# SCIENCE 7 Curricular Document

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<table>
<tr><th colspan="2">Desired Results</th></tr>
<tr><td colspan="2">COURSE DESCRIPTION</td></tr>
<tr><td colspan="2">Elmbrook’s Middle School Science Programming is designed to build scientific thinking and inquiry by exploring various scientific disciplines such as physical, life, earth & space sciences as well as engineering. Overall, our middle school science programming aims to instill a love for science, nurture critical thinking skills, and lay the groundwork for further scientific study as students progress through their education. Students strengthen their ability to solve problems, become more curious about the world around them, foster a scientific mindset, and discover the wonders of science in their classrooms and their lives.</td></tr>
<tr><td>ENDURING UNDERSTANDINGS<br>These are big ideas of science, a.k.a.crosscutting concepts, that provide lenses for viewing phenomena and understanding problems in the world around us, and which transfer across all areas of science and engineering.</td><td>ESSENTIAL QUESTIONS<br>In this course, students will ponder, investigate, reflect, argue, and discuss these open-ended,  inquiry questions.</td></tr>
<tr><td>Patterns:  Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.</td><td>Unit 1: Chemical Reactions & Matter<br>● How can we make something new that was not there before?</td></tr>
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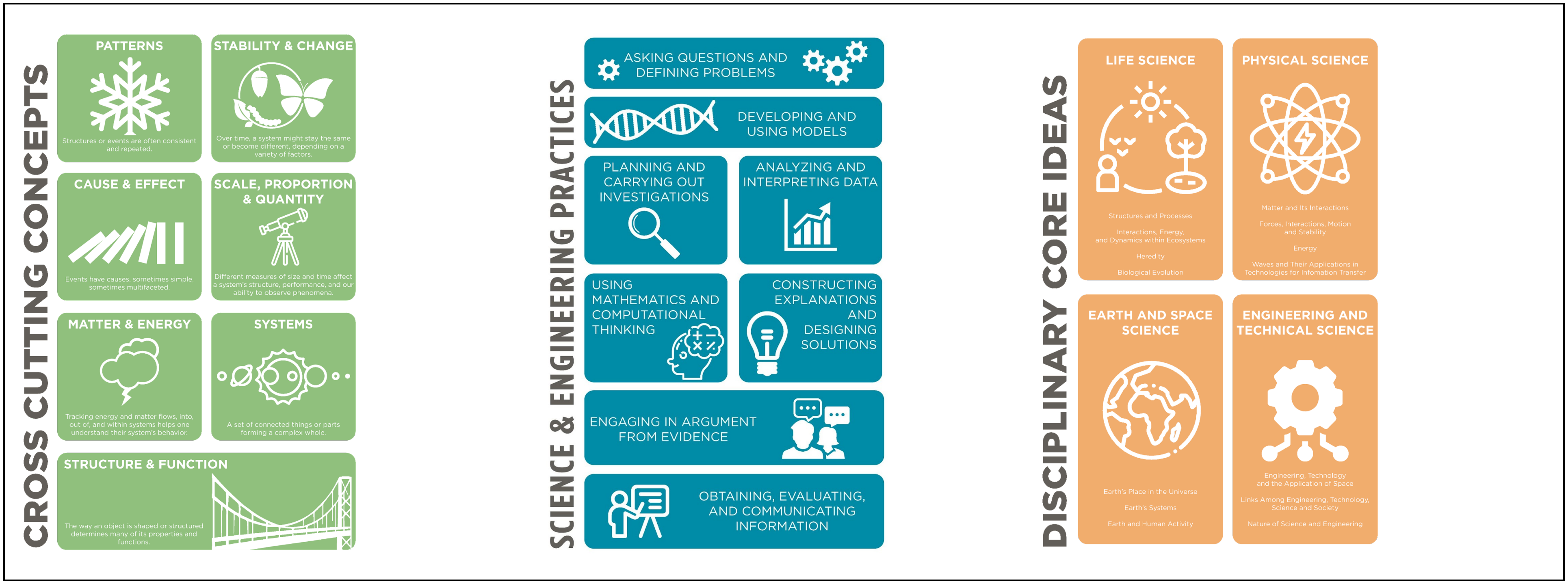
| **Cause and Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.<br><br>**Scale, Proportion, and Quantity:** In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.<br><br>**Systems and Models:** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.<br><br>**Energy and Matter:** Tracking energy and matter flows, into, and out of, and within systems helps one understand their system's behavior.<br><br>**Structure and Function:** The way an object is shaped or structured determines many of its properties and functions.<br><br>**Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control the rates of change are critical elements to consider and understand. | Unit 2: Chemical Reactions & Energy<br>● How can we use chemical reactions to design a solution to a problem?<br>Unit 3: Metabolic Reactions<br>● How do things inside our bodies work together to make us feel the way we do?<br>Unit 4: Matter Cycling & Photosynthesis<br>● Where does food come from and where does it go next?<br>Unit 5: Ecosystem Dynamics<br>● How does changing an ecosystem affect what lives there?<br>Unit 6: Earth's Resources & Human Impact<br>● How do changes in the Earth's system impact our communities and what can we do about it? |
| **3 Dimensional Standards** | |




| Crosscutting Concepts Science Standards by Grade Level Band and Unit | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 |
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| **Cross Cutting Concepts- Grade Level Band** | | | | | | |
| **Standard SCI.CC1 - Patterns**<br>Students recognize macroscopic patterns are related to the nature of microscopic and atomic level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human-designed systems. They use patterns to identify cause and effect relationships and use graphs and charts to identify patterns in data. | x | x | x | x | x | x |
| **Standard SCI.CC2 - Cause and Effect**<br>Students classify relationships as either causal or correlational, and recognize correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be explained using probability. | | x | x | | x | x |
| **Standard SCI.CC3 - Scale, Proportion, and Quantity**<br>Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations. | x | x | | | | x |
| **Standard SCI.CC4 - Systems and System Models** | | x | x | x | x | x |

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| Students understand systems may interact with other systems: They may have sub-systems and be a part of larger complex systems. They use models to represent systems and their interactions- such as inputs, processes, and outputs,-- and energy, matter, and information flows within systems. They also learn that models are limited in that they only represent certain aspects of the system understudy. | | | | | | |
| **Standard SCI.CC5 - Energy and Matter**<br>Students understand matter is conserved because atoms are conserved in physical and chemical processes. They also understand that within a natural or designed system the transfer of energy drives the motion and cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion". The transfer of energy can be tracked as energy flows through a designed or natural system. | x | x | x | x | | x |
| **Standard SCI.CC6 - Structure and Function**<br>Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among their parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. | | x | | | | |
| **Standard SCI.CC7 - Stability and Change**<br>Students explain stability and change in natural or designed systems by examining changes over time and considering forces at different scales, including the atomic scale. They understand changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be distributed by either sudden events or gradual changes that accumulate over time. | | | | | x | x |

