Allamuchy Township School District
Allamuchy, NJ

Course Title
7th Grade Science

CURRICULUM GUIDE
FINAL DRAFT

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This curriculum may be modified through varying techniques, strategies and materials, as per an individual student's Individualized Education Plan (IEP).

Approved by the Allamuchy Board of Education
At the regular meeting held on
And
Aligned with the New Jersey Core Curriculum Content Standards
And Common Core Content Standards

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Philosophy and Rationale

The Allamuchy Township School Grade 6-8 Science Curriculum is based on the Next Generation Science Standards. The standards are broken down into 4 main sections. Middle School Life Science, Middle School Earth and Space Science, Middle School Physical Science, and Middle School Engineering Design.
The purpose of scientific study is to understand the world in which we live. We believe in inquiry based learning, exploring and discovering using tools, technology and text. Students are encouraged to be curious and inquisitive in a multi-sensory, material-rich environment. Students learn science by exploring and discovering; using tools, technology, and media; asking questions/making connections; communicating what they know; taking risks and being creative; networking with the community; and utilizing community resources. The science and engineering practices that the NGSS are based on include developing and using models, analyzing and interpreting data, constructing explanations and designing solutions and engaging in argument from evidence.

Mission Statement

The mission of the Allamuchy Township District, in partnership with the larger community, is to provide a comprehensive, caring program for all of our students which:

*Nurtures the unique talents and interests of each individual
*Supports social responsibility and a love of learning
*Embraces the total development of each student intellectually, morally and physically
*Develops confidence, creativity and skills necessary to face the challenges of a technologically advanced and ever-changing society
*Promotes a culture of mutual respect with all other community members
*Supports the attainment of the New Jersey Core Curriculum Content Standards

The District seeks to exceed objective standards of achievement set by both the State and Federal government and to provide an educational experience beyond the boundaries established by the Core Curriculum Standards.

Unit 1 Structure and Properties of Matter

Scope and Sequence
Time: Approximately 23 days

In this unit of study students build understandings of what occurs at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They also provide a molecular level accounts to explain states of matter and changes between states.
Corresponds to Module J in textbook

Stage 1: Desired Results

Content Standards
MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.
MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Essential Questions
How is it that everything is made of stardust?

Enduring Understandings

- Substances are made from different types of atom. Atoms are the basic units of matter.
- Substances combine with one another in various ways. Molecules are two or more atoms joined together.
- Atoms from molecules that range in size from two to thousands of atoms. Molecules can be simple or very complex.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g. crystals).
- Each pure substance has characteristics physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Substances react chemically in characteristic ways.
- In a chemical process, the atoms that make up the original substances are regrouped into different molecules; these new substances have different properties from those of the reactants.
- The analysis of data on the properties of products and reactants can be used to determine whether a chemical process has occurred.
- Density, melting point, boiling point, solubility, flammability, and odor are characteristic properties that can be used to identify a pure substance.
- Macroscopic patterns are related to the nature of the atomic-level structure of a substance.

Knowledge and Skills (SWBAT embedded course proficiencies)
Students who understand the concepts are able to:

- Develop a model of a simple molecule.
- Use the model of the simple molecule to describe its atomic composition.
- Develop a model of an extended structure.
- Use a model of the extended structure to describe its repeating subunits.
- Analyze and interpret data to determine similarities and differences from results of chemical reactions between substances before and after they undergo a chemical process.

- Analyze and interpret data on the properties of substances before and after they undergo a chemical process.
- Identify and describe possible correlation and causation relationships evidenced in chemical reactions.
- Make logical and conceptual connections between evidence that chemical reactions have occurred and explanations of the properties of substances before and after they undergo a chemical process.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan

Within this unit, students will use informational text and models (which can include student-generated drawings, 3-D ball-and-stick structures, or computer representations) to understand that matter is composed of atoms and molecules. These models should reflect that substances are made from different types of atoms. Student models can be manipulated to show that molecules can be disassembled into their various atoms and reassembled into new substances according to chemical reactions. This scientific knowledge can be used to explain the properties of substances. Students will examine and differentiate between physical and chemical properties of matter. They are limited to the analysis of the following characteristic properties: density, melting point, boiling point, solubility, flammability, and odor. This analysis of properties serves as evidence to support that chemical reactions of substances cause a rearrangement of atoms to form different molecules.

Students will also recognize that they are using models to observe phenomena too small to be seen. Students who demonstrate this understanding can develop or modify a model of simple molecules to describe the molecules' atomic composition. Examples of molecules that can be modeled include water, oxygen, carbon dioxide, ammonia, and methanol. Additionally, students will develop and modify a model that describes the atomic composition of an extended structure showing a pattern of repeating subunits. Examples may include sodium chloride and diamonds. Due to the repeating subunit patterns, models can include student-generated drawings, 3-D ball-and-stick structures, and computer representations.

