POCONO MOUNTAIN SCHOOL DISTRICT

COURSE: Grade 7 Physical Science	**GRADE(S):** 7
Unit 1: Nature of Science	

PA ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

S8.A.1 1 Explain, interpret, and apply scientific, environmental, or technological knowledge presented in a variety of formats (e.g., visuals, scenarios, graphs).

- **S8.A.1.1.1** Distinguish between a scientific theory and an opinion, explaining how a theory is supported with evidence, or how new data/information may change existing theories and practices.
- **S8.A.1.1.2** Explain how certain questions can be answered through scientific inquiry and/or technological design.
- **S8.A.1.1.3** Use evidence, such as observations or experimental results, to support inferences about a relationship.
- **S8.A.1.1.4** Develop descriptions, explanations, predictions, and models using evidence.

S8.A.1.2 Identify and explain the impacts of applying scientific, environmental, or technological knowledge to address solutions to practical problems.

- **S8.A.1.2.1** Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).
- **S8.A.1.2.3** Describe fundamental scientific or technological concepts that could solve practical problems (e.g., Newton's laws of motion, Mendelian genetics).

S8.A.1.3 Identify and analyze evidence that certain variables may have caused measurable changes in natural or human-made systems.

- **S8.A.1.3.1** Use ratio to describe change (e.g., percents, parts per million, grams per cubic centimeter, mechanical advantage).
- **S8.A.1.3.2** Use evidence, observations, or explanations to make inferences about change in systems over time (e.g., carrying capacity, succession, population dynamics, loss of mass in chemical reactions, indicator fossils in geologic time scale) and the variables affecting these changes.
- **S8.A.1.3.3** Examine systems changing over time, identifying the possible variables causing this change, and drawing inferences about how these variables affect this change.
- **S8.A.1.3.4** Given a scenario, explain how a dynamically changing environment provides for the sustainability of living systems

S8.A.2.1 Apply knowledge of scientific investigation or technological design in different contexts to make inferences to solve problems.

- **S8.A.2.1.1** Use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships.
- **S8.A.2.1.2** Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
- **S8.A.2.1.3** Design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant.
- **S8.A.2.1.4** Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
- **S8.A.2.1.5** Use evidence from investigations to clearly communicate and support conclusions.
- **S8.A.2.1.6** Identify a design flaw in a simple technological system and devise possible working solutions.

S8.A.2.2 Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.

- **S8.A.2.2.1** Describe the appropriate use of instruments and scales to accurately and safely measure time, mass, distance, volume, or temperature under a variety of conditions.
- **S8.A.2.2.2** Apply appropriate measurement systems (e.g., time, mass, distance, volume, temperature) to record and interpret observations under varying conditions.
- **S8.A.2.2.3** Describe ways technology (e.g., microscope, telescope, micrometer, hydraulics, barometer) extends and enhances human abilities for specific purposes.

S8.A.3.1 Explain the parts of a simple system, their roles, and their relationships to the system as a whole.
- **S8.A.3.1.2** Explain the concept of order in a system [e.g., (first to last: manufacturing steps, trophic levels)

S8.A.3.2 Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.
- **S8.A.3.2.1** Describe how scientists use models to explore relationships in natural systems (e.g., an ecosystem, river system, the solar system).
- **S8.A.3.2.2** Describe how engineers use models to develop new and improved technologies to solve problems.
- **S8.A.3.2.3** Given a model showing simple cause and-effect relationships in a natural system, predict results that can be used to test the assumptions in the model (e.g., photosynthesis, water cycle, diffusion, infiltration).

S8.C.1.1 Explain concepts about the structure and properties (physical and chemical) of matter.
- **S8.C.1.1.1** Explain the differences among elements, compounds, and mixtures.
- **S8.C.1.1.2** Use characteristic physical or chemical properties to distinguish one substance from another (e.g., density, thermal expansion/contraction, freezing/melting points, streak test).
- **S8.C.1.1.3** Identify and describe reactants and products of simple chemical reactions.

S8.C.2.1 Describe energy sources, transfer of energy, or conversion of energy.
- **S8.C.2.1.1** Distinguish among forms of energy(e.g., electrical, mechanical, chemical, light, sound, nuclear) and sources of energy (i.e., renewable and nonrenewable energy)
- **S8.C.2.1.2** Explain how energy is transferred from one place to another through convection, conduction, or radiation.
- **S8.C.2.1.3** Describe how one form of energy (e.g., electrical, mechanical, chemical, light, sound, nuclear) can be converted into a different form of energy.

S8.C.2.2 Compare the environmental impact of different energy sources chosen to support human endeavors.
- **S8.C.2.2.1** Describe the Sun as the major source of energy that impacts the environment.
- **S8.C.2.2.2** Compare the time span of renewability for fossil fuels and the time span of renewability for alternative fuels.
- **S8.C.2.2.3** Describe the waste (i.e., kind and quantity) derived from the use of renewable and nonrenewable resources and their potential impact on the environment.

S8.C.3.1 Describe the effect of multiple forces on the movement, speed, or direction of an object.
- **S8.C.3.1.1** Describe forces acting on objects (e.g., friction, gravity, balanced versus unbalanced).
- **S8.C.3.1.2** Distinguish between kinetic and potential energy.
- **S8.C.3.1.3** Explain that mechanical advantage helps to do work (physics) by either changing a force or changing the direction of the applied force (e.g., simple machines, hydraulic systems).

UNIT OBJECTIVES/ESSENTIAL KNOWLEDGE

1. Select appropriate equipment (probeware, triple beam balances, thermometers, metric rulers, graduated cylinders, electronic balances, or spring scales) and utilize correct techniques to measure length, mass, density, weight, volume, temperature, and force.
   - Systematic investigations require standard measures and consistent and reliable tools. International System of Units (SI or metric) measures, recognized around the world, are a standard way to make measurements.
2. Design a data table that includes space to organize all components of an investigation in a meaningful way, including levels of the independent variable, measured responses of the dependent variable, number of trials, and mathematical means.
   - The number of repeated trials needs to be considered in the context of the investigation. Often "controls" are used to establish a standard for comparing the results of manipulating the independent variable. Controls receive no experimental treatment. Not all experiments have a control, however.
3. Record measurements, using the following metric (SI) units: liter, milliliter (cubic centimeters), meter, centimeter, millimeter, grams, degrees Celsius, and newtons.
   - In the metric system of measurement, the most common units of distance are millimeters,

centimeters, meters, and kilometers. Mass is used to measure the weight of an object. In the metric system of measurement, the most common units of mass are the gram and kilogram. Celsius is the measurement for temperature, and the newton (symbol: N) is the International System of Units (SI) derived unit of force.

4. Recognize metric prefix units and make common metric conversions between the same base metric unit (for example, nanogram to milligram or kilometer to meter).
- The metric prefixes indicate that the basic unit has either been multiplied or divided by a factor of ten. It can either be a positive or a negative factor of ten. These prefixes, which are used from the lowest to the highest value are as follows:
  - Milli-
  - Centi-
  - Deci-
  - Meter/Gram/Liter
  - Deca-
  - Hecto-
  - Kilo-

5. Use a variety of graphical methods to display data; create an appropriate graph for a given set of data; and select the proper type of graph for a given set of data, identify and label the axes, and plot the data points.
- Systematic investigations require organized reporting of data. The way the data are displayed can make it easier to see important patterns, trends, and relationships. Frequency distributions, scatterplots, line plots, and histograms are powerful tools for displaying and interpreting data

6. Gather, evaluate, and display data; create an appropriate graph for a given set of data; and select the proper type of graph for a given set of data, identify and label the axes, and plot the data points.
- Investigation not only involves the careful application of systematic (scientific) methodology, but also includes the review and analysis of prior research related to the topic. Numerous sources of information are available from print and electronic sources, and the researcher needs to judge the authority and credibility of the sources.

7. Identify the key components of controlled experiments: hypotheses, independent and dependent variables, constants, controls, and repeated trials.
- Different kinds of problems and questions require differing approaches and research. Scientific methodology almost always begins with a question, is based on observation and evidence, and requires logic and reasoning. Not all systematic investigations are experimental.