| Science & Engineering Practices Science Standards by Grade Level Band and Unit | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 |
|---|---|---|---|---|---|---|
| Science and Engineering Practices | | | | | | |
| **Standard SCI.SEP1 - Asking Questions and Defining Problems**<br>Students ask questions to specify relationships between variables and clarify arguments and models. This includes the following:<br>● Ask questions that arise from careful observation of phenomena, models, or unexpected results to clarify or seek additional information.<br>● Ask questions to identify and clarify evidence and the premise(s) of an argument.<br>● Ask questions to determine relationships between independent and dependent variables and relationships in models.<br>● Ask questions to clarify or refine a model, an explanation, or an engineering problem.<br>● Ask questions that require sufficient and appropriate empirical evidence to answer.<br>● Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.<br>● Ask questions that challenge the premise(s) of an argument of a data set.<br>● Students can define a design problem that can be solved through the development of an object, tool, process, or system, and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. | x | x | x | x | x | x |
| **Standard SCI.SEP2 - Developing and Using Models**<br>Students develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. This includes the following:<br>● Evaluate limitations of a model for a proposed object or tool.<br>● Develop or modify a model - based on evidence - to match what happens if a variable or component of a system is changed.<br>● Use and develop a model of simple systems with uncertain and less predictable factors.<br>● Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.<br>● Develop and use a model to predict and describe phenomena.<br>● Develop a model to describe unobservable mechanisms.<br>● Develop and use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. | x | x | x | x | x | x |
| **Standard SCI.SEP3 - Planning and Conducting Investigations**<br>Students plan and carry out investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models: This includes the following: | x | x | x | x | x | |

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| • Individually and collaboratively plan an investigation, identifying: independent and dependent variables and controls, tools needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.<br>• Conduct an investigation. Evaluate and revise the experimental design to produce data that serve as the basis for evidence to meet the goals of the investigation.<br>• Evaluate the accuracy of various methods for collecting data.<br>• Collect data under a range of conditions that serve as the basis for evidence to answer scientific questions or test design solutions.<br>• Collect data about the performance of a proposed object, tool, process, or system under a range of conditions. | | | | | | |
| **Standard SCI.SEP4 - Analyze and Interpret Data**<br>Students extend quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. This includes the following:<br>• Construct, analyze, or interpret graphical displays of data and large data sets to identify linear and nonlinear relationships.<br>• Use graphical displays (e.g., maps, charts, graphs, and tables) of large data sets to identify temporal and spatial relationships.<br>• Distinguish between causal and correlational relationships in data.<br>• Analyze and interpret data to provide evidence for explanations of phenomena.<br>• Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.<br>• Consider limitations of data analysis (e.g., measurement, error), and seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).<br>• Analyze and interpret data to determine similarities and differences in findings.<br>• Analyze data to define an optimal operational range for a proposed object, tool, process, or system that best meets criteria for success. | x | x | x | | x | x |
| **Standard SCI.SEP5 - Mathematics and Computational Thinking**<br>Students identify patterns in large data sets and use mathematical concepts to support explanations and arguments. This includes the following:<br>• Decide when to use qualitative and quantitative data.<br>• Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.<br>• Use mathematical representations to describe and support scientific conclusions and design solutions.<br>• Create algorithms (a series of ordered steps) to solve a problem.<br>• Apply mathematical concepts and processes (such as ratio, rate, percent, basic operations, and simple algebra) to scientific and engineering questions and problems.<br>• Use digital tools and mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. | | | | | x | x |
| **Standard SCI.SEP6 - Construct Explanations and Design Solutions**<br>Students construct explanations supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. This includes the following:<br>• Construct an explanation that includes qualitative or quantitative relationships between variables that predict and describe phenomena.<br>• Construct an explanation using models or representations.<br>• Construct a scientific explanation based on valid and reliable evidence obtained from sources, including the students' own experiments. Solutions should build on the following assumption: Theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.<br>• Apply scientific ideas, principles, and evidence to construct, revise, or use an explanation for real-world phenomena, examples, or events.<br><br>Students design solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. This includes the following:<br>• Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process, or system.<br>• Undertake a design project, engaging in the design cycle, to construct and implement a solution that meets specific design criteria and constraints.<br>• Optimize performance of a design by prioritizing criteria, making trade-offs, testing, revising, and retesting. | x | x | x | x | x | x |
| **Standard SCI.SEP7 - Engage in Arguments**<br>Students construct a convincing argument that supports or refutes claims for either explanations or solutions about the natural world. This includes the following:<br>• Compare and critique two arguments on the same topic. Analyze whether they emphasize similar or different evidence and interpretations of facts. | x | x | x | x | x | x |

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| • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.<br>• Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.<br>• Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system. Based the argument on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.<br>• Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. | | | | | | |
| **Standard SCI.SEP8 - Obtain, evaluate, and Communication Information**<br>Students evaluate the validity and reliability of claims, methods, and designs. This includes the following:<br>• Critically read scientific texts adapted for classroom use to determine the central ideas, to obtain scientific and technical information, and to describe patterns in and evidence about the natural and designed world(s).<br>• Clarify claims and findings by integrating text-based qualitative and quantitative scientific information with information contained in media and visual displays.<br>• Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication. Describe how they are supported or not supported by evidence and evaluate methods used.<br>• Evaluate data, hypotheses, and conclusions in scientific and technical texts in light of competing information or accounts.<br>• Communicate scientific and technical information (e.g., about a proposed object, tool process, or system) in writing and through oral presentations. | | x | | x | x | x |

| Disciplinary Core Ideas Science Standards by Grade Level Band and Unit | | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 |
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| **Disciplinary Core Ideas** | | | | | | | |
| **Life Science- Grade Band Level** | ***Essential Elements***<br>*These are alternate standards aligned with college, career, and community ready expectations for students with the most significant cognitive disabilities.* | | | | | | |
| **Standard SCI.LS1- STRUCTURES AND PROCESSES**<br>A. STRUCTURE & FUNCTION: All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.<br>B. GROWTH AND DEVELOPMENT OF ORGANISMS: Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.<br>C. ORGANIZATION FOR MATTER AND FLOW IN ORGANISMS: Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.<br>D. INFORMATION PROCESSING: Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain resulting in immediate behavior or memories. | EE.MS-LS1-3:Make a claim about how a structure (e.g., organs and organ systems) and its related function supports the survival of animals (circulatory, digestive, and respiratory systems).<br><br>EE.MS-LS1-5: Interpret data to show that environmental resources (e.g., food, light, space, water) influence growth of organisms (e.g., drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, fish growing larger in large ponds than small ponds). | x | | x | x | | |
| **Standard SCI.LS2- INTERACTIONS, ENERGY, AND DYNAMICS WITHIN ECOSYSTEMS**<br>A. INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS: Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.<br>B. CYCLES OF MATTER AND ENERGY TRANSFER IN ECOSYSTEMS: The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem. | EE.MS-LS2-2: Use models of food chains/webs to identify producers and consumers in aquatic and terrestrial ecosystems. | | | | x | x | |

