HAZLETON AREA SCHOOL DISTRICT

SCIENCE CURRICULUM

7TH GRADE

2023

Quarter 1: Biological Sciences

Unit 1: What is Life? & Cell Theory

Standards (Established Goals):
Standard 3.1.6-8.A • Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers of cells contribute to the function. ○ **Clarifying Statement:** Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells. ○ **Assessment Boundary:** N/A

Enduring Understandings	**Essential Questions**
Big Ideas: • All organisms have characteristics structures that enable functions and behaviors that allow them to grow, reproduce, and die. **Crosscutting Concepts:** • Phenomena that can be observed at one scale may not be observable at another scale.	How do the structures of organisms enable life's functions?
The students will know	**Enrichment Standards**
• **Vocabulary:** ◦ Organism, Unicellular, Multicellular, Tissue, Organ **Disciplinary Core Ideas:** • All living things are made up of cells, which are the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular)) or many different ideas (multicellular).	**Science and Engineering** • **Planning and carrying out investigations**: Develop and use a model to describe phenomena.

Unit 2: Parts and Function of Cells

Standards (Established Goals):

Standard 3.1.6-8.B
• Develop and use a model to describe the function of a cell as a whole and the ways that parts of cells contribute to the function.
  ○ **Clarifying Statement:** Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.
  ○ **Assessment Boundary:** Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.
Standard 3.1.6-8.C
• Use arguments for how the body is a system of interacting subsystems composed of groups of cells.
  ○ **Clarifying Statement**: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.
  ○ **Assessment Boundary:** Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.

Enduring Understandings	**Essential Questions**
Big Ideas: • Organisms have characteristic structures that enable functions and behaviors that allow them to grow, reproduce, and die. **Crosscutting Concepts:** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural. structures/systems can be analyzed to determine how they function.	• How do the structure of organisms enable life's functions?

The students will know	Enrichment Standards
• **Vocabulary:** ◦ Osmosis, diffusion, cell membrane, nucleus, mitochondria, cell wall, cytoplasm, Golgi, ribosome, endoplasmic reticulum, organelle, tissue, organ, body systems, types of specialized cells **Disciplinary Core Ideas:** • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions	**Science and Engineering** • **Planning and carrying out investigations:** Develop and use a model to describe phenomena. • **Engaging in Argument from Evidence**: Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon

Unit 3: Cycles of Matter & Flow of Energy

Standards (Established Goals):

Standard: 3.1.6-8.F
• 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.
  ○ **Clarifying Statement:** Emphasis is on tracing movement of matter and flow of energy.
  ○ **Assessment Boundary:** Assessment does not include the biochemical mechanisms of photosynthesis.
Standard 3.1.6-8.G
• Develop a model 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.
  ○ **Clarifying Statement:** Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.
  ○ **Assessment Boundary:** Assessment does not include details of the chemical reactions for photosynthesis or respiration.

Enduring Understandings	**Essential Questions**
Big Ideas: • The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live. **Crosscutting Concepts:** • Energy and Matter Within a natural system, the transfer of energy drives the motion and/or cycling of matter. • Matter is conserved because atoms are conserved in physical and chemical processes.	• How do organisms obtain and use the matter and energy they need to live and grow?
The students will know	**Enrichment Standards**

- **Vocabulary:**
  - Glucose, Energy, CO2, Oxygen, Chloroplast, Stomata, Mitochondria, Chemical Reaction Energy Transformation, Atmosphere, Cellular respiration, Sugar, Conservation of Matter, Cycle
    - Technology and Engineering; inexhaustible, consume, by-product

Disciplinary Core Ideas:

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.
- The chemical reaction by which plants produce complex food within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.
- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary)

Science and Engineering

- **Constructing Explanations and Designing Solutions:** Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that 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.
- **Developing and Using Models:** Develop a model to describe unobservable mechanisms.

Environmental Literacy and Sustainability

- **3.4.6-8A** Develop a model to describe how agriculture and food systems function, including the sustainable use of natural resources and the production, processing, and management of food, fiber, and energy.