8. Formulate conclusions that are supported by the gathered data.
- The analysis of data from a systematic investigation may provide the researcher with a basis to reach a reasonable conclusion. Conclusions should not go beyond the evidence that supports them. Additional scientific research may yield new information that affects previous conclusions.

9. Apply the methodology of scientific inquiry: begin with a question, design an investigation, gather evidence, formulate an answer to the original question, communicate the investigative process and results, and realize this methodology does not always follow a prescribed sequence.
- Different kinds of problems and questions require differing approaches and research.

10. Communicate in written form the following information about investigations: the purpose/problem of the investigation, procedures, materials, data and/or observations, graphs, and an interpretation of the results.
- To communicate the plan of an experiment accurately, the independent variable, dependent variable, and constants must be explicitly defined.
- It is important to communicate systematically the design and results of an investigation so that questions, procedures, tools, results, and conclusions can be understood and replicated.

11. Use current technologies to model and simulate experimental conditions.
- New discoveries based on nanoscience investigations have allowed the production of superior new materials with improved properties (e.g., computers, cell phones).

12. Recognize examples of the use of nanotechnology and its applications.

- Nanotechnology is the study of materials at the molecular (atomic) scale. Items at this scale are so small they are no longer visible with the naked eye. Nanotechnology has shown that the behavior and properties of some substances at the nanoscale (a nanometer is one-billionth of a meter) contradict how they behave and what their properties are at the visible scale.

ACTIVITIES:

1. Engage in hands-on activities requiring the measurement of length, measure length, mass, density, weight, volume, temperature, and force.
2. After completing an investigation, students will work in groups to design a data table that includes all components of the investigation including the independent variable, dependent variable, and number of trials.
3. Given a variety of samples, student will accurately record measurements, using the metric system.
4. Recognize metric prefix units and make common metric conversions between the same base metric unit (for example, nanogram to milligram or kilometer to meter).
5. Create an appropriate graph for a given set of data; and select the proper type of graph for a given set of data, identify and label the axes, and plot the data points
6. Read and summarize on an article on an environmental concern and identify any author bias.
7. After the completion of an investigation, formulate conclusions that are supported by the gathered data.
8. Design an experiment to test a hypothesis. For example, diaper A holds more liquid than diaper B. Conduct the investigation, record results, and communicate findings to classmates.

RESOURCES:

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ASSESSMENTS:

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- Group Discussions
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- Individual Projects
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REMEDIATION:

- Class Notes
- Graphic Organizers
- Chunking of Information
- Oral Questioning
- Group Discussion
- Small Lab Group Participation
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- Review Games
- Content Review

ENRICHMENT:

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UNIT 2: Introduction to Chemistry

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UNIT OBJECTIVES/ESSENTIAL KNOWLEDGE

1. Describe the particle theory of matter.
   - Matter is anything that has mass and occupies space. All matter is made up of small particles called atoms. Matter can exist as a solid, a liquid, a gas, or plasma.
2. Explain how to determine whether a substance is an element, compound, or mixture.
   - Matter can be classified as elements, compounds, and mixtures. The atoms of any element are alike but are different from atoms of other elements.
   - Compounds consist of two or more elements that are chemically combined in a fixed ratio.
   - Mixtures also consist of two or more substances, but the substances are not chemically combined.
3. Define compounds as inorganic or organic.
   - Organic compounds will include things like the nucleic acids, found in DNA, lipids and fatty acids found in the cells of living organisms, proteins and enzymes that are necessary for cellular processes to take place, and more.
   - Inorganic compounds include the salts, metals, and other elemental compounds.
4. Identify and describe the properties of solids, liquids, gases, and plasma.

- A solid has a definite shape and volume because the molecules that make up the solid are packed closely together and move slowly.
- A liquid has a definite volume but takes the shape of its container. Examples of liquids include water and oil.
- A gas has neither a definite volume nor a definite shape. Some gasses can be seen and felt, while others are intangible for human beings.
- Plasma has neither a definite volume nor a definite shape. Plasma often is seen in ionized gases, but it is distinct from a gas because it possesses unique properties. Free electrical charges (not bound to atoms or ions) cause the plasma to be electrically conductive. The plasma may be formed by heating and ionizing a gas. Examples of plasma include stars, lightning, fluorescent lights, and neon signs.

5. Distinguish between physical properties (i.e., shape, density, solubility, odor, melting point, boiling point, and color) and chemical properties (i.e., acidity, basicity, combustibility, and reactivity).

6. Matter can be described by its physical properties, which include shape, density, solubility, odor, melting point, boiling point, and color. Some physical properties, such as density, boiling point, and solubility, are characteristic of a specific substance and do not depend on the size of the sample. Characteristic properties can be used to identify unknown substances.

7. Find the mass and volume of substances and calculate and compare their densities.
- Objects with the same mass but different volumes have different densities.
- Objects with different masses but the same volume have different densities.
- Liquids with different densities can be layered.
- Equal volumes of different substances usually have different masses.

8. Analyze the pH of a solution and classify it as acidic, basic, or neutral.

9. Acids make up an important group of compounds that contain hydrogen ions. When acids dissolve in water, hydrogen ions (H+) are released into the resulting solution. A base is a substance that releases hydroxide ions (OH–) into solution. pH is a measure of the hydrogen ion concentration in a solution. The pH scale ranges from 0–14. Solutions with a pH lower than 7 are acidic; solutions with a pH greater than 7 are basic. A pH of 7 is neutral. When an acid reacts with a base, a salt is formed, along with water.

10. Determine the identity of an unknown substance by comparing its properties to those of known substances.
- Every substance has a unique set of properties that allow us to differentiate between them. These properties are classified as physical properties and chemical properties. Physical properties are those that can be determined or measured without changing the composition or identity of the substance. These properties include color, odor, taste, density, melting point, boiling point, conductivity, and hardness.
- Chemical properties tell us how the substance interacts with other substances and may include reaction with oxygen (oxidation), chlorine, metals, etc.. Determination of chemical properties results in the change of the identity of the substance.

11. Design an investigation from a testable question related to physical and chemical properties of matter. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.
- Different kinds of problems and questions require differing approaches and research. Scientific methodology almost always begins with a question, is based on observation and evidence, and requires logic and reasoning. Not all systematic investigations are experimental.

12. Use the periodic table to obtain the following information about the atom of an element:
- symbol
- atomic number
- atomic mass
- state of matter at room temperature

13. Describe the organization of the periodic table in terms of atomic number metals, metalloids, and nonmetals groups/families vs. periods.
- The periodic table of elements is a tool used to organize information about the elements. Each box in the periodic table contains information about the structure of an element.
- An atom's identity is directly related to the number of protons in its nucleus. This is the basis for the arrangement of atoms on the periodic table of elements.
- The periodic table is arranged in order of atomic number

- A period is a horizontal row of the periodic table.
- A group is a vertical row of the periodic table.
- Elements of the periodic table are grouped as metals, metalloids or semimetals, and nonmetals. The metalloids separate the metals and nonmetals on a periodic table. Also, many periodic tables have a stair-step line on the table identifying the element groups.

14. Categorize a given element as metal, nonmetal, or metalloid.

- Most elements are metals. Examples of metals include iron, tin, sodium, and plutonium. Metals exhibit the following properties:
  - usually solid at room temperature (mercury is an exception)
  - high luster (shiny)
  - metallic appearance
  - good conductors of heat and electricity
  - malleable (can be bent and pounded into thin sheets)
  - ductile (can be drawn into wire)
  - corrode or oxidize in air and sea water
  - usually dense (exceptions include lithium, potassium, and sodium)
  - may have a very high melting point
  - readily lose electrons
- Examples of metalloids include boron, silicon, and arsenic. Metalloids have some of the properties of metals and some nonmetallic characteristic.
  - dull or shiny
  - usually conduct heat and electricity, though not as well as metals
  - often make good semiconductors
  - often exist in several forms
  - often ductile
  - often malleable
  - may gain or lose electrons in reactions
- Nonmetals exhibit very different properties from metals. Examples of nonmetals include oxygen, chlorine, and argon. Nonmetals display some or all of the following characteristics:
  - dull appearance
  - usually brittle
  - poor conductors of heat and electricity
  - usually less dense, compared to metals
  - usually low melting point of solids, compared with metals
  - tend to gain electrons in chemical reactions

15. Given a chemical formula of a compound, identify the elements and the number of atoms of each that comprise the compound.