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| C. ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE: Ecosystems characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.<br>D. SOCIAL INTERACTIONS AND GROUP BEHAVIOR: Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on - for example, water purification and recycling. | | | | | | | |
| **Standard SCI.LS3- HEREDITY**<br>A. INHERITANCE OF TRAITS: Genes chiefly regulate a specific protein, which affect an individual's traits.<br>B. VARIATION OF TRAITS: In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism. | EE.MS-LS3-2: Make a claim supported by evidence that offspring inherit traits from their parents | | | | | | |
| **Standard SCI.LS4- BIOLOGICAL EVOLUTION**<br>A. EVIDENCE OF COMMON ANCESTRY AND DIVERSITY: The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.<br>B. NATURAL SELECTION: Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.<br>C. ADAPTATION: Species can change over time in response to changes in environmental conditions through adaptation by natural selection action over generations. Traits that support successful survival and reproduction in the new environment become more common.<br>D. BIODIVERSITY AND HUMANS: Changes in biodiversity can influence humans' resources and ecosystem services they rely on. | | | | | | x | |
| **Physical Science** | ***Essential Elements*** | | | | | | |
| **Standard SCI.PS1- MATTER AND ITS INTERACTIONS**<br>A. STRUCTURE AND FUNCTION: The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.<br>B. CHEMICAL REACTIONS: Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy. | EE.MS-PS1-2: Interpret and analyze data on the properties (e.g., color, texture, odor, and state of matter) of substances before and after chemical changes have occurred (e.g., burning sugar or burning steel wool, rust, effervescent tablets). | x | x | x | x | | |
| **Standard SCI.PS2- FORCES, INTERACTIONS, MOTION, AND STABILITY**<br>A. FORCES AND MOTION: Motion and changes in motion can be qualitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction). The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force (Newton's first and second law". For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).<br>B. TYPES OF INTERACTIONS: Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object. | EE.MS-PS2-2: Investigate and predict the change in motion of objects based on the forces acting on those objects. | | | | | | |
| **Standard SCI.PS3- ENERGY**<br>A. DEFINITIONS OF ENERGY: Kinetic energy can be distinguished from the various forms of potential energy. | EE.MS-PS3-3: Test and refine a device (e.g., foam cup, insulated box, or thermos) to either minimize or maximize thermal energy transfer (e.g., keeping liquids hot or cold, preventing liquids from | | | | | | |

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| B. CONSERVATION OF ENERGY AND ENERGY TRANSFER: Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.<br>C. RELATIONSHIPS BETWEEN ENERGY AND FORCES: When two objects interact, each one exerts a force on the other, and these forces can transfer energy<br>D. ENERGY IN CHEMICAL PROCESSES AND EVERYDAY LIFE: Sunlight captured by plants and used in a chemical reaction to produce sugar molecules for storing this energy. This stored energy can be released by respiration or combustion, which can be reversed by burning those molecules to release energy. | freezing, keeping hands warm in cold temperatures). | | | | | | |
| **Standard SCI.PS4- WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER**<br>**A.** WAVE PROPERTIES: A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.<br>B. ELECTROMAGNETIC RADIATION: The construct of a wave is used to model how light interacts with objects.<br>C. INFORMATION TECHNOLOGIES AND INSTRUMENTATION: Waves can be used to transmit digital information. Digitized information is comprised of a pattern of 1s and 0s. | EE.MS-PS4-2: Use a model to show how light waves (e.g., light through a water glass, light on colored objects) or sound waves are reflected, absorbed, or transmitted through various materials (e.g., water, air, table). | | | | | | |
| **Earth and Space Science** | ***Essential Elements*** | | | | | | |
| **Standard SCI.ESS1- EARTH'S PLACE IN THE UNIVERSE**<br>A. THE UNIVERSE AND ITS STARS: The solar system is part of the Milky Way, which is one of many billions of galaxies.<br>B. EARTH AND THE SOLAR SYSTEM: The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.<br>C. THE HISTORY OF PLANET EARTH: Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.. | EE.5-ESS1-2: Represent and interpret data on a picture, line, or bar graph to show seasonal patterns in the length of daylight hours.<br><br>EE.MS-ESS1-1: Use an Earth-Sun-Moon model to show that Earth's orbit around the Sun corresponds to a calendar year and the orbit of the Moon around Earth corresponds to a month. | | | | | | |
| **Standard SCI.ESS2- EARTH'S SYSTEMS**<br>A. EARTH MATERIALS AND SYSTEMS: Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.<br>B. PLATE TECTONICS AND LARGE-SCALE SYSTEM INTERACTIONS: Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.<br>C. THE ROLES OF WATER IN EARTH'S SURFACE PROCESSES: Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.<br>D. WEATHER AND CLIMATE: Complex interactions determine local weather patterns and influence climate, including the role of the ocean.<br>E. BIOGEOLOGY: The fossil record documents the existence, diversity, extinction, and change of many life forms throughout history. | EE.5-ESS2-1: Develop a model showing how water (hydrosphere) affects the living things (biosphere) found in a region.<br><br>EE.MS-ESS2-1: Use a model to describe the change within the rock cycle between the igneous, metamorphic, and sedimentary rock.<br><br>EE.MS-ESS2-2: Explain how geoscience processes that occur daily (e.g., wind, rain, runoff) slowly change the surface of Earth, while catastrophic events (e.g., earthquakes, tornadoes, floods) can quickly change the surface of Earth.<br><br>EE.MS-ESS2-6: Interpret basic weather information (e.g., radar, map) to make predictions about future conditions (e.g., precipitation, temperature, wind). | | | | | | |
| **Standard SCI.ESS3- EARTH AND HUMAN ACTIVITY**<br>A. NATURAL RESOURCES: Humans depend on Earth's land, oceans, fresh water, atmosphere, and biosphere for different resources, many of which are limited or not | EE.5-ESS3-1: Use information to describe how people can help protect the Earth's resources and how that affects the environment. | | | | | x | x |

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| renewable.  Resources are distributed unevenly around the planet as a result of past geologic process<br>B. NATURAL HAZARDS:  Patterns can be seen through mapping the history of natural hazards in a region and understanding related geological forces.<br>C. HUMAN IMPACTS ON EARTH SYSTEMS:  Human activities have altered the hydrosphere, atmosphere, and lithosphere which in turn has altered the biosphere.  Changes to the biosphere can have different impacts for different living things.  Activities and technologies can be engineered to reduce people's impacts on Earth.<br>D. GLOBAL CLIMATE CHANGE:  Evidence suggests human activities affect global warming.  Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.. | EE.MS-ESS3-1: Interpret, based on evidence, how the geoscience processes (e.g., weathering, erosion) create resources.<br><br>EE.MS-ESS3-3: Develop a plan to monitor and minimize a human impact on the local environment (e.g., water, land, pollution). | | | | | | |
| **Engineering and Technical Science** | ***Essential Elements*** | | | | | | |
| **Standard SCI.ETS1- ENGINEERING, TECHNOLOGY, AND THE APPLICATION OF SCIENCE**<br>**A.** DEFINING AND DELIMITING ENGINEERING PROBLEMS: The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.  Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.<br>B. DEVELOPING POSSIBLE SOLUTIONS: A solution needs to be tested and then modified on the basis of test results in order to improve it.  There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.  Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.  Models of all kinds are important for testing solutions.<br>C. Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process- That is, some of those characteristics may be incorporated into the new design.  The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. | | | x | | | x | x |
| **Standard SCI.ETS2- ILINKS AMONG ENGINEERING, TECHNOLOGY, SCIENCE, AND SOCIETY**<br>**A.** INTERDEPENDENCE OF SCIENCE, ENGINEERING, AND TECHNOLOGY:  A solution needs to be tested and then modified on the basis of the test results in order to improve it.  There are systematic processes for evaluation solutions with respect to how well they meet the criteria and constraints of a problem.<br>B. INFLUENCE OF ENGINEERING, TECHNOLOGY, AND SCIENCE ON SOCIETY AND THE NATURAL WORLD:  All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.  The uses of technologies are driven by people's needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources,and economic conditions. | | | | | | | |
| **Standard: SCI.ETS3: NATURE OF SCIENCE AND ENGINEERING**<br>A. SCIENCE AND ENGINEERING ARE HUMAN ENDEAVORS:  Individuals and teams from many nations, cultures, and backgrounds have contributed to advances in science and engineering.  Scientists and engineers are persistent, use creativity, reasoning, and skepticism, and remain open to new ideas.<br>B. SCIENCE AND  ENGINEERING ARE UNIQUE WAYS OF THINKING WITH DIFFERENT PURPOSES:  Science asks questions to understand the natural world and assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.  Science carefully considers and evaluates anomalies in data and evidence.  Engineering seeks solutions to human problems, including issues that arise due to human interaction with the environment.  It uses some of the same practices as science and often applies scientific principles to | | | | | | | |

