be an e-portfolio, presentation or formal poster session) to an authentic audience.

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	Vision to Practice: Design, build and test a ramp system onto which a ball can be placed so that it rolls down a ramp and continues a specific distance on the table. Describe what properties of the system were important (and those not important) in the design. Provide different target distances for the launched ball to travel on the designed course and hit a given target within three trials. • Investigate the relationship between speed, frequency and wavelength for a transverse wave traveling through a Slinky® . Make claims about what happens to the speed and the wavelength of the wave as the frequency is increased and give evidence to support any claims. For example, use information from the investigation to explore the implications of cell phone usage. Include beneficial and harmful aspects of the use of this technology for a modern convenience. Present findings and draw a conclusion using data and research in multiple formats

Time Frame	*Curriculum Units with Assessment (Evidence)*	*Opportunities for Integration*	*Resources (Curriculum /Textbook)*	*Instructional Practices/ Differentiation*
Weeks 27-29 Waves	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs	**ELA/Literacy** WHST.3 Write precise descriptions of step-by-step procedures used in investigations so that another person could replicate and obtain the same results **Mathematics** Translate quantitative or technical information expressed in words in a text into visual form (e.g.,	**McGraw-Hill** *Chapters 9-13* • Chapter 9 all, chapters 10-13 sections that apply **Chapter 9** Pages Section 1: The Nature of Waves Section 2: Wave Properties Lab 1 Section 3: The Behavior of Waves Lab 2 How Science Works Study Guide Assessment	**Intervention** ♦ Phet: Wave on a String: frequency, speed, and amplitude: https://phet.colorado.edu/en/simulation/wave-on-a-string ♦ Phet: Sound (specifically the Doppler Effect) http://phet.colorado.edu/en/simulation/sound **Extension** ♦ See this Science Net Links website for more information on Pendulums: http://sciencenetlinks.com/lessons/exploring-pendulums/

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	Summative Assessments • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	**Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	
Weeks 30-32 Energy & Waves	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may*	**Writing** WHST.3 Write precise descriptions of step-by-step procedures used in investigations so that another person could replicate and obtain the same results **ELA/Literacy** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **Mathematics**	**McGraw-Hill** *Chapters 9-13, Pages 272-427* • all sections that apply **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	**Intervention** ♦ Phet: Energy Skate Park: Computer Based Activity Web Address: https://phet.colorado.edu/sims/html/energy-skate-park-basics/latest/energy-skate-park-basics_en.html **Extension** ♦ Coaster Creator computer game at Jason.org ♦ Trebuchet: See how a medieval Trebuchet uses the transfer of Potential and Kinetic energy. http://thinktv.pbslearningmedia.org/resource/hew06.sci.phys.maf.trebuchet/energy-transfer-in-a-trebuchet/

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	be at the **emergent** level.	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.		
Weeks 30-31 Electricity	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	**ELA/Literacy** RST.4 Determine the meaning of symbols, key terms, and other domain specific words and phrases as they are used in a specific scientific or technical context relevant to texts and topics. WHST.9 Draw evidence from informational texts to support analysis, reflection, and research. Reflection and research on IIIE1	**McGraw-Hill** *Chapter 6, Pages 168-199* Section 1: Electric Charge Section 2: Electric Current Lab 1 Section 3: More Complex Circuits Lab 2 Science and History Study Guide Assessment **Discovery Education** *http://www.discoveryeducation.com/* Google log-in **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	**Intervention** ♦ More background information about electricity: www.explainthatstuff.com/electricity.html **Extension** ♦ This website provides a lesson plan for extending the basic series and parallel circuits to making a working circuit from every day materials (cellphone chargers etc.) http://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_housing/cub_housing_lesson02.xml ♦ Inquiry Activity: "Lighting a Light Bulb" Google creating electrical circuit using citrus fruit or pickles.

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Weeks 32-34 Universe	**Unit:**  **Formative Assessments** • 4-7 performance tasks that reach DOK level 4 AND/OR • 3-5 FATPs / RAFTs **Summative Assessments** • At least 1 GRASP *Students' level of understanding *may* be at the **emergent** level.	RST.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. Determine the central ideas or conclusions of text WHST.9 Draw evidence from informational texts to support analysis, reflection, and research.	**McGraw-Hill** *Earth Science Book* *Chapters 29 & 30, Pages 829-889* **All sections that apply* **Discovery Education Video** ("United Streaming"): "How the Universe Works: Extreme Star" ♦ "Dying Stars and Birth of Elements" http://www.library.csi.cuny.edu/~supernova7/robbins/AST160/XRaySNR_sm.pdf ♦ "Windows to the Universe" website curated by Earth Science Teachers with all things Earth Science: http://www.windows2universe.org/ ♦ This is a good video that shows the scale of the universe in which we live: www.scaleofuniverse.com **Gizmos** https://www.explorelearning.com/index.cfm?method=cuser.dsploginjoin Google log-in	**Instructional Practice** Investigate the relative ages of star clusters by plotting data and analyzing the results of an H-R diagram **Extension:** ♦ Webcast of Columbia University Astrophysicist discussing the birth of stars: https://www.nsf.gov/news/news_summ.jsp?cntn_id=117262