- The formula of a compound specifies the number of each kind of atom present in one molecular unit of a compound. Since every unique chemical substance has a definite composition, every such substance must be describable by a chemical formula.
- The number of atoms of each element is written as a subscript;
- When only a single atom of an element is present, the subscript is omitted.
- In the case of organic (carbon-containing) compounds, it is customary to place the symbols of the elements C, H, (and if present,) O, N in this order in the formula.

16. Recognize that the number of electrons in the outermost energy level determines an element's chemical properties or chemical reactivity.

- Atoms are most stable when they have filled the outer shell of electrons which normally holds a max of 8.
- Atoms react to form chemically stable substances that are held together by chemical bonds and are represented by chemical formulas. To become chemically stable, atoms gain, lose, or share electrons.

17. Describe the difference between ionic and covalent bonding.

- A covalent bond is a chemical bond between atoms that occurs when they share one or more electrons. Since neither atom is strong enough to attract an electron from the other, they share electrons in a covalent bond. These bonds form a fixed, definite shape. They generally occur between two non-metallic atoms.
- An ionic bond is a chemical bond between atoms that occurs when they are attracted

because of opposite charges. An ionic bond can form between a cation and anion because one has a positive charge and the other has a negative charge. These bonds do not have a definite shape. They generally occur between a metallic and a non-metallic atom.

ACTIVITIES:

1. Create a model of a chemical compound
2. Identify given substances as a solution or mixtures
3. Given a list of compounds, sort as inorganic or organic.
4. Draw a visual representation of the molecule arrangement of solids, liquids and gases.
5. Record mass and volume of provided samples using appropriate measurement tools and procedures
6. Predict the pH of common household products then using litmus paper record actual pH and identify as a base, acid, or neutral
7. List the physical properties of given substances
8. Identify property changes as physical or chemical
9. Using substances physical and/or chemical properties identify an unknown substance
10. Locate common elements on the periodic table (students should not be required to memorize all elements listed on the periodic table)
11. Based on location within the periodic table, identify elements as metals or nonmetals
12. Create a 3-D model of the an atom

RESOURCES:

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COURSE: Grade 7 Physical Science	**GRADE(S):** 7
UNIT 3: Energy	

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- **S8.A.1.2.1** Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).
- **S8.A.1.2.3** Describe fundamental scientific or technological concepts that could solve practical problems (e.g., Newton's laws of motion, Mendelian genetics).

S8.A.1.3 Identify and analyze evidence that certain variables may have caused measurable changes in natural or human-made systems.

- **S8.A.1.3.1** Use ratio to describe change (e.g., percents, parts per million, grams per cubic centimeter, mechanical advantage).
- **S8.A.1.3.2** Use evidence, observations, or explanations to make inferences about change in systems over time (e.g., carrying capacity, succession, population dynamics, loss of mass in chemical reactions, indicator fossils in geologic time scale) and the variables affecting these changes.
- **S8.A.1.3.3** Examine systems changing over time, identifying the possible variables causing this change, and drawing inferences about how these variables affect this change.
- **S8.A.1.3.4** Given a scenario, explain how a dynamically changing environment provides for the sustainability of living systems

S8.A.2.1 Apply knowledge of scientific investigation or technological design in different contexts to make inferences to solve problems.

- **S8.A.2.1.1** Use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships.
- **S8.A.2.1.2** Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
- **S8.A.2.1.3** Design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant.
- **S8.A.2.1.4** Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
- **S8.A.2.1.5** Use evidence from investigations to clearly communicate and support conclusions.
- **S8.A.2.1.6** Identify a design flaw in a simple technological system and devise possible working solutions.

S8.A.2.2 Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.

- **S8.A.2.2.1** Describe the appropriate use of instruments and scales to accurately and safely measure time, mass, distance, volume, or temperature under a variety of conditions.
- **S8.A.2.2.2** Apply appropriate measurement systems (e.g., time, mass, distance, volume, temperature) to record and interpret observations under varying conditions.
- **S8.A.2.2.3** Describe ways technology (e.g., microscope, telescope, micrometer, hydraulics,

barometer) extends and enhances human abilities for specific purposes.

S8.A.3.1 Explain the parts of a simple system, their roles, and their relationships to the system as a whole.

- **S8.A.3.1.2** Explain the concept of order in a system [e.g., (first to last: manufacturing steps, trophic levels)

S8.A.3.2 Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

- **S8.A.3.2.1** Describe how scientists use models to explore relationships in natural systems (e.g., an ecosystem, river system, the solar system).
- **S8.A.3.2.2** Describe how engineers use models to develop new and improved technologies to solve problems.
- **S8.A.3.2.3** Given a model showing simple cause and-effect relationships in a natural system, predict results that can be used to test the assumptions in the model (e.g., photosynthesis, water cycle, diffusion, infiltration).

S8.C.1.1 Explain concepts about the structure and properties (physical and chemical) of matter.

- **S8.C.1.1.1** Explain the differences among elements, compounds, and mixtures.
- **S8.C.1.1.2** Use characteristic physical or chemical properties to distinguish one substance from another (e.g., density, thermal expansion/contraction, freezing/melting points, streak test).
- **S8.C.1.1.3** Identify and describe reactants and products of simple chemical reactions.

S8.C.2.1 Describe energy sources, transfer of energy, or conversion of energy.

- **S8.C.2.1.1** Distinguish among forms of energy(e.g., electrical, mechanical, chemical, light, sound, nuclear) and sources of energy (i.e., renewable and nonrenewable energy)
- **S8.C.2.1.2** Explain how energy is transferred from one place to another through convection, conduction, or radiation.
- **S8.C.2.1.3** Describe how one form of energy (e.g., electrical, mechanical, chemical, light, sound, nuclear) can be converted into a different form of energy.

S8.C.2.2 Compare the environmental impact of different energy sources chosen to support human endeavors.

- **S8.C.2.2.1** Describe the Sun as the major source of energy that impacts the environment.
- **S8.C.2.2.2** Compare the time span of renewability for fossil fuels and the time span of renewability for alternative fuels.
- **S8.C.2.2.3** Describe the waste (i.e., kind and quantity) derived from the use of renewable and nonrenewable resources and their potential impact on the environment.

S8.C.3.1 Describe the effect of multiple forces on the movement, speed, or direction of an object.

- **S8.C.3.1.1** Describe forces acting on objects (e.g., friction, gravity, balanced versus unbalanced).
- **S8.C.3.1.2** Distinguish between kinetic and potential energy.
- **S8.C.3.1.3** Explain that mechanical advantage helps to do work (physics) by either changing a force or changing the direction of the applied force (e.g., simple machines, hydraulic systems).

Unit Objectives/Essential Understanding

1. Differentiate between potential and kinetic energy.
- Energy is the ability to do work.
- Potential energy is stored energy based on position or chemical composition.
- The amount of potential energy associated with an object depends on its position.
- Kinetic energy is energy of motion.
- The amount of kinetic energy depends on the mass and velocity of the moving object.

2. Identify and give examples of common forms of energy.
- Forms of energy include radiant, thermal, chemical, electrical, mechanical, and nuclear energy. Visible light is a form of radiant energy and sound is a form of mechanical energy.

3. Illustrate energy transformations.
- Energy can be transformed from one type to another. In any energy conversion, some of the energy is lost to the environment as thermal energy.

4. Distinguish between heat and temperature.
- Heat and temperature are not the same thing.
- Heat is the transfer of thermal energy between substances of different temperature.
- As thermal energy is added, the temperature of a substance increases.

5. Explain Celsius and Kelvin temperature and describe absolute zero.
- Temperature is a measure of the average kinetic energy of the molecules of a substance.
- Increased temperature means greater average kinetic energy of the molecules in the substance being measured, and most substances expand when heated.
- The temperature of absolute zero (–273oC/0 K) is the theoretical point at which molecular motion stops.

6. Explain the effect of the addition or subtraction of thermal energy on the motion of molecules.
- Atoms and molecules are perpetually in motion.
- Adding heat energy increases the motion of molecules.
- Removing heat energy, or cooling, decreases the motion of molecules.