Building upon these experiences, students will analyze and interpret data on the properties of substances in order to provide evidence that a chemical reaction has occurred. They will also analyze and interpret data to determine similarities and differences in findings. Students will recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They will use patterns to identify cause-and-effect relationships and graphs and charts to identify patterns in data.

Suggested Activity: Make a model of a simple molecule and complex molecule. Examples include 3D ball or stick structure.; Do an experiment with a reaction to determine if it is a chemical reaction. Examples include burning sugar or rusting steel wool.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Cite specific textual evidence to support analysis of science and technical texts on the characteristic properties of pure substances. Attend to precise details of explanations or descriptions about the properties of substances before and after they undergo a chemical process.
- Integrate qualitative information (flowcharts, diagrams, models, graphs, or tables) about the characteristic properties of substances before and after a chemical process has occurred with a version of that information expressed visually, or integrated technical information about the characteristic properties of substances before and after a chemical process has occurred with a version of that information expressed visually.

Mathematics

- Integrate quantitative or technical information about the composition of simple molecules and extended structures that is expressed in words in a text with a version of that information expressed in a model.
- Reason quantitatively (with amounts, numbers, sizes) and abstractly (with variables).
- Develop a mathematical model to describe the atomic composition of simple molecules and extended structures.
- Use ratio and rate reasoning to describe the atomic composition of simple molecules and extended structures.
- Reason quantitatively with amounts, numbers, and sizes for properties like density, melting point, boiling point, solubility, flammability, and odor and reason abstractly by assigning labels or symbols.
- Display numerical data for properties such as density, melting point, solubility, flammability, and order in plots on a number line, including dot plots, histograms, and box plots.
- Summarize numerical data sets on the properties of substances before and after the substances interact to determine whether a chemical reaction has occurred. The summary of the numerical data sets must be in relation to their context.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

Unit 2- Interactions of Matter

Scope and Sequence
Time: Approximately 23 days

In this unit of study, students build understandings of what occur at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from single type of atom or molecule. They also provide a molecular level accounts to explain states of matter and changes between states.

Corresponds to Module J in textbook

Stage 1: Desired Results

Content Standards
MS-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-PS1-4: Develop a model that predicts and describe changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Essential Questions
How can we trace synthetic materials back to natural ingredients?

Enduring Understandings
- Changes in particle motion, temperature, and state of a pure substance occur when thermal energy is added or removed.
- Qualitative molecular-level models of solids, liquids, and gases can be used to show that adding or removing thermal energy increases or decreases the kinetic energy of the particles until a change of state occurs.
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others.
- In a gas, the molecules are widely spaced except when they happen to collide.
- In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using models of matter.
- The term heat as used in everyday language refers both to thermal energy and the transfer of that thermal energy from one object to another.
- Thermal energy is the motion of atoms or molecules within a substance.
- In science, heat is used to refer to the energy transferred due to the temperature differences between two objects.
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material).
- The details of the relationship between the average internal kinetic energy and the potential energy per atom or molecule depend on the type of atom or molecule and the interactions among the atoms in the material.
- Temperature is not a direct measure of a system's total thermal energy.
- The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.

- Cause-and-effect relationships may be used to predict and describe changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural systems.
- Each pure substance has characteristic physical and chemical properties that can be used to identify it.
- Substances react chemically in characteristic ways.
- In a chemical process, the atoms that make up the original substances are regrouped into different molecules.
- New substances that result from chemical processes have different properties from those of the reactants.
- Natural resources can undergo a chemical process to form synthetic material.
- Structures can be designed to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.
- Engineering advances have led to discoveries of important synthetic materials, and scientific discoveries have led to the development of entire industries and engineered systems using these materials.
- Technology use varies from region to region and over time.
- The uses of technologies (engineered/synthetic materials) and any limitations on their use are driven by individual or societal needs, desires, and values.
- The uses of technologies and any limitations on their uses are driven by findings of scientific research and by differences in such factors as climate, natural resources, and economic conditions.

Knowledge and Skills (SWBAT embedded course proficiencies)

Students who understand the concepts are able to:

- Develop a model that predicts and describes changes in particle motion that could include molecules or inert atoms or pure substances.
- Use cause-and-effect relationships to predict changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural or designed systems.
- Obtain, evaluate, and communicate information to show that synthetic materials comes from natural resources and affect society.
- Gather, read, and synthesize information about how synthetic materials formed from natural resources affect society.
- Assess the credibility, accuracy, and possible bias of each publication and methods used within the publication.
- Describe how information about how synthetic materials formed from natural resources affect society is supported or not supported by evidence.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan

Students will locate information that describes changes in particle motion, changes in temperature, or changes in state as thermal energy is added to or removed from a pure substance. Students will then use models to predict and describe the changes in particle motion, temperature, and state of a pure substance. An example could include the change of state of water from its solid (ice) to liquid and vapor with the addition of thermal energy. Students will come to understand that this process is reversible through the removal of thermal energy, where the pure substance can return from a vapor to a liquid and back to a solid state.