Technology and Engineering

- **3.5.6-8D** Analyze how the creation and use of technologies consumes renewable, non-renewable, and inexhaustible resources; creates waste; and may contribute to environmental challenges.

Quarter 2: Biological Sciences

Unit 4: Organization of Matter and Energy Flow in Organizations

Standards (Established Goals):

Standard 3.1.6-8.J
• Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
  ○ **Clarifying Statement:** Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.
  ○ **Assessment Boundary:** N/A
 	
Standard 3.1.6-8.L
• Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
  ○ **Clarifying Statement:** Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.
  ○ **Assessment Boundary:** N/A
 	
Standard 3.1.6-8.T
• Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
  ○ **Clarifying Statement:** : Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.
  ○ **Assessment Boundary:** Assessment does not include Hardy Weinberg calculations

Enduring Understandings	**Essential Questions**
Big Ideas: • Ecosystems are complex systems that include both living (biotic) and non-living (abiotic) components that interact with each other. • As the environment and populations of species change, there are resulting changes in ecosystems. • When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which	• How does the environment influence populations of organisms over multiple generations? • How does a change in environment impact ecosystems?

over many generations can change the make-up of a population. **Crosscutting Concepts:** • Patterns: Patterns can be used to identify cause and effect relationships. • Stability and Change: Small changes in one part of a system might cause large changes in another part. • Cause and Effect: Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability	
The students will know	**Enrichment Standards**
• **Vocabulary:** ◦ symbiotic, parasitism, mutualism, commensalism, competition, predator, prey, camouflage, mimicry, adaptation, natural selection, Resilience, ecosystem, population, environmental disruptors, ◦ Technology and Engineering; systems thinking, relationship, environment. **Disciplinary Core Ideas:** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the	**Science and Engineering** • **Construct Explanations and designing Solutions:** Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. • **Using Mathematics and Computational Thinking:** Use mathematical representations to support scientific conclusions and design solutions. • **Engaging in Argument from Evidence**: Construct an oral and written argument 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. **Environmental Literacy and Sustainability** • **3.4.6-8A** Develop a model to describe how agriculture and food systems function, including the sustainable use of natural resources and the production, processing, and management of food, fiber, and energy. • **3.4.6-8B** Analyze and interpret data about how different societies (economic and social systems) and cultures use and manage natural resources differently. • **3.4.6-8D** Gather, read, and synthesize information from multiple sources to investigate how Pennsylvania environmental issues affect Pennsylvania's human and natural systems. • **3.4.6-8F** Obtain and communicate information on how integrated pest management could improve indoor and outdoor environments.

distribution of traits in a population changes	**Technology and Engineering** • **3.5.6-8FF** Demonstrate how systems thinking involves considering relationships between every part, as well as how the systems interact with the environment in which it is used.

Unit 5: Biomes & Ecosystems

Standards (Established Goals):

Standard 3.1.6-8.I
• Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
  ○ **Clarifying Statement:** Emphasis is on cause-and-effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.
  ○ **Assessment Boundary:** N/A
Standard 3.1.6-8.K
• Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
  1. **Clarifying Statement:** Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.
  2. **Assessment Boundary:** Assessment does not include the use of chemical reactions to describe the processes
Standard 3.1.6-8.U
• Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
  ○ **Clarifying Statement:** : Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.
  ○ **Assessment Boundary:** N/A

Enduring Understandings	Essential Questions
Big Ideas: • Ecosystems are complex systems that include both living (biotic) and non-living (abiotic) components that interact with each other. • The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the physical environment. • Humans depend on biodiversity, the variety of species and ecosystems, for resources. Human actions can impact the diversity of species. **Crosscutting Concepts:** • Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Cause and Effect: Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. • Energy and Matter The transfer of energy can be tracked as energy flows through a natural system. • Stability and Change Small changes in one part of a system might cause large changes in another part.	• How do organisms interact with the living and nonliving environments to obtain matter and energy? • How do matter and energy move through an ecosystem? • How do humans affect biodiversity, and how does it affect humans? Mutually impact?
The students will know	**Enrichment Standards**