7. Compare and contrast methods of thermal energy transfer (conduction, convection, and radiation) and provide and explain common examples.
- The transfer of thermal energy occurs in three ways: by conduction, by convection, and by radiation.
- As thermal energy is added to or taken away from a system, the temperature does not always change. There is no change in temperature during a phase change (freezing, melting, condensing, evaporating, boiling, and vaporizing) as this energy is being used to make or break bonds between molecules.

8. Explain the principle of thermal energy transfer as it applies to heat engines, thermostats, refrigerators, heat pumps, and geothermal systems.
- Heat engines can be used to pump heat from colder to hotter bodies. This always needs an input of work. Examples are fridges, air conditioners and heat pumps. These are all essentially the same, but the in the first two the purpose is to cool (or keep cool) a fridge, room or building and in the last, the purpose is to heat (or keep hot) a building.
- A geothermal power plant works by tapping into steam or hot water reservoirs underground; the heat is used to drive an electrical generator.

9. Explain how machines help people do work and the difference between work output and total work input.
- A machine is a device with moving parts that work together to accomplish a task.
- A machine transfers energy from one place to another and does work that may not be able to be done otherwise.
- A simple machine is a device with few moving parts that allow the user to convert an applied force to some type of useful work.
- Work input: the work or energy supplied to the process (or machine)
- Work output: the work or energy that comes out of the process (or machine).

10. Identify the six simple machines and provide a brief description of each.
- Inclined plane, lever, wheel and axle, pulley, wedge, and screw.
- Inclined plane, a simple machine that is a sloping surface (ramp)
- A Lever is a solid bar that rotates or turns around a fixed point.
- Wheel and axle is a simple machine made of a wheel attached to a shaft or axle.
- Pulley is a wheel with a grooved rim and a rope or cable that rides in the groove.
- Wedge is a simple machine that has a thick and thin end.
- Screw is an inclined plane wrapped around a cylinder or cone to form a spiral.

11. Explain why a machine does not reduce the work done on an object.
- When a machine increases force or speed, there is always a price to be paid because work must be conserved. Hence, it remains constant throughout the system.

12. Calculate the mechanical advantage of a machine.
- The number of times a machine multiplies the input force is the machine's mechanical advantage. Mechanical Advantage= $\frac{\text{Output Forces}}{\text{Input Force}}$

13. Determine the relationship between frequency and wavelength.
- All waves exhibit certain characteristics: wavelength, frequency, and amplitude. As wavelength increases, frequency decreases.
- Sound is produced by vibrations and is a type of mechanical energy. Sound travels in compression waves and at a speed much slower than light. It needs a medium (solid, liquid, or gas) in which to travel. In a compression wave, matter vibrates in the same direction in which the wave travels.
- The wavelength and frequency of light are closely related. The higher the frequency, the

shorter the wavelength. Because all light waves move through a vacuum at the same speed, the number of wave crests passing by a given point in one second depends on the wavelength. That number, also known as the frequency, will be larger for a short-wavelength wave than for a long-wavelength wave.

14. Classify waves by how they move.
- Some waves transfer an up and down or side to side motion. Other waves transfer a forward and backward motion.
- Transverse waves are up and down like the snapping of a rope.
- Longitudinal waver travel in the same direction as the disturbance like sound waves.

15. Describe how waves interact with materials.
- The bouncing back of a wave after it strikes a barrier is called reflection.
- Refraction is the bending of a wave as it enters different mediums.
- Diffraction is the spreading out of waves through and opening around the edge of an obstacle.

16. Explain how sound waves are produced and detected.
- Sound is a wave that is produced by a vibrating object and travel through matter
- The shape of the human ear helps it collect sound waves

17. Analyze factors that determine the speed of sound through various materials and interpret graphs and charts that display this information.
- It is easier for sound waves to go through solids than through liquids because the molecules are closer together and more tightly bonded in solids.
- It is harder for sound to pass through gases than through liquids, because gaseous molecules are farther apart.
- The speed of sound is faster in solid materials and slower in liquids or gases.

18. Describe how the frequency of a sound wave affects the way it sounds and the sound quality
- Frequency is the number of waves passing a fixed point in a given time.
- High frequency wave with short wave lengths makes a high pitched sound.
- A low frequency wave with long wavelengths makes a low pitched sound.
- The combination of pitches is the main factor affecting the quality of a sound.
- Another factor in sound quality is the way a sound starts and stops.

ACTIVITIES:

1. Given illustrations differentiate between potential and kinetic energy.
2. Create a booklet describing the common forms of energy.
3. Illustrate energy transformations.
4. Engage in reading temperatures of various substances using both Celsius and Fahrenheit thermometers.
5. Act out the motion of Atoms and molecules in a solid, liquid and gas state.
6. Create a PowerPoint presentation on heat engines, refrigerators, heat pumps, and/or geothermal systems.
7. Demonstrate how a machine help people do work and the difference between work output and total work input.
8. Build a simple machine and demonstrate how it works.
9. Identify the six simple machines and provide a brief description of each.
10. Create a musical instrument that produces sound.
11. Compare musical instruments in relationship to frequency and pitch.

REMEDIATION:
- Class Notes
- Graphic Organizers
- Chunking of Information
- Oral Questioning
- Group Discussion
- Small Lab Group Participation
- Reinforcement Videos and Animations
- Computer Simulation/Modeling Projects
- Web-based Reinforcement Activities
- Cooperative Learning Groups
- Peer Tutoring
- Individualized Assistance
- Small Group Assistance
- Review Games
- Content Review

ENRICHMENT:
- Class Presentations
- Project-Based Assignments
- Online Research
- Group Discussions
- Online Review Games
- Independent Investigations

RESOURCES: Textbook: McDougal Littell Physical Science www.acs.org Discovery Learning	• Individualized Teacher Support • Peer Tutoring

COURSE: Grade 7 Physical Science	**GRADE(S)**: 7
UNIT 4: Light, Optics, and Electromagnetic Waves	

PA ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

S8.A.1 1 Explain, interpret, and apply scientific, environmental, or technological knowledge presented in a variety of formats (e.g., visuals, scenarios, graphs).

- **S8.A.1.1.1** Distinguish between a scientific theory and an opinion, explaining how a theory is supported with evidence, or how new data/information may change existing theories and practices.
- **S8.A.1.1.2** Explain how certain questions can be answered through scientific inquiry and/or technological design.
- **S8.A.1.1.3** Use evidence, such as observations or experimental results, to support inferences about a relationship.
- **S8.A.1.1.4** Develop descriptions, explanations, predictions, and models using evidence.

S8.A.1.2 Identify and explain the impacts of applying scientific, environmental, or technological knowledge to address solutions to practical problems.

- **S8.A.1.2.1** Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).
- **S8.A.1.2.3** Describe fundamental scientific or technological concepts that could solve practical problems (e.g., Newton's laws of motion, Mendelian genetics).

S8.A.1.3 Identify and analyze evidence that certain variables may have caused measurable changes in natural or human-made systems.

- **S8.A.1.3.1** Use ratio to describe change (e.g., percents, parts per million, grams per cubic centimeter, mechanical advantage).
- **S8.A.1.3.2** Use evidence, observations, or explanations to make inferences about change in systems over time (e.g., carrying capacity, succession, population dynamics, loss of mass in chemical reactions, indicator fossils in geologic time scale) and the variables affecting these changes.
- **S8.A.1.3.3** Examine systems changing over time, identifying the possible variables causing this change, and drawing inferences about how these variables affect this change.
- **S8.A.1.3.4** Given a scenario, explain how a dynamically changing environment provides for the sustainability of living systems

S8.A.2.1 Apply knowledge of scientific investigation or technological design in different contexts to make inferences to solve problems.

- **S8.A.2.1.1** Use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships.
- **S8.A.2.1.2** Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
- **S8.A.2.1.3** Design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant.
- **S8.A.2.1.4** Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
- **S8.A.2.1.5** Use evidence from investigations to clearly communicate and support conclusions.
- **S8.A.2.1.6** Identify a design flaw in a simple technological system and devise possible working solutions.

S8.A.2.2 Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.