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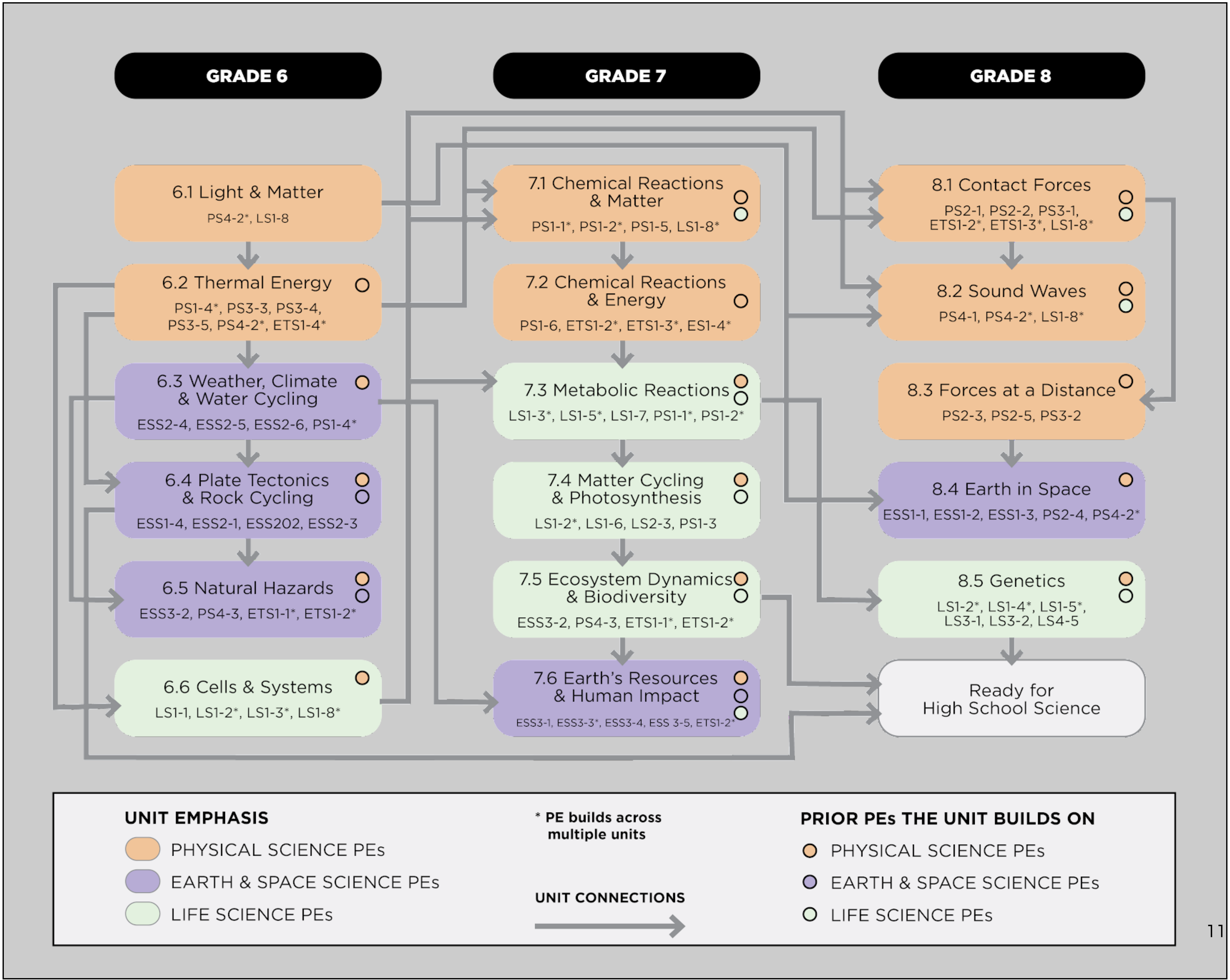
| solutions. Science and engineering have direct impacts on the quality of life for all people. Therefore, scientists and engineers need to pursue their work in an ethical manner that requires honesty, fairness, and dedication to public health, safety, and welfare.<br>C. SCIENCE AND ENGINEERING USE MULTIPLE APPROACHES TO CREATE NEW KNOWLEDGE AND SOLVE PROBLEMS: A theory is an explanation of some aspect of the natural world. Scientists develop theories by using multiple approaches. Validity of these theories and explanations is increased through a peer review process that tests and evaluates the evidence supporting scientific claims. Theories are explanations for observable phenomena based on a body of evidence developed over time. A hypothesis is a statement that can be tested to evaluate a theory. Scientific laws describe cause and effect relationships among observable phenomena. Engineers develop solutions using multiple approaches and evaluate their solutions against criteria such as cost, safety, time, and performance. This evaluation often involves tradeoffs between constraints to find the optimal solution. | | | | | | | |