- **Vocabulary:**
  - Ecosystem, Abiotic, Biotic, Population, Living, Nonliving, predator, prey, limiting factors competition, habitat, energy diagram (food Web), symbiotic, parasitism, mutualism, commensalism, competition, predator, prey, camouflage, mimicry, adaptation, natural selection, Resilience, ecosystem, population, environmental disruptors, producer, consumer, decomposer/recycler, ecosystem, conservation of matter, Resilience, ecosystem, population, environmental disruptors, biodiversity, design solutions, ecosystem services
  - **Technology and Engineering**; economic social system

Disciplinary Core Ideas:

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
- In any ecosystem, organisms, and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
- Growth of organisms and population increases are limited by access to resources.
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level.
- Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
- 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. (secondary)

Science and Engineering

- **Analyzing and Interpreting Data**: Analyze and interpret data to provide evidence for phenomena.
- **Developing and Using Models**: Develop a model to describe phenomena.
- **Engaging in Argument from Evidence:** Evaluate competing design solutions based on jointly developed and agreed upon design criteria.

Environmental Literacy and Sustainability

- **3.4.6-8B** Analyze and interpret data about how different societies (economic and social systems) and cultures use and manage natural resources differently.
- **3.4.6-8C** Develop a model to describe how watersheds and wetlands function as systems, including the roles and functions they serve.
- **3.4.6-8D** Gather, read, and synthesize information from multiple sources to investigate how Pennsylvania environmental issues affect Pennsylvania's human and natural systems.
- **3.4.6-8E** Collect, analyze, and interpret environmental data to describe a local environment.
- **3.4.6-8G** Obtain and communicate information to describe how best resources management practices and environmental laws are designed to achieve environmental sustainability.
- **3.4.6-8H** Design a solution to an environmental issue in which individuals and societies can engage as stewards of the environment.
- **3.4.6-8I** Construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity.

Technology and Engineering

- **3.5.6-8Z** Analyze how different technological systems often interact with economic, environmental, and social systems.

Quarter 3: Physical Sciences

Unit 6: Forces and Gravity

Standards (Established Goals):

Standard3.2.6-8.G
• Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
  ○ **Clarifying Statement:** Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.
  ○ **Assessment Boundary:** Assessment is limited to vertical or horizontal interactions in one dimension.
 	
Standard 3.2.6-8.H
• Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object
  ○ **Clarifying Statement:** Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.
  ○ **Assessment Boundary:** Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.
 	
Standard 3.2.6-8.L
• Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object.
  ○ **Clarifying Statement:** Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.
  ○ **Assessment Boundary:** N/A

Enduring Understandings	Essential Questions
Big Idea: ● A change in motion of interacting objects can be explained and predicted by forces. ● Energy can be modeled as either motions of particles or as being stored in force fields. **Crosscutting Concepts**: • Systems and System Models; models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. • Stability and Change; Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. • **Scale, Proportion, and Quantity** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes**.**	● How can one predict an object's continued motion, changes in motion, or stability? ● What is Energy?
The students will know	**Enrichment Standards**
● **Vocabulary:** ○ Force, net force, balanced, unbalanced, Newton's 1st law, Newton's 2nd law, Newton's 3rd law, reference point, mass, acceleration, motion, Speed, Velocity, Acceleration, Kinetic Energy, Mass **Disciplinary Core Ideas**: • 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 opposite direction (Newton's third law) • The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion	**Science and Engineering Practices** ● **Constructing Explanations and Designing Solutions –** Apply scientific ideas or principles to design an object, tool, process or system. ● **Planning and Carrying Out Investigations** Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. ● Analyzing and Interpreting Data Construct and interpret graphical displays of data to identify linear and nonlinear relationships.

will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.	