- **S8.A.2.2.1** Describe the appropriate use of instruments and scales to accurately and safely measure time, mass, distance, volume, or temperature under a variety of conditions.
- **S8.A.2.2.2** Apply appropriate measurement systems (e.g., time, mass, distance, volume, temperature) to record and interpret observations under varying conditions.
- **S8.A.2.2.3** Describe ways technology (e.g., microscope, telescope, micrometer, hydraulics,

barometer) extends and enhances human abilities for specific purposes.

S8.A.3.1 Explain the parts of a simple system, their roles, and their relationships to the system as a whole.

- **S8.A.3.1.2** Explain the concept of order in a system [e.g., (first to last: manufacturing steps, trophic levels)

S8.A.3.2 Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

- **S8.A.3.2.1** Describe how scientists use models to explore relationships in natural systems (e.g., an ecosystem, river system, the solar system).
- **S8.A.3.2.2** Describe how engineers use models to develop new and improved technologies to solve problems.
- **S8.A.3.2.3** Given a model showing simple cause and-effect relationships in a natural system, predict results that can be used to test the assumptions in the model (e.g., photosynthesis, water cycle, diffusion, infiltration).

S8.C.1.1 Explain concepts about the structure and properties (physical and chemical) of matter.

- **S8.C.1.1.1** Explain the differences among elements, compounds, and mixtures.
- **S8.C.1.1.2** Use characteristic physical or chemical properties to distinguish one substance from another (e.g., density, thermal expansion/contraction, freezing/melting points, streak test).
- **S8.C.1.1.3** Identify and describe reactants and products of simple chemical reactions.

S8.C.2.1 Describe energy sources, transfer of energy, or conversion of energy.

- **S8.C.2.1.1** Distinguish among forms of energy(e.g., electrical, mechanical, chemical, light, sound, nuclear) and sources of energy (i.e., renewable and nonrenewable energy)
- **S8.C.2.1.2** Explain how energy is transferred from one place to another through convection, conduction, or radiation.
- **S8.C.2.1.3** Describe how one form of energy (e.g., electrical, mechanical, chemical, light, sound, nuclear) can be converted into a different form of energy.

S8.C.2.2 Compare the environmental impact of different energy sources chosen to support human endeavors.

- **S8.C.2.2.1** Describe the Sun as the major source of energy that impacts the environment.
- **S8.C.2.2.2** Compare the time span of renewability for fossil fuels and the time span of renewability for alternative fuels.
- **S8.C.2.2.3** Describe the waste (i.e., kind and quantity) derived from the use of renewable and nonrenewable resources and their potential impact on the environment.

S8.C.3.1 Describe the effect of multiple forces on the movement, speed, or direction of an object.

- **S8.C.3.1.1** Describe forces acting on objects (e.g., friction, gravity, balanced versus unbalanced).
- **S8.C.3.1.2** Distinguish between kinetic and potential energy.
- **S8.C.3.1.3** Explain that mechanical advantage helps to do work (physics) by either changing a force or changing the direction of the applied force (e.g., simple machines, hydraulic systems).

Unit Objectives/Essential Understanding

1. Define visible light and describe how light waves travel
- Visible light is a form of radiant energy that moves in transverse waves.
- All transverse waves exhibit certain characteristics: wavelength, crest, trough, frequency, and amplitude. As wavelength increases, frequency decreases. There is an inverse relationship between frequency and wavelength.
- Visible light includes all the wavelengths of light that the human eye can detect. Humans and virtually all other organisms depend on visible light to survive.
- Most of the visible light on Earth comes from the sun. The sun produces light because it is so hot. Glowing with visible light because of a high temperature is called incandescence.

2. Identify common sources of visible light.
- Visible light can be produced by incandescence or luminescence.
- Incandescence is the production of light by an object that is so hot it glows.
- Luminescence is the production of light by other means, such as chemical reactions.

3. Explain how light interacts with matter.
- Light may interact with matter in several ways, including reflection, refraction, transmission, and

absorption.
- All objects you can see that do not produce their own light are reflecting light from another source. This is known as illumination.
- Radiant energy travels in straight lines until it strikes an object where it can be reflected, absorbed, or transmitted.
- As visible light travels through different media, it undergoes a change in speed that may result in refraction.
- Matter can be classified on the basis of how light interacts with it as transparent, translucent, or opaque.

4. Describe the colors of visible light.
- The wavelength of visible light determines the color that the light appears.
- Red light has the longest wavelength, and violet light has the shortest wavelength.
- The primary colors of light are red, green, and blue. All other colors of light can be created by combining the primary colors.

5. Outline how light is reflected.
- According to the law of reflection, light is reflected at the same angle that it strikes a reflective surface.

6. Describe how mirrors reflect light and form images.
- Mirrors reflect all of the light that strikes them and form images.
- A plane, or flat, mirror forms virtual, life-sized images.
- A concave mirror forms either enlarged virtual images or reduced real images.
- A convex mirror forms only reduced virtual images.

7. Explain the refraction of light.
- Refraction, or bending, of light occurs when light passes from one medium to another at an angle other than 90° and the speed of light changes in the new medium.
- The greater the change in speed, the more light bends.

8. Describe how lenses refract light and form images.
- Lenses are transparent objects with curved surfaces that refract light and form images.
- Concave lenses form only reduced virtual images.
- Convex lenses form either enlarged virtual images or real images that may be enlarged or reduced.

9. Explain how mirrors and lenses are used in optical instruments.
- Mirrors and lenses are used in optical instruments to reflect or refract light.
- Optical instruments include microscopes, telescopes, cameras, and lasers.

10. Describe the structure and function of the eye.
- The structures of the human eye collect and focus light. They form a reduced, upside-down image on the retina at the back of the eye.

11. Explain how the eyes and brain work together to enable vision.
- The image focused by the eye travels through the optic nerve to the brain as electrical signals. The brain interprets the signals and "tells" us what we are seeing.

12. Identify common vision problems and how they can be corrected.
- Common vision problems include nearsightedness (myopia), which can be corrected with concave lenses, and farsightedness (hyperopia), which can be corrected with convex lenses.

13. Describe electromagnetic waves.
- An electromagnetic wave consists of vibrating electric and magnetic fields.
- Electromagnetic waves are transverse waves that can travel across space without a medium. When the waves strike matter, they may reflect, refract, or diffract, or they may be converted to other forms of energy.
- The most important source of electromagnetic waves on Earth is the sun, which provides virtually all the energy that supports life on Earth.
- Other sources of electromagnetic radiation depend on technology and are used for communications, cooking, and other purposes.

14. State how electromagnetic waves travel.
- Electromagnetic waves are transverse waves that can travel across space without a medium.
- When the waves strike matter, they may reflect, refract, or diffract, or they may be converted to other forms of energy.

15. Summarize the wave-particle theory of light.
- Electromagnetic radiation behaves like particles as well as waves. This prompted Albert Einstein

to develop his wave-particle theory.

16. Identify sources of electromagnetic waves.
- The most important source of electromagnetic waves on Earth is the sun, which provides virtually all the energy that supports life on Earth.
- Other sources of electromagnetic radiation depend on technology and are used for communications, cooking, and other purposes.

17. Describe how are electromagnetic waves arranged on the electromagnetic spectrum
- Electromagnetic waves are arranged on the electromagnetic spectrum by wavelength.
- All types of electromagnetic radiation travel at the speed of light, but differ in wavelength.
- The electromagnetic spectrum includes gamma rays, X-rays, ultraviolet, visible light, infrared, and radio and microwaves.
- Radio waves are the lowest energy waves and have the longest wavelength and the lowest frequency.
- Gamma rays are the highest energy waves and have the shortest wavelength and the highest frequency.
- Visible light lies in between and makes up only a small portion of the electromagnetic spectrum.

18. Describe the speed of electromagnetic waves.
- All electromagnetic waves travel at the same speed through space, called the speed of light, which equals 3.0 × 108 meters per second.
- Electromagnetic waves travel more slowly through a medium.

19. Relate wavelength and frequency of electromagnetic waves.
- Electromagnetic waves differ in their wavelengths and frequencies.
- The higher the frequency of an electromagnetic wave, the greater its energy.
- The speed of an electromagnetic wave is the product of its wavelength and frequency, so a wave with a shorter wavelength has a higher frequency, and vice versa.