GRADE 6
GRADE 7
GRADE 8
6.1 Light & Matter
PS4-2*, LS1-8
6.2 Thermal Energy
PS1-4*, PS3-3, PS3-4, PS3-5, PS4-2*, ETS1-4*
6.3 Weather, Climate & Water Cycling
ESS2-4, ESS2-5, ESS2-6, PS1-4*
6.4 Plate Tectonics & Rock Cycling
ESS1-4, ESS2-1, ESS202, ESS2-3
6.5 Natural Hazards
ESS3-2, PS4-3, ETS1-1*, ETS1-2*
6.6 Cells & Systems
LS1-1, LS1-2*, LS1-3*, LS1-8*
7.1 Chemical Reactions & Matter
PS1-1*, PS1-2*, PS1-5, LS1-8*
7.2 Chemical Reactions & Energy
PS1-6, ETS1-2*, ETS1-3*, ES1-4*
7.3 Metabolic Reactions
LS1-3*, LS1-5*, LS1-7, PS1-1*, PS1-2*
7.4 Matter Cycling & Photosynthesis
LS1-2*, LS1-6, LS2-3, PS1-3
7.5 Ecosystem Dynamics & Biodiversity
ESS3-2, PS4-3, ETS1-1*, ETS1-2*
7.6 Earth's Resources & Human Impact
ESS3-1, ESS3-3*, ESS3-4, ESS 3-5, ETS1-2*
8.1 Contact Forces
PS2-1, PS2-2, PS3-1, ETS1-2*, ETS1-3*, LS1-8*
8.2 Sound Waves
PS4-1, PS4-2*, LS1-8*
8.3 Forces at a Distance
PS2-3, PS2-5, PS3-2
8.4 Earth in Space
ESS1-1, ESS1-2, ESS1-3, PS2-4, PS4-2*
8.5 Genetics
LS1-2*, LS1-4*, LS1-5*, LS3-1, LS3-2, LS4-5
Ready for High School Science
UNIT EMPHASIS
PHYSICAL SCIENCE PEs
EARTH & SPACE SCIENCE PEs
LIFE SCIENCE PEs
* PE builds across multiple units
UNIT CONNECTIONS
PRIOR PEs THE UNIT BUILDS ON
PHYSICAL SCIENCE PEs
EARTH & SPACE SCIENCE PEs
LIFE SCIENCE PEs

## UNIT 1: Chemical Reactions and Matter

*Seventh grade chemistry students' conceptual understanding of chemical reactions for middle school science is foundational to much science learning. Understanding atomic level reactions is crucial for learning physical, life, earth, and space science. Even more importantly, they open up new windows of curiosity for students to see the world around them. By seventh grade, students are ready to take on the abstract nature of the interactions of atoms and molecules far too small to see. To pique 7th grade students' curiosity and anchor the learning for the unit in the visible and concrete, students start with an experience of observing and analyzing a bath bomb as it fizzes and eventually disappears in the water. Their observations and questions about what is going on drive learning that digs into a series of related phenomena as students iterate and improve their models depicting what happens during chemical reactions for middle school science. By the end of the unit, students have a firm grasp on how to model simple molecules, know what to look for to determine if chemical reactions have occurred, and apply their knowledge to chemical reactions to show how mass is conserved when atoms are rearranged.*

## UNIT 1 DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

➔ How can we make something new that was not there before?

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ Patterns | ➔ Constructing Explanations and Designing Solutions (primary) | ➔ PS1.A |
| ➔ Scale, Proportion, and Quantity | ➔ Analyzing and Interpreting Data (primary) | ➔ PS1.B |
| ➔ Energy and Matter | ➔ Engaging in Argument from Evidence (primary) | ➔ LS1-D |
| | ➔ Developing and Using Models (supporting) | |
| | ➔ Planning and Carrying Out Investigations (supporting) | |

**3 DIMENSIONAL LEARNING TARGETS**

➔ MS-PS1-1: I can develop models to describe [Scale, Proportion, and Quantity] the atomic composition of simple molecules and extended structures.
➔ MS-PS1-2: I can analyze and interpret data [Energy and Matter, Patterns]on the properties of substances before and after the substances interact to

determine if a chemical reaction has occurred.

- ➔ MS-PS1-5: I can develop and use a model to describe [Energy and Matter, Patterns] how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
- ➔ MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. (This is developed throughout 6th, 7th, and 8th grade)

## UNIT 1 ASSESSMENT EVIDENCE

*Performance is evaluated in terms of... Students will show their learning by...*

***Performance Task Description:***

Given an authentic scenario, students will demonstrate understanding of the unit 3 dimensional learning targets:

- ➔ develop models to describe [Scale, Proportion, and Quantity] the atomic composition of simple molecules and extended structures.
- ➔ analyze and interpret data [Energy and Matter, Patterns] on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- ➔ develop and use a model to describe [Energy and Matter, Patterns] how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
  - ◆ Example: Students will construct an argument about whether the gas(es) produced from water using energy from a battery is made of the same particles that were produced from heating the water.
  - ◆ Example: Students construct two explanations having to do with the bath bomb reaction. One explanation is around how the same atoms that are in the molecules of the starting substances rearrange to form new products made of different molecules. The second explanation is about whether more than one substance can be produced during a chemical reaction.
  - ◆ Example: Students analyze data about interactions between different substances in the environment around the Taj Mahal and the marble surface of the monument to determine if a chemical reaction is occurring between any of the substances and the marble that could be causing it to be crumbling and falling apart.
- ➔ Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. (This is developed throughout 6th, 7th, and 8th grade)

***Success Criteria Rubrics***

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.
  - ◆ Construct Explanations and Design Solutions
  - ◆ Analyze and Interpret Data
  - ◆ Engage in Argument from Evidence
- ➔ Constructing Explanations and Designing Solutions (primary)
- ➔ Analyzing and Interpreting Data (primary)
- ➔ Engaging in Argument from Evidence (primary)

***Key Feedback & Assessment Strategies:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - ◆ *Driving Question Board to gather background knowledge and activate prior knowledge*
  - ◆ *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - ◆ *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*

- *Progress Tracker*
- *Assess unit vocabulary terms*
- *Evaluate student investigation tasks*
- *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & AP Readiness may include:*
- Students could learn how to balance chemical equations using coefficients in order to conserve matter in a chemical reaction.
- Students could investigate erosion of other materials as the iron in the rods and clamps of the Taj Mahal and pollutants in acid rain.
- Lesson 6: This lesson is a transfer task in which students watch two video clips of the Elephant Toothpaste investigation and read second hand data from this investigation. If there is interest and time, this investigation could be done as a demonstration in class. This would allow students to use first hand data and observe this investigation closer up.
- Lesson 10: If you have the supplies, you could have students work in small groups and conduct the electrolysis investigation with their small group.

## UNIT 2: Chemical Reactions

*Students are introduced to the anchoring phenomenon—a flameless heater in a Meal, Ready-to-Eat (MRE) that provides hot food to people by just adding water. In the first lesson set, students explore the inside of an MRE flameless heater, then do investigations to collect evidence to support the idea that this heater and another type of flameless heater (a single-use hand warmer) are undergoing chemical reactions as they get warm. Students have an opportunity to reflect on the engineering design process, defining stakeholders, and refining the criteria and constraints for the design solution. In the second lesson set, students develop their design solutions by investigating how much food and reactants they should include in their homemade heater designs and go through a series of iterative testing and redesigning. This iterative design cycle includes peer feedback, consideration of design modification consequences, and analysis of impacts on stakeholders. Finally, students optimize their designs and have another team test their homemade heater instructions.*

## UNIT 2 DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

➔ How can we use chemical reactions to design a solution to a problem?