Unit 7 & 8: Types of Interaction (Motion and Newton's Laws)

Standards (Established Goals):

Standard 3.2.6-8.I
• Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
  ○ **Clarifying Statement:** Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.
  ○ **Assessment Boundary:** Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.
Standard 3.2.6-8.J
• Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
  ○ **Clarifying Statement**: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.
  ○ **Assessment Boundary:** Assessment does not include Newton's Law of Gravitation or Kepler's Laws.
Standard 3.2.6-8.K
• Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
  ○ **Clarifying Statement:** Examples of this phenomenon could include the interactions of magnets, electrically charged strips of tape, and electrically charged pith balls. Examples of investigations could include first-hand experiences or simulations.
  ○ **Assessment Boundary**: Assessment is limited to electric and magnetic fields and limited to qualitative evidence for the existence of fields.

Enduring Understandings	Essential Questions
Big Idea: • All forces between objects, regardless of size or direction, arise from only a few types of interactions. **Crosscutting Concepts**: • Systems and System Models; models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. • Cause and effect relationships may be used to predict phenomena in natural or designed systems.	• What underlying forces explain the variety of interactions observed?
The students will know	**Enrichment Standards**
• **Vocabulary**: ○ Magnetic force, electric current, electromagnetic gravitational forces, law of universal gravity, mass, weight, electric force, gravitational **Disciplinary Core Ideas**: • Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. • Gravitational forces are always attractive. There is a gravitation force between any two masses, but it is very small except when one or both objects have larger mass - e.g, Earth, and the sun. • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).	**Science and Engineering Practices** • **Asking Questions and Defining Problem - A**sk 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. • **Engaging in Argument from Evidence** - construct 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. • **Planning and Carrying Out Investigations -** Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can serve as the basis for evidence that can meet the goals of the investigation.

Unit 9: Technology and Engineering

Standards (Established Goals):

Standard 3.5.6-8KK
• Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations.
  ○ **Clarifying Statement:** Creativity requires an individual to use knowledge and experience from different subjects to create something new or to use something in a new way. Many inventions are inspired by perceived needs and wants—the toothbrush, for example. At other times, inventions emerge in unexpected ways. For example, Stephanie Kwolek was working to find a replacement for steel cords in tires when she inadvertently invented Kevlar. Creatively exploring new ideas is often key to improvement of technological products and systems.
  ○ **Assessment Boundary:** N/A
Standard 3.5.6-8LL
• Compare how different technologies involve different sets of processes.
  ○ **Clarifying Statement**: For example, data processing includes designing, summarizing, storing, retrieving, reproducing, evaluating, and communicating information. The processes of construction include designing, developing, evaluating, making and producing, marketing, and managing.
  ○ **Assessment Boundary:** N/A
Standard 3.5.6-8I
• Examine the ways that technology can have both positive and negative effects at the same time.
  ○ **Clarifying Statement**: The form and function of technologies are shaped by the criteria considered when the technology is developed. Even beneficial and well-intentioned solutions can have negative impacts. For example, flush toilets led to improved health and hygiene; at the same time, they created a need for water treatment strategies that consume large amounts of energy and fresh water. This type of example provides students an opportunity to consider the importance of design criteria.
  ○ **Assessment Boundary**: N/A
Standard 3.5.6-8C
• Hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected.
  ○ **Clarifying Statement**: Skill development typically starts with guided instruction, and many tasks require following a specific sequence of steps.
  ○ **Assessment Boundary**: N/A
Standard 3.5.6-8G
• Analyze how an invention or innovation was influenced by the context and circumstances in which it is developed.
  ○ **Clarifying Statement:** Students can begin to explore more fully the idea of intended, unintended, positive, and negative outcomes inherent in technologies. Students at this age learn how their own lives have been impacted through technology and how technological processes generate undesirable waste and emissions.
  ○ **Assessment Boundary:** N/A
Standard 3.5.6-8AA
• Adapt and apply an existing product, system, or process to solve a problem in a different setting.
  ○ **Clarifying Statement:** Technology transfer is a creative way for people to address needs and wants. For instance, an automated pump based on biology laboratory designs was created for the Mars Viking space probe. The pump was modified for use as an insulin delivery mechanism, providing patients with a way to automatically regulate blood sugar. In classrooms, this concept is often already implicitly achieved as students apply existing technologies in novel ways. An example that may be highlighted is the use of a microcontroller to solve a design problem.