ACTIVITIES:

1. Create a booklet to define visible light and describe how light waves travel.
2. Demonstrate examples of light reflection, refraction, transmission, and absorption.
3. Explore with prisms to display the colors of visible light.
4. Using flashlights and mirrors, observe how light is reflected at the same angle that it strikes a reflective surface.
5. Using flexible mirrors, observe images when bending mirror in concave vs. convex manner
6. Observe refraction when a pencil is placed in a glass half filled with water
7. Create a PowerPoint presentation on the history and uses of lenses
8. Investigate electromagnetic waves with a student made spectrometer

RESOURCES:

Textbook: McDougal Littell Physical Science
www.acs.org
Discovery Learning

ASSESSMENTS:
- ATBs/Closure Activities
- Daily Participation
- Daily Classwork
- Homework
- Group Discussions
- Group Projects
- Individual Projects
- Cooperative Learning Activities
- Model Creations
- Writing Prompts
- Reading Guides
- Demonstrations
- Lab Participation
- Lab Reports
- Online Research
- Group Presentations
- Individual Presentations
- Quizzes
- Unit Tests
- Final Exams

REMEDIATION:
- Class Notes
- Graphic Organizers
- Chunking of Information
- Oral Questioning
- Group Discussion
- Small Lab Group Participation
- Reinforcement Videos and

	Animations • Computer Simulation/Modeling Projects • Web-based Reinforcement Activities • Cooperative Learning Groups • Peer Tutoring • Individualized Assistance • Small Group Assistance • Review Games • Content Review **ENRICHMENT:** • Class Presentations • Project-Based Assignments • Online Research • Group Discussions • Online Review Games • Independent Investigations • Individualized Teacher Support • Peer Tutoring

COURSE: Grade 7 Physical Science | **GRADE(S):** 7

UNIT 5: Motion, Forces, and Newton's Laws of Motion

PA ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

S8.A.1 1 Explain, interpret, and apply scientific, environmental, or technological knowledge presented in a variety of formats (e.g., visuals, scenarios, graphs).

- **S8.A.1.1.1** Distinguish between a scientific theory and an opinion, explaining how a theory is supported with evidence, or how new data/information may change existing theories and practices.
- **S8.A.1.1.2** Explain how certain questions can be answered through scientific inquiry and/or technological design.
- **S8.A.1.1.3** Use evidence, such as observations or experimental results, to support inferences about a relationship.
- **S8.A.1.1.4** Develop descriptions, explanations, predictions, and models using evidence.

S8.A.1.2 Identify and explain the impacts of applying scientific, environmental, or technological knowledge to address solutions to practical problems.

- **S8.A.1.2.1** Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).
- **S8.A.1.2.3** Describe fundamental scientific or technological concepts that could solve practical problems (e.g., Newton's laws of motion, Mendelian genetics).

S8.A.1.3 Identify and analyze evidence that certain variables may have caused measurable changes in natural or human-made systems.

- **S8.A.1.3.1** Use ratio to describe change (e.g., percents, parts per million, grams per cubic centimeter, mechanical advantage).
- **S8.A.1.3.2** Use evidence, observations, or explanations to make inferences about change in systems over time (e.g., carrying capacity, succession, population dynamics, loss of mass in chemical reactions, indicator fossils in geologic time scale) and the variables affecting these changes.
- **S8.A.1.3.3** Examine systems changing over time, identifying the possible variables causing this change, and drawing inferences about how these variables affect this change.
- **S8.A.1.3.4** Given a scenario, explain how a dynamically changing environment provides for the sustainability of living systems

S8.A.2.1 Apply knowledge of scientific investigation or technological design in different contexts to make inferences to solve problems.

- **S8.A.2.1.1** Use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships.
- **S8.A.2.1.2** Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
- **S8.A.2.1.3** Design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant.
- **S8.A.2.1.4** Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
- **S8.A.2.1.5** Use evidence from investigations to clearly communicate and support conclusions.
- **S8.A.2.1.6** Identify a design flaw in a simple technological system and devise possible working solutions.

S8.A.2.2 Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.

- **S8.A.2.2.1** Describe the appropriate use of instruments and scales to accurately and safely measure time, mass, distance, volume, or temperature under a variety of conditions.
- **S8.A.2.2.2** Apply appropriate measurement systems (e.g., time, mass, distance, volume, temperature) to record and interpret observations under varying conditions.
- **S8.A.2.2.3** Describe ways technology (e.g., microscope, telescope, micrometer, hydraulics, barometer) extends and enhances human abilities for specific purposes.

S8.A.3.1 Explain the parts of a simple system, their roles, and their relationships to the system as a whole.
- **S8.A.3.1.2** Explain the concept of order in a system [e.g., (first to last: manufacturing steps, trophic levels)

S8.A.3.2 Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.
- **S8.A.3.2.1** Describe how scientists use models to explore relationships in natural systems (e.g., an ecosystem, river system, the solar system).
- **S8.A.3.2.2** Describe how engineers use models to develop new and improved technologies to solve problems.
- **S8.A.3.2.3** Given a model showing simple cause and-effect relationships in a natural system, predict results that can be used to test the assumptions in the model (e.g., photosynthesis, water cycle, diffusion, infiltration).

S8.C.1.1 Explain concepts about the structure and properties (physical and chemical) of matter.
- **S8.C.1.1.1** Explain the differences among elements, compounds, and mixtures.
- **S8.C.1.1.2** Use characteristic physical or chemical properties to distinguish one substance from another (e.g., density, thermal expansion/contraction, freezing/melting points, streak test).
- **S8.C.1.1.3** Identify and describe reactants and products of simple chemical reactions.

S8.C.2.1 Describe energy sources, transfer of energy, or conversion of energy.
- **S8.C.2.1.1** Distinguish among forms of energy(e.g., electrical, mechanical, chemical, light, sound, nuclear) and sources of energy (i.e., renewable and nonrenewable energy)
- **S8.C.2.1.2** Explain how energy is transferred from one place to another through convection, conduction, or radiation.
- **S8.C.2.1.3** Describe how one form of energy (e.g., electrical, mechanical, chemical, light, sound, nuclear) can be converted into a different form of energy.

S8.C.2.2 Compare the environmental impact of different energy sources chosen to support human endeavors.
- **S8.C.2.2.1** Describe the Sun as the major source of energy that impacts the environment.
- **S8.C.2.2.2** Compare the time span of renewability for fossil fuels and the time span of renewability for alternative fuels.
- **S8.C.2.2.3** Describe the waste (i.e., kind and quantity) derived from the use of renewable and nonrenewable resources and their potential impact on the environment.

S8.C.3.1 Describe the effect of multiple forces on the movement, speed, or direction of an object.
- **S8.C.3.1.1** Describe forces acting on objects (e.g., friction, gravity, balanced versus unbalanced).
- **S8.C.3.1.2** Distinguish between kinetic and potential energy.
- **S8.C.3.1.3** Explain that mechanical advantage helps to do work (physics) by either changing a force or changing the direction of the applied force (e.g., simple machines, hydraulic systems).

UNIT OBJECTIVES/ESSENTIAL KNOWLEDGE

1. Define motion, and relate it to frame of reference.
- Motion is a change of position. The perception of motion depends on a person's frame of reference.

2. Describe how to measure distance.
- Distance is the length of the route between two points. The SI unit for distance is the meter (m).

3. Explain how to represent direction.
- Direction is just as important as distance in describing motion. A vector is a quantity that has both size and direction. It can be used to represent the distance and direction of motion.

4. Outline how to calculate the speed of a moving object.
- Speed is a measure of how fast or slow something moves. It depends on the distance traveled and how long it takes to travel that distance. The average speed of an object is calculated as the change in distance divided by the change in time.

5. Explain how velocity differs from speed.
- Velocity is a measure of both speed and direction. It is a vector that can be represented by an arrow. Velocity changes with a change in speed, a change in direction, or both.

6. Define acceleration.

- Acceleration is a measure of the change in velocity of a moving object. It shows how quickly velocity changes and whether the change is positive or negative. It may reflect a change in speed, a change in direction, or both.

7. Explain how to calculate acceleration.
- To calculate acceleration without a change in direction, divide the change in velocity by the change in time.

8. Describe velocity-time graphs.
- The slope of a velocity-time graph represents acceleration.

9. Define force, and give examples of forces.
- Force is a push or a pull acting on an object. Examples of force include friction and gravity. Force is a vector because it has both size and direction. The SI unit of force is the newton (N).