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ Systems & System Models | ➔ Developing & Using Models | ➔ PS1.A |
| ➔ Energy & Matter | ➔ Planning & Carrying Out Investigations | ➔ PS3.A |
| ➔ Structure & Function | ➔ Analyzing & Interpreting Data | ➔ PS3.B |
| ➔ | ➔ Constructing Explanations & Designing Solutions | ➔ PS4.B |
| ➔ | ➔ Engaging in Argument from Evidence | ➔ ETS1.A |
| ➔ | ➔ | ➔ ETS1.B |

**3 DIMENSIONAL LEARNING TARGETS**

➔ MS-PS1-6: I can undertake a design project to construct, test, and modify [Structure & Function] a device that either releases or absorbs thermal energy by chemical processes.

- ➔ MS-ETS1-2: I can evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- ➔ MS-ETS1-3: I can analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- ➔ MS-ETS1-4: I can develop a model to generate data for iterative testing and modification of a proposed object, tool, or process so that an optimal design can be achieved.

## UNIT 2 ASSESSMENT EVIDENCE

*Performance is evaluated in terms of… Students will show their learning by…*

***Performance Task Description:***

Given an authentic scenario, students will demonstrate understanding of the unit 3 dimensional learning targets (above). This may include …

- ◆ Example: Students will have an opportunity to demonstrate understanding on a summative assessment transfer task about sea turtle incubators. They will also have a chance to demonstrate understanding and surface any unanswered or new questions as they review their Progress Trackers in combination with the Design Questions board with a partner.

***Success Criteria Rubrics***

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.
  - ◆ Making Models
  - ◆ Planning and Conducting Investigations
  - ◆ Analyze and Interpret Data
  - ◆ Construct Explanations and Design Solutions
  - ◆ Engage in Argument from Evidence

***Key Feedback & Assessment Strategies:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - ◆ *Driving Question Board to gather background knowledge and activate prior knowledge*
  - ◆ *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - ◆ *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - ◆ *Progress Tracker*
  - ◆ *Assess unit vocabulary terms*
  - ◆ *Evaluate student investigation tasks*
  - ◆ *Assess key unit concepts (Unit summative assessment)*
- ➔ *Extensions & AP Readiness may include:*
  - ◆ Lesson 2: Students may question temperature change if the amount of hand warmers used changed. Give students an opportunity to test additional hand warmers, and give students an opportunity to wonder about and investigate the cost of this option to get adequate temperature changes to warm food.
  - ◆ Lesson 3: Students may notice that there are a lot of bubbles on the steel wool when it is submerged in vinegar. Vinegar is used to clean the surface of the steel wool by removing oils left on it after manufacturing. Iron in the freshly cleaned steel surface slowly

starts to react with vinegar to produce hydrogen. As an extension activity, students can collect some of the gas and conduct a flammability test as in OpenSciEd Unit 7.1: How can we make something new that was not there before? (Bath Bombs Unit). The root killer and aluminum foil in saltwater reaction also produces small hydrogen bubbles due to the sodium chloride disrupting the oxide layer on the foil; though, this may not be noticeable since it will occur inside of the closed cup. Therefore, this reaction could also be subject to a flammability test. The bubbles produced by the reaction of baking soda and vinegar contain carbon dioxide gas that will extinguish a flame and therefore is not flammable.

- Lesson 9: Students may want to create a video or type their how-to instructions (especially if that would be an improvement in the ease of use for their design from a previously handwritten version of the directions). If you choose to allow students the video option, they would film their video during the trial run on day 2, but then they may need extra time to edit the video before another team tests the design on day 3.
- Lesson 9: After teams test their own optimized design, you may want to give them more time to undergo another round of redesign and testing. Students will probably need another class period to make and test meaningful design modifications. This decision is up to your discretion and should be based on available time and student interest.
- As an extension activity, students can collect some of the gas and conduct a flammability test as in OpenSciEd Unit 7.1: How can we make something new that was not there before? (Bath Bombs Unit). The root killer and aluminum foil in saltwater reaction also produces small hydrogen bubbles due to the sodium chloride disrupting the oxide layer on the foil; though, this may not be noticeable since it will occur inside of the closed cup. Therefore, this reaction could also be subject to a flammability test. The bubbles produced by the reaction of baking soda and vinegar contain carbon dioxide gas that will extinguish a flame and therefore is not flammable.

## UNIT 3: Metabolic Reactions

*This unit on metabolic reactions in the human body starts out with students exploring a real case study. The case study sparks questions and ideas for investigations around trying to figure out which pathways and processes in the body might be functioning differently than a healthy system and why. Students investigate data specific to the case in the form of doctor's notes, endoscopy images and reports, growth charts, and micrographs. They also draw from their results from laboratory experiments on the chemical changes involving the processing of food and from digital interactives to explore how food is transported, transformed, stored, and used across different body systems in all people. Through this work of figuring out what is causing the case study's symptoms, the class discovers what happens to the food we eat after it enters our bodies and how different symptoms are connected.*

## UNIT 3 DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

➔ How do things inside our bodies work together to make us feel the way we do?

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ Systems & System Models | ➔ Developing & Using Models | ➔ LS1.A |
| ➔ Structure & Function | ➔ Analyzing & Interpreting Data | ➔ LS1.B |
| ➔ | ➔ Engaging in Argument from Evidence | ➔ LS1.C |
| ➔ | ➔ | ➔ PS3.D |

**3 DIMENSIONAL LEARNING TARGETS**

➔ MS-LS1-3: I can use argument supported by evidence [Systems & System Models, Structure & Function] for how the body is a system of interacting subsystems composed of groups of cells.

➔ MS-LS1-5: I can construct a scientific explanation based on evidence [Systems & System Models, Structure & Function] for how environmental and genetic factors influence the growth of organisms.

➔ MS-LS1-7: I can develop a model [Systems & System Models, Structure & Function] to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

➔ MS-PS1-1: I can develop models [Systems & System Models] to describe the atomic composition of simple molecules and extended structures.*

➔ MS-PS1-2: I can analyze and interpret data [Systems & System Models] on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.*

*This unit reinforces these NGSS PEs that students should have previously developed.

## UNIT 3 ASSESSMENT EVIDENCE

*Performance is evaluated in terms of... Students will show their learning by...*

***Performance Task Description:***

Given an authentic scenario, students will demonstrate understanding of the unit 3 dimensional learning targets (above). This may include ...

- Example: Students will have an opportunity to demonstrate understanding on a summative assessment about a person's illness and a transfer task about bear hibernation.

***Success Criteria Rubrics***

- Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.
  - Making Models
  - Analyze and Interpret Data
  - Engage in Argument from Evidence

***Key Feedback & Assessment Strategies:***

- *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- *Assessment of Unit Skills- Examples for Targeted Data Collection*
  - *Driving Question Board to gather background knowledge and activate prior knowledge*
  - *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
  - *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
  - *Progress Tracker*
  - *Assess unit vocabulary terms*
  - *Evaluate student investigation tasks*
  - *Assess key unit concepts (Unit summative assessment)*
- *Extensions & AP Readiness may include:*
  - Lesson 8: During the simulation Connecting the Structure of Villi to Their Function, you could extend students' explanation to include the idea of surface area. There are additional experiments around surface area to volume ratio and the size of cells that is most efficient for absorption using agar cubes of various sizes, a PH indicator and vinegar or other acid. Cut agar cubes made with a pH indicator of different sizes and place them into vinegar. Over time you will see how much of the solution diffusers into each cube. The simulation in the unit shows the size of cells remaining constant when the villi height is increased, but surface area to volume experiments could help answer additional questions such as, "What would happen to percent absorption if the size of the individual cells was increased?" or "Why are cells inside our body so small?" Make sure your students have the necessary math skills needed to understand the surface to volume ratio concept.
  - Lesson 13: In the activity section "Develop individual explanations for M'Kenna's other symptoms" you could enhance this by building out a more robust model for the nervous system as a class for explaining her symptom of brain fog. This could answer questions such as, "What does our brain need? What makes up our nervous systems and how is it connected to the other body systems?" as well as providing opportunities for connections back to OpenSciEd Unit 6.6: How do living things heal? (Healing Unit).