- **Assessment Boundary:** N/A

Standard 3.5.6-8U

- Evaluate and assess the strengths and weaknesses of various design solutions given established principles and elements of design.
  - **Clarifying Statement:** Students assess quality in designs based in part upon the principles and elements of design. With teacher guidance, students in this grade band can articulate reasons why they believe some designs are more effective than others.
  - **Assessment Boundary:** N/A

Standard 3.5.6-8V

- Refine design solutions to address criteria and constraints.
  - **Clarifying Statement:** Students design within provided criteria and constraints and recognize trade-offs associated with optimization.
  - **Assessment Boundary:** N/A

Standard 3.5.6-8O

- Interpret the accuracy of information collected.
  - **Clarifying Statement:** : Developing specific criteria for what information is useful is important in making these judgments. Sometimes determining accuracy is easy—taking information from physical measuring devices like a water- purity tester, for example. At other times, accuracy is more difficult to determine, as when assessments are based on public opinion, which can differ greatly from group to group.
  - **Assessment Boundary:** N/A

Enduring Understandings	**Essential Questions**
Big Idea: • The study of technology and engineering requires knowledge of the natural world and the human-made world. • The study of technology and engineering as a human activity is interdisciplinary. • Technology and engineering have both positive and negative impacts on society and the environment. • The needs and wants of society often shape technology and engineering developments. • Technological knowledge and practices advance – and are advanced by – other fields. • Design optimization is driven by criteria and constraints. • People should gather, synthesize, and analyze information before drawing conclusions when assessing a technological product, system, or process.	• Why is it important to have an understanding of the natural and human-made worlds? • How does the interdisciplinary nature of technology and engineering influence human activity. • How can one assess the impact of technology and engineering on society? • How does technology and engineering address the needs and wants of society? • How do advancements from one field impact another? • How do criteria and constraints drive design? • How can information be used to evaluate technological products, systems, and processes

The students will know	Enrichment Standards
• **Vocabulary**: Engineering, creativity, natural-world, human-made, innovation, evaluate, beneficial, solution, positive impact, negative impact, hypothesize, positive outcome, negative outcome, need, want, invention, innovation, adapt, advancement, design principle, design element, evaluate, strength, weakness, design solution, articulate, effectiveness, criteria, constraint, optimize, criteria, accuracy, precision, judgment. **Disciplinary Core Ideas**: • Technology advances through the processes of innovation and invention. Sometimes a technology developed for one purpose is adapted to serve other purposes. • Describe and analyze positive and negative impacts on society from the introduction of a new or improved technology, including both expected and unanticipated effects. • Use a digital model of a system to conduct a simulation. Explain how changes in the model result in different outcomes. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. • 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. • 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 these characteristics may be incorporated into the new design. • Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. • Students evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources. • Critically read scientific texts adapted for classroom use to	**Science, Technology and Engineering Practices** • **Obtaining, Evaluating, and Communicating Information** Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • **Creativity** Defends technological decisions based on evidence. • **Making and Doing** Exhibits safe, effective ways of producing technological products, systems, and processes • **Systems Thinking** Uses the systems model to show how parts of technological systems work together. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • **Attention to Ethics** Shows an understanding of ways to regulate technologies and the reasons for doing so. Shows an understanding of ways to regulate technologies and the reasons for doing so. • **Engaging in Argument From Evidence** Construct, use, and/or present an oral and written argument 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. 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. • **Constructing Explanations and Designing Solutions** Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • **Optimism** Critiques technological products and systems to identify areas of improvement. • **Asking Questions and Defining Problems** Define a design problem that can be solved through the development of an object, tool, process or

determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).	system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. • **Analyzing and Interpreting Data** Analyze and interpret data to determine similarities and differences in findings. • **Communicate** Exhibits effective technical writing, graphic, and oral communication abilities.