10. Describe how forces combine and affect motion.
- The combined forces acting on an object are called the net force. When forces act in opposite directions, they are subtracted to yield the net force. When they act in the same direction, they are added to yield the net force.

11. Describe friction and how it opposes motion.
- Friction is a force that opposes motion between two surfaces that are touching. Friction occurs because no surface is perfectly smooth. Friction is greater when objects have rougher surfaces or are heavier so they press together with greater force.

12. Identify types of friction.
- Types of friction include static friction, sliding friction, rolling friction, and fluid friction. Fluid friction with air is called air resistance.

13. Define gravity.
- Gravity is traditionally defined as a force of attraction between two masses. Weight measures the force of gravity and is expressed in newtons (N).

14. State Newton's law of universal gravitation.
- According to Newton's law of universal gravitation, gravity is a force of attraction between all objects in the universe, and the strength of gravity depends on the masses of the objects and the distance between them. Einstein's theory of gravity states that gravity is an effect of curves in space and time around massive objects such as Earth.

15. Explain how gravity affects the motion of objects.
- Gravity causes falling objects to accelerate at 9.8 m/s2. Gravity also causes projectile motion and orbital motion.

16. Define elasticity and elastic force.
- Elasticity is the ability of a material to return to its original shape after being stretched or compressed. Elastic force is the counter force that resists the stretching or compressing of an elastic material.

17. Describe uses of elastic force.
- Elastic force is very useful. It is used in rubber bands, bungee cords, and bed springs, to name just a few uses.

18. State Newton's first law of motion.
- Newton's first law of motion states that an object's motion will not change unless an unbalanced force acts on the object. If the object is at rest, it will stay at rest. If the object is in motion, it will stay in motion.

19. Define inertia, and explain its relationship to mass.
- Inertia is the tendency of an object to resist a change in its motion. The inertia of an object depends on its mass. Objects with greater mass have greater inertia. To overcome inertia, an unbalanced force must be applied to an object.

20. State Newton's second law of motion.
- Newton's second law of motion states that the acceleration of an object equals the net force acting on the object divided by the object's mass.

21. Identify the relationship between acceleration and weight.
- Weight is a measure of the force of gravity pulling on an object of a given mass. It equals the mass of the object (in kilograms) times the acceleration due to gravity (9.8 m/s2).

22. State Newton's third law of motion.
- Newton's third law of motion states that every action has an equal and opposite reaction.

23. Describe momentum and the conservation of momentum.
- Momentum is a property of a moving object that makes it hard to stop. It equals the object's

mass times its velocity. When an action and reaction occur, momentum may be transferred from one object to another, but their combined momentum remains the same. This is the law of conservation of momentum.

ACTIVITIES:

1. Engage in multiple activities designed to provide students with the opportunity measure distance.
2. Using a stopwatch, calculate the speed of a moving object.
3. Start a ball rolling on the floor or on a table. Once it's rolling, cause the ball to change speed but not direction.
4. Start a ball rolling on the floor or on a table. Once it's rolling, cause the ball to change direction but not speed.
5. Start a ball rolling on the floor or on a table. Once it's rolling, cause the ball to change both speed and direction.
6. Set up ramps with different textures and send toy cars down have students share observations and explain.
7. Move car up and down varying ramps to observe the effect of slope on force and velocity.
8. Students gather data from cars rolling down ramps and representations of moving vehicles to investigate and solve speed problems. Students will create and analyze distance-versus-time graphs.
9. Build a car out of clay to facilitate maximum acceleration.
10. Use spring scales to establish the relationship between force and mass.
11. Students describe all of the forces acting on an egg throughout an egg drop activity.

RESOURCES:

Textbook: McDougal Littell Physical Science
www.acs.org
Discovery Learning

ASSESSMENTS:

- ATBs/Closure Activities
- Daily Participation
- Daily Classwork
- Homework
- Group Discussions
- Group Projects
- Individual Projects
- Cooperative Learning Activities
- Model Creations
- Writing Prompts
- Reading Guides
- Demonstrations
- Lab Participation
- Lab Reports
- Online Research
- Group Presentations
- Individual Presentations
- Quizzes
- Unit Tests
- Final Exams

REMEDIATION:

- Class Notes
- Graphic Organizers
- Chunking of Information
- Oral Questioning
- Group Discussion
- Small Lab Group Participation
- Reinforcement Videos and Animations
- Computer Simulation/Modeling Projects
- Web-based Reinforcement Activities
- Cooperative Learning Groups
- Peer Tutoring
- Individualized Assistance
- Small Group Assistance
- Review Games
- Content Review

ENRICHMENT:

- Class Presentations
- Project-Based Assignments
- Online Research
- Group Discussions
- Online Review Games
- Independent Investigations
- Individualized Teacher Support
- Peer Tutoring

COURSE: Grade 7 Physical Science | **GRADE(S):** 7

UNIT 6: Electricity

PA ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

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- **S8.A.1.1.1** Distinguish between a scientific theory and an opinion, explaining how a theory is supported with evidence, or how new data/information may change existing theories and practices.
- **S8.A.1.1.2** Explain how certain questions can be answered through scientific inquiry and/or technological design.
- **S8.A.1.1.3** Use evidence, such as observations or experimental results, to support inferences about a relationship.
- **S8.A.1.1.4** Develop descriptions, explanations, predictions, and models using evidence.

S8.A.1.2 Identify and explain the impacts of applying scientific, environmental, or technological knowledge to address solutions to practical problems.

- **S8.A.1.2.1** Describe the positive and negative, intended and unintended, effects of specific scientific results or technological developments (e.g., air/space travel, genetic engineering, nuclear fission/fusion, artificial intelligence, lasers, organ transplants).
- **S8.A.1.2.3** Describe fundamental scientific or technological concepts that could solve practical problems (e.g., Newton's laws of motion, Mendelian genetics).

S8.A.1.3 Identify and analyze evidence that certain variables may have caused measurable changes in natural or human-made systems.

- **S8.A.1.3.1** Use ratio to describe change (e.g., percents, parts per million, grams per cubic centimeter, mechanical advantage).
- **S8.A.1.3.2** Use evidence, observations, or explanations to make inferences about change in systems over time (e.g., carrying capacity, succession, population dynamics, loss of mass in chemical reactions, indicator fossils in geologic time scale) and the variables affecting these changes.
- **S8.A.1.3.3** Examine systems changing over time, identifying the possible variables causing this change, and drawing inferences about how these variables affect this change.
- **S8.A.1.3.4** Given a scenario, explain how a dynamically changing environment provides for the sustainability of living systems

S8.A.2.1 Apply knowledge of scientific investigation or technological design in different contexts to make inferences to solve problems.

- **S8.A.2.1.1** Use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships.
- **S8.A.2.1.2** Use space/time relationships, define concepts operationally, raise testable questions, or formulate hypotheses.
- **S8.A.2.1.3** Design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant.
- **S8.A.2.1.4** Interpret data/observations; develop relationships among variables based on data/observations to design models as solutions.
- **S8.A.2.1.5** Use evidence from investigations to clearly communicate and support conclusions.
- **S8.A.2.1.6** Identify a design flaw in a simple technological system and devise possible working solutions.

S8.A.2.2 Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.

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UNIT OBJECTIVES/ESSENTIAL KNOWLEDGE

1. Define electric charge and electric force.
- Electric charge is a physical property of particles or objects that causes them to attract or repel each other without touching.
- Positive and negative particles attract each other. Particles with the same charge repel each other.
- The force of attraction or repulsion between charged particles is called electric force.

2. Describe electric fields.
- A charged particle can attract or repel other, nearby particles without touching them because it is surrounded by an electric field.
- This is a space around the particle where it exerts electric force on other particles.

3. Identify ways that electric charge is transferred.
- Objects become charged when they transfer electrons. This can happen through friction, conduction, or polarization. Although electrons are transferred, the total charge remains the same.
- Polarization may cause a buildup of charges on an object known as static electricity. Static discharge occurs when the built-up charges suddenly flow from the object. An example of

static discharge is lightning.

4. Define electric current.
- Electric current is a continuous flow of electric charge. It is measured in amperes (A). Direct current (DC) flows in just one direction. Alternating current (AC) keeps reversing direction.