## UNIT 4: Matter Cycling and Photosynthesis

*Based on the preceding unit, students argue that they know what happens to the sugar in syrup when they consume it. It is absorbed into the circulatory system and transported to cells in their body to be used for fuel. Students explore what else is in food and discover that food from plants, like bananas, peanut butter, beans, avocado, and almonds, not only have sugars but proteins and fats as well. This discovery leads them to wonder how plants are getting these food molecules and where a plant's food comes from. Students figure out that they can trace all food back to plants, including processed and synthetic food. They obtain and communicate information to explain how matter gets from living things that have died back into the system through processes done by decomposers. Students finally explain that the pieces of their food are constantly recycled between living and nonliving parts of a system.*

## UNIT 4 DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

- ➔ Where does food come from and where does it go next?

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ Systems and System Models | ➔ Developing and Using Models | ➔ LS1.C |
| ➔ Energy and Matter | ➔ Constructing Explanations and Design Solutions | ➔ LS2.B |
| ➔ | ➔ Engaging in Argument from Evidence | ➔ PS1.A |
| ➔ | ➔ Obtaining, Evaluating, and Communication Information | ➔ PS1.B |
| ➔ | ➔ | ➔ PS3.D |

**3 DIMENSIONAL LEARNING TARGETS**

- ➔ MS-LS1-6: I can construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- ➔ MS-LS2-3: I can develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- ➔ MS-PS1-3: I can gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

- ➔ MS-LS1-2: I can develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. (Specifically, chloroplasts and mitochondria.) *(Partial PE alignment)*

## UNIT 4 ASSESSMENT EVIDENCE

*Performance is evaluated in terms of… Students will show their learning by…*

***Performance Task Description:***

Given an authentic scenario, students will demonstrate understanding of the unit 3 dimensional learning targets (above). This may include …

- ◆ Example: Students will have an opportunity to demonstrate understanding on a summative assessment about how did the lettuce get its food molecules that then we eat and a transfer task about how whale carcusses provide food to deep sea organisms.

***Success Criteria Rubrics***

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.
    - ◆ Making Models
    - ◆ Construct Explanations and Design Solutions
    - ◆ Engage in Argument from Evidence
    - ◆ Obtain, Evaluate, and Communicate Information

***Key Feedback & Assessment Strategies:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills- Examples for Targeted Data Collection*
    - ◆ *Driving Question Board to gather background knowledge and activate prior knowledge*
    - ◆ *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
    - ◆ *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
    - ◆ *Progress Tracker*
    - ◆ *Assess unit vocabulary terms*
    - ◆ *Evaluate student investigation tasks*
    - ◆ *Assess key unit concepts (Unit summative assessment)*
- ➔ *Extensions & AP Readiness may include:*
    - ◆ Lesson 2: Instead of jigsawing the different food indicators, student groups could test each of the indicators with the corresponding type of food.
    - ◆ Lesson 11: Provide time for students to work on the alternate activity where students dissect one of the seeds to look for evidence of that sprouting starting. You can also give students the option to each take three seeds from the investigation home, put them back in a wet paper towel in a ziplock bag as they were when students got them, and tape the bag to a window in their house to watch them sprout.
    - ◆ Lesson 13: Students can carry out the What Happens to Uneaten Food? investigation in the classroom using BTB (like in Lessons 7 and 11) or the carbon dioxide/relative humidity detector (like they used in Lessons 4 and 10).
    - ◆ Lesson 13: Students could spend more time researching details of their chosen decomposer and/or students could communicate the information they've learned in a different format than the suggested slide or to a different audience than just their peers.

| UNIT 5: Ecosystem Dynamics |
|---|
| *In this unit on ecosystem dynamics and biodiversity, students spend the first lesson better understanding the complexity of a problem, which cannot be solved with simple solutions. Students will establish the need for a better design for the problem. The final set of lessons engage students in investigations of alternative approaches to growing food compared to large-scale monocrop farms. Students work to design a solution that simultaneously supports specific animal populations and the income of farmers and community members.* |

## UNIT 5 DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

- ➔ How does changing an ecosystem affect what lives there?

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ Cause and Effect | ➔ Asking Questions and Defining Problems | ➔ LS2.A |
| ➔ System and System Models | ➔ Developing and Using Models | ➔ LS2.C |
| ➔ Stability and Change | ➔ Planning and Carrying Out Investigations | ➔ LS4.D |
| ➔ | ➔ Mathematics and Computation Thinking | ➔ ESS3.C |
| ➔ | ➔ | ➔ ETS1.A |

**3 DIMENSIONAL LEARNING TARGETS**

- ➔ MS-LS2-1: I can analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- ➔ MS-LS2-4: I can construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- ➔ MS-LS2-2: I can construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- ➔ MS-LS2-5: I can evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- ➔ MS-ESS3-3: I can apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- ➔ MS-ETS1-1: I can define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

## UNIT 5 ASSESSMENT EVIDENCE

*Performance is evaluated in terms of... Students will show their learning by...*

***Performance Task Description:***

Given an authentic scenario, students will demonstrate understanding of the unit 3 dimensional learning targets:

- ➔ MS-LS2-1: I can analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- ➔ MS-LS2-4: I can construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
    - ◆ Example: Students demonstrate their new understanding using a related phenomenon of monarch butterfly populations that depend on the prairie, which has largely been converted for agricultural use. Prior to engaging in the individual assessment, spend time setting up the new context of monarch butterflies on the prairie and mapping the new case to the orangutan case.
    - ◆ Example: Students' demonstrate understanding of ecosystem interactions and disruptions that can change systems over time. The context of the assessment is a real-world debate in the southwestern United States. The case focuses on the southwestern willow flycatcher population, which has been impacted by invasive tamarisks and tamarisk (leaf) beetles.
- ➔ MS-LS2-5: I can evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- ➔ MS-ESS3-3: I can apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- ➔ MS-ETS1-1: I can define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
    - ◆ Example: Lesson 17 and 18 include instructionally-embedded tasks within the context of students redesigning oil palm farms in Indonesia to support orangutan populations, while also supporting farmers and local villagers. Students will then construct an argument around the recommendation (claim) they want to make for redesigning the land.