Quarter 4: Physical Sciences

Unit 10: Conservation of Energy and Energy Transfer

Standards (Established Goals):

Standard 3.2.6-8.M

- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
  - **Clarifying Statement:** Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.
  - **Assessment Boundary:** Assessment does not include calculating the total amount of thermal energy transferred.

Standard 3.2.6-8.N

- Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
  - **Clarifying Statement:** Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.
  - **Assessment Boundary**: Assessment does not include calculating the total amount of thermal energy transfer.

Standard 3.2.6-8.O

- Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
  - **Clarifying Statement:** Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.
  - **Assessment Boundary:** Assessment does not include calculations of energy.

Standard 3.2.6-8P

- Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
  - **Clarifying Statement:** Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at

varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.

- **Assessment Boundary:** Assessment is limited to two objects and electric, magnetic, and gravitational interactions.

Enduring Understandings	**Essential Questions**
Big Idea: ● The total change of energy in any system is always equal to the total energy transferred into or out of the system. ● Forces between objects can result in transfer of energy between these objects. **Crosscutting Concepts** ● **Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. ● **Scale, Proportion, and Quantity** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. ● **Systems and System Models;** Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.	● What is meant by conservation of energy? ● How is energy transferred between objects or systems? ● How are forces related to energy?
The students will know	**Enrichment Standards**
● **Vocabulary:** ○ Thermal energy, temperature, heat conductivity, energy transfer, kinetic energy, Potential Energy, Electrical Force, Magnetic, Gravitational Force **Disciplinary Core Ideas:** ● Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy	**Science and Engineering Practices** ● **Constructing Explanations and Designing Solutions**; Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. ● **Planning and Carrying Out Investigations**; Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how

of a system depends on the types, states, and amounts of matter present. ● Energy is spontaneously transferred out of hotter regions or objects and into colder ones. ● The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. ● A system of objects may also contain stored (potential) energy, depending on their relative positions. ● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	measurements will be recorded, and how many data are needed to support a claim. ● **Developing and Using Models;** support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. ● **Developing and using models;** develop a model to describe unobservable mechanisms.

Unit 11: Sound, Light, and Communication Waves

Standards (Established Goals):

Standard 3.2.6-8.Q
• Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
  ○ **Clarifying Statement:** Emphasis is on describing waves with both qualitative and quantitative thinking.
  ○ **Assessment Boundary**: Assessment does not include electromagnetic waves and is limited to standard repeating waves.
 	
Standard 3.2.6-8.R
• Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.
  ○ **Clarifying Statement:** Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.
  ○ **Assessment Boundary:** Assessment is limited to qualitative applications pertaining to light and mechanical waves.
 	
Standard 3.2.6-8.S
• Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
  ○ **Clarifying Statement:** Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.
  ○ **Assessment Boundary:** Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device

Enduring Understandings	**Essential Questions**
Big Ideas: ● Waves are repeating patterns of motion that transfer energy and information without transferring matter. ● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave pattern of changing electric and magnetic fields that interact with matter. ● Useful modern technologies and instruments have been designed based on an understanding of waves and their interactions with matter. **Crosscutting Concepts** ● **Patterns** Graphs and charts can be used to identify patterns in data.	● What are the characteristic properties and behaviors of waves? ● What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there? ● How are instruments that transmit and detect waves used to extend human senses?

• **Structure and Function** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. • **Structure and Function;** Structures can be designed to serve particular functions.	
The students will know	**Enrichment Standards**
• **Vocabulary:** ○ Amplitude, frequency, crest. Trough, wavelength, frequency, color, light, reflection, transmission, absorption, waves, transmission **Disciplinary Core Ideas** • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. • A sound wave needs a medium through which it is transmitted. • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. • A wave model of light is useful for explaining brightness, color, and the frequency dependent bending of light at a surface between media. • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. • Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	**Science and Engineering Practices** • **Using Mathematics and Computational** Thinking Use mathematical representations to describe and/or support scientific conclusions and design solutions. • **Developing and Using Models**; Develop and use a model to describe phenomena. • **Information Technologies and Instrumentation** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information