5. Explain how voltage is related to electric current.
- Electric current occurs whenever there is a difference in electric potential energy, or voltage. Voltage is measured in volts (V).

6. Identify sources of voltage
- Sources of voltage include electric generators and cells. Electric generators change kinetic energy to electrical energy.
- Chemical cells change chemical energy to electrical energy, and solar cells change solar energy to electrical energy.

7. Relate electric current to materials.
- Electric current needs a material through which to travel, but particles of the material may resist the flow of current.
- Materials differ in how much they resist electric current.
- Materials with low resistance are called electric conductors, and materials with high resistance are called electric insulators.

8. State Ohm's law
- According to Ohm's law, current increases when voltage increases or resistance decreases. Current can be calculated as voltage divided by resistance.

9. Identify the parts of an electric circuit.
- An electric circuit is a closed loop through which electric current can flow. A circuit must include a source of voltage and conductors such as wires to carry the current from the source of voltage and back again. Types of circuits are series and parallel circuits.

10. Define electric power, and state how to calculate electrical energy use.
- Electric power is the rate at which an electric device changes electric current to another form of energy. It is measured in watts or kilowatts and equals current (amps) times voltage (volts).
- The electrical energy used by a device is measured in kilowatt-hours and equals the power of the device (kilowatts) times the amount of time (hours) the device is used.

11. Identify electric safety features and how to use electricity safely.
- Electric shorts can be hazardous and start fires. Electric safety features include three-prong plugs, circuit breakers, and GFCI outlets.

12. Describe electronic signals.
- The use of electric current to encode information is called electronics. Electronic signals may be digital or analog signals. Both types of signals encode information by changing the voltage of an electric current, but they do so in different ways.

13. Identify types of electronic components.
- Electronic components are the parts used in electronic devices. They are made of p-type and n-type semiconductors. Examples of electronic components include diodes, transistors, and integrated circuits (microchips).

14. Explain how computers use electronics.
- Electronic devices include computers, mobile phones, and TV remotes, to name just a few. All of them contain many electronic components that use electric current to encode, analyze, or transmit information.

ACTIVITIES:

1. Use balloons to demonstrate: static electricity will force the balloon to stick to neutrally charged surfaces, such as walls, by attracting the positive charge to the surface. ... The two balloons will stick together if one is charged in the same way the balloon sticks to the wall. However, two negatively charged balloons will repel each other.

2. Create an electroscope to detect static electricity.

3. Design and build series and parallel circuits, draw labeled diagrams identifying the components used in each, and describe the role of each component

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in the circuit. **4.** Build and test a device that transforms electrical energy into another form of energy in order to perform a function (e.g. a device that makes sound, moves, or lights up). **5.** Using a battery and a small led light test a variety of objects to explore conductivity. **6.** Create a simple circuit board. To make a circuit, you need copper wire, a 6 volt lantern battery, alligator clips, and a lightbulb. **RESOURCES:** Textbook: McDougal Littell Physical Science www.acs.org Discovery Learning	• Demonstrations • Lab Participation • Lab Reports • Online Research • Group Presentations • Individual Presentations • Quizzes • Unit Tests • Final Exams **REMEDIATION:** • Class Notes • Graphic Organizers • Chunking of Information • Oral Questioning • Group Discussion • Small Lab Group Participation • Reinforcement Videos and Animations • Computer Simulation/Modeling Projects • Web-based Reinforcement Activities • Cooperative Learning Groups • Peer Tutoring • Individualized Assistance • Small Group Assistance • Review Games • Content Review **ENRICHMENT:** • Class Presentations • Project-Based Assignments • Online Research • Group Discussions • Online Review Games • Independent Investigations • Individualized Teacher Support • Peer Tutoring

COURSE: Grade 7 Physical Science	**GRADE(S):** 7
UNIT 7: Engineering Design with focus on Aeronautics	

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UNIT OBJECTIVES/ESSENTIAL KNOWLEDGE

1. Explain what a design process is.

- The word design has several meanings. One meaning is a plan or drawing that shows the look and function of an object or structure before it is made.
- A process by which a design for an object or a structure is created is called a design process.
- All design processes have similarities. They all involve creativity. They all involve making decisions.

2. Explain how engineering design differs from other design processes.

- Engineering design tends to require a more extensive and specialized knowledge of technology, math, and science than other types of design.

3. Explain the different steps in the engineering design process.

- Define the problem- In the problem definition step, the needs of potential customers are investigated; potential competitors are identified and their market positions are characterized; constraints imposed by government regulations or technological limitations

are identified; and constraints on the design effort such as available personnel, time, and money are established. The problem definition process results in a clear understanding of the scope of the design project and the resources available to solve the design problem. This understanding is often expressed in a problem statement. This understanding is also expressed in the form of criteria and constraints.

- Identify criteria and constraints- Criteria and constraints are used to evaluate the quality of a design. Constraints describe conditions that must be met by the design and design process; a design must meet all constraints. Criteria are measurable values that can be used to compare several designs and determine which is better.
- Generate ideas-Once criteria and constraints are identified, the design team generates ideas for designs. These ideas come from many different sources; these include existing products (including competitors' products), brainstorming and other creative activities, and market and technical research. Ideas are combined to generate potential designs; at this stage, designs are concepts without a significant level of detail.
- Explore possibilities- After potential designs are generated, they are explored to understand their characteristics and likely advantages and disadvantages.
- Select design concept- Potential designs are evaluated relative to the constraints and criteria, and one or more is selected to be designed in detail and prototyped. This selection is made using a structured process that requires the constraints to be met and chooses the best design according to the criteria.
- Develop a detailed design- The selected design is developed in more detail. The design architecture is established by identifying physical and functional chunks. Shapes and dimensions are determined, materials and fabrication processes are selected, and product components are identified. The design is developed in enough detail that prototypes and models of the design can be made.
- Create models and prototypes- One or more prototypes are typically implemented to characterize various aspects of the design. Prototypes may be physical models of the design in which dimensions, materials, and fabrication processes emulate important aspects of the design. Increasingly, prototypes are implemented using computer modeling software that simulates mechanical, electrical, and other characteristics of the product.
- Test and evaluate- Prototypes are tested to see whether the design meets all constraints and performs acceptably relative to the criteria.

4. Describe how the implementation the design process affects the quality of the resulting design.

- As the design team has gone through the design process, they have kept records of the different processes that they used and results of these processes. Often, this information is used to create user manuals and maintenance manuals for the product. This information is important for team members who will be required to update or modify the design in the future.

ACTIVITIES:

1. Students participate in simple hands-on activities that demonstrate Daniel Bernoulli's principle of air pressure and air flight.
2. Students create displays showing types of aircrafts that might include airplanes, helicopters, balloons, blimps, and rockets.
3. Work with a team to design and construct a model of a hot air balloon.
4. Students study examples of paper airplanes and then create their own paper airplane models.
5. Build a flying scale model of the Wright brothers' 1902 aircraft using balsa wood and tissue paper.
6. Design, assemble and launch a model rocket which is finished so that it is aerodynamically stable, produces a minimum of drag, maximum momentum and uses an appropriate recovery system.

ASSESSMENTS:

- ATBs/Closure Activities
- Daily Participation
- Daily Classwork
- Homework
- Group Discussions
- Group Projects
- Individual Projects
- Cooperative Learning Activities
- Model Creations
- Writing Prompts
- Reading Guides
- Demonstrations
- Lab Participation
- Lab Reports
- Online Research
- Group Presentations

RESOURCES: Textbook: McDougal Littell Physical Science Discovery Learning	• Individual Presentations • Quizzes • Unit Tests • Final Exams **REMEDIATION:** • Class Notes • Graphic Organizers • Chunking of Information • Oral Questioning • Group Discussion • Small Lab Group Participation • Reinforcement Videos and Animations • Computer Simulation/Modeling Projects • Web-based Reinforcement Activities • Cooperative Learning Groups • Peer Tutoring • Individualized Assistance • Small Group Assistance • Review Games • Content Review **ENRICHMENT:** • Class Presentations • Project-Based Assignments • Online Research • Group Discussions • Online Review Games • Independent Investigations • Individualized Teacher Support • Peer Tutoring