***Success Criteria Rubrics***

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.
    - ◆ Asking Questions/Defining Problems
    - ◆ Making Models
    - ◆ Planning and Conducting Investigations
    - ◆ Using Mathematics and Computational Thinking

***Key Feedback & Assessment Strategies:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills- Examples for Targeted Data Collection*
    - ◆ *Driving Question Board to gather background knowledge and activate prior knowledge*
    - ◆ *Student evidence notebooks: focus notes, CER argument writing, model & model revisions*
    - ◆ *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
    - ◆ *Progress Tracker*
    - ◆ *Assess unit vocabulary terms*
    - ◆ *Evaluate student investigation tasks*
    - ◆ *Assess key unit concepts (Unit summative assessment)*
- ➔ *Extensions & AP Readiness may include:*
    - ◆

# UNIT 6: Earth's Resources & Human Impact

*Students investigate the Earth's resources and human impact. Students develop models, gather evidence to support a scientific explanation, then evaluate different types of solutions to the identified problems. Students work through a systematic evaluation process to consider (1) each solution's potential to solve the carbon imbalance, (2) tradeoffs associated with solutions based on student-identified constraints, and (3) whether the solution in question makes sense for their community's stakeholders.*

## UNIT 6 DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

➔ How do changes in the Earth's system impact our communities and what can we do about it?

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ Stability and Change (primary) | ➔ Asking Questions and Defining Problems (primary) | ➔ ESS3.A |
| ➔ Cause and Effect (primary) | ➔ Using Mathematics and Computational Thinking (primary) | ➔ ESS3.C |
| ➔ Scale, Proportion, and Quantity (primary) | ➔ Obtaining, Evaluating, and Communicating Information (primary) | ➔ ESS3.D |
| ➔ Patterns (supplemental) | ➔ Developing and Using Models (supplemental) | ➔ ETS1.B |
| ➔ Systems and System Models (supplemental) | ➔ Analyzing and Interpreting Data (supplemental) | |
| ➔ Energy and Matter (supplemental) | ➔ Constructing Explanations and Designing Solutions (supplemental) | |
| | ➔ Engaging in Argument from Evidence (supplemental) | |

**3 DIMENSIONAL LEARNING TARGETS**

➔ MS-ESS3-1. I can construct a scientific explanation based on evidence [Cause & Effect, Scale, Proportion, & Quantity] for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

- ➔ MS-ESS3-3.* I can apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- ➔ MS-ESS3-4. I can construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- ➔ MS-ESS3-5. I can ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- ➔ MS-ETS1-2.* I can evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

*Performance Expectations marked with an asterisk are partially developed in this unit and shared with other units.

## UNIT 6 ASSESSMENT EVIDENCE

*Performance is evaluated in terms of... Students will show their learning by...*

***Performance Task Description:***

Given an authentic scenario, students will demonstrate understanding of the unit 3 dimensional learning targets (above). This may include ...

- ➔ MS-ESS3-1. I can construct a scientific explanation based on evidence [Cause & Effect, Scale, Proportion, & Quantity] for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- ➔ MS-ESS3-4. I can construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- ➔ MS-ESS3-5. I can ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century..
    - ◆ Example: In lesson 6, students construct another explanation for an Alaskan community experiencing related changes to the other case sites. This is a transfer task that asks students to draw upon ideas developed in Lessons 2-5 but with the addition of new climate impacts: sea ice decline and wildfires. Students then compare the Alaskan claims to the previous work done on the Alaska Wildfire and Sea Ice Transfer Task to determine the similarities and differences between the Alaskan claims and their case site claims. Students determine that all cases are impacted by increasing temperatures.
- ➔ MS-ESS3-3.* I can apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- ➔ MS-ETS1-2.* I can evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
    - ◆ Lesson 17 includes instructionally-embedded tasks within the context of students designing a climate resilience plan for their school or community.

***Success Criteria Rubrics***

- ➔ Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.
    - ◆ Asking Questions/Defining Problems
    - ◆ Using Mathematics and Computational Thinking
    - ◆ Obtaining, Evaluating, and Communicating Information

***Key Feedback & Assessment Strategies:***

- ➔ *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- ➔ *Assessment of Unit Skills- Examples for Targeted Data Collection*
    - ◆ *Driving Question Board to gather background knowledge and activate prior knowledge*

- *Student evidence notebooks: focus notes, CER argument writing,  model & model revisions*
- *Checks for understanding (exit slips, quickwrites, etc.) aligned to unit guiding questions*
- *Progress Tracker*
- *Assess unit vocabulary terms*
- *Evaluate student investigation tasks*
- *Assess key unit concepts (Unit summative assessment)*

➔ *Extensions & AP Readiness may include:*
- Lesson 7: Have students read about common ideas related to the warming atmosphere using Exploring Possible Causes of Warming.
- Lesson 8: Use the full PhET simulation for students to more fully explore ideas; however, please note that this simulation uses high school level ideas and should only be offered to students who have fully mastered the middle school ideas.
- Lesson 9: Have students explore the long-term (800,000 years) $CO_2$ data using the Tuva platform.
- Lesson 10: Have students explore the more recent $CO_2$ data using the Tuva platform.
- Lesson 10: Include the uneven distribution of fossil fuel extension in Extension Opportunity: Uneven Distribution of Fossil Fuel Resources, Fossil Fuel Formation Illustrations, and Fossil Fuels Long Ago and Today.
- Lesson 17: Create and include any locally utilized or considered local water or heat solutions to the Water Adaptation Solutions.

## Capstone Unit: Science & Engineering Challenge

*In this mini capstone unit, students have the opportunity to transfer their 3 dimensional learning from the year to a Science & Engineering Challenge. The challenge may be determined as a grade level, class, or individual, and includes an authentic audience component. Examples may include but are not limited to: Science Fair, Rube Goldberg, a hands-on career connected problem/project, etc.*

## Capstone DESIRED RESULTS

**ESSENTIAL QUESTION:** *Students will keep considering...*

- *How do Science cutting concepts and Science & Engineering Practices help explain everyday phenomena about Science Disciplinary Core Ideas ?*

**UNIT PRIORITY STANDARDS:** *Students will know and be able to...*

| *Cross Cutting Concepts* | *Science & Engineering Practices (SEP)* | *Disciplinary Core Idea (DCI)* |
|---|---|---|
| ➔ All | ➔ All | ➔ Dependent on challenge |

## Capstone ASSESSMENT EVIDENCE

*Performance is evaluated in terms of... Students will show their learning by...*

***Performance Task Description:***

- Students will demonstrate their 3 Dimensional learning in multiple ways to an authentic audience which may include creation of design or solution, an oral presentation or defense, portfolio, real world performance task, etc.

***Success Criteria Rubrics***

- Standards-aligned rubrics are used for communicating the success criteria, goal setting, reflecting during & after the unit learning, and feedback.

***Key Feedback & Assessment Strategies:***

- *Conferring/Strategy Groups: Use current evidence of standards & learning targets, feedback is scaffolded based on student strengths, needs, and goals.*
- *Reflection on Science & Engineering Practices, Crosscutting Concepts, Disciplinary Core Ideas, teamwork/collaboration skills, process, and product management skills.*