Students who accurately demonstrate understanding will be able to develop qualitative molecular-level models of solids, liquids, and gases to show the cause-and- effect relationships of adding or removing thermal energy, which increases or decreases the kinetic energy of the particles until a change of state occurs. Models could include drawings and diagrams.

Students will also need to use mathematics to demonstrate their understanding of the particle motion that is taking place during these changes in state. They will use positive and negative numbers to represent the changes in particle motion and temperature as thermal energy is added or removed. They will then integrate an expression of that same quantitative information in a visual format.

It is important to note that students will need to be responsible for developing the models that they use. It is possible that the teacher could model the process with one type of model and provide opportunities for students to use different types of model to illustrate the same process. After students have a firm understanding of the motion of particles during a phase change, they will be able to move to the next section of this unit. In this portion of the unit of study, students will apply their understanding of particle and chemical change from Unit 1 to make sense of how natural resources react chemically to produce new substances. Students will explain that as a result of the rearrangement of atoms during a chemical process, the synthetic substance has different characteristic properties than the original pure substance. For example, pure substances like methane, carbon monoxide, and carbon dioxide can be combined chemically to form synthetic fuel. The synthetic fuel would have different characteristic properties than the original pure substances.

Within this unit, students will gather, read, and synthesize qualitative information from multiple sources about the use of natural resources to form synthetic materials and how these new materials affect society. Examples of new materials could include new medicine, foods, and alternative fuels. Some sources could include journals, articles, brochures, or digital media from government publications and/or private industries. Students will cite some of these sources to support the analysis of evidence that these synthetic materials were formed from natural resources and have an impact on society. They will pay special attention to the precise details of explanations or descriptions of how these new substances affect society. Students will also include relevant information from multiple print and digital sources about these impacts. While gathering this information, they will use search terms effectively, assess the credibility and accuracy of each source, and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

Suggested Activity: Discuss man made materials and why they are important to the world. Example: Lecture on a new drug or new fuel source.; Do an experiment to show that heat energy can change substances. Example: An experiment where water goes through solid, liquid, or gas by adding heat.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Cite specific text to support the analysis of evidence that synthetic materials formed from natural resources affect society. Attend to the precise details of explanations or descriptions.
- Gather relevant information from multiple print and digital sources about the impact on society of synthetic materials that are formed from natural resources. Use search terms effectively, assess the credibility and accuracy of each source, and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

Mathematics

- Integrate quantitative information about changes in particle motion, temperature, and state of pure substance when thermal energy is added or removed that is expressed in words with a version of that information that is expressed visually.
- Understand that positive and negative numbers are used together to describe quantities having opposite directions or values. Use positive and negative numbers to represent changes in particle motion and temperature when thermal energy is added or removed, explaining the meaning of zero in each situation.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

Unit 3 -Chemical Reactions

Scope and Sequence
Time: Approximately 28 days

In this unit of study, students provide molecular level accounts of states of matters and changes between states, of how chemical reactions involve regrouping of atoms to form new substances, and of how atoms rearrange during chemical reactions. Students also apply their understanding of optimization design and process in engineering to chemical reaction systems.

Corresponds to Module J in textbook

Stage 1: Desired Results

Content Standards
MS-PS1-5: Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-PS1-6: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
MS-ETS1-3: 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.

Essential Questions
How do substances combine or change (react) to make new substances?

Enduring Understandings
- Substances react chemically in characteristic ways.
- In a chemical process, the atoms that make up the original substances are regrouped into different molecules.
- New substances created in a chemical process have different properties for those of the reactants.
- The total number of each type of atom is a chemical process is conserved, and thus the mass does not change (the law of conservation of matter).
- Matter is conserved because atoms are conserved in physical and chemical processes.
- The law of conservation of mass is a mathematical description of natural phenomena.
- Some chemical reactions release energy, while others store energy.
- The transfer of thermal energy can be tracked as energy flows through a designed or natural system.
- Models of all kinds are important for testing solutions.
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- 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.
- A solution needs to be tested and then modified on the basis of the test results in order for it to be improved.
- 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.
- Some of the characteristics identified as having the best performance may be incorporated into the new design.

Knowledge and Skills (SWBAT embedded course proficiencies)

Students who understand the concepts are able to:

- Use physical models or drawings, including digital forms, to represent atoms in a chemical process.
- Use mathematical descriptions to show that the number of atoms before and after a chemical process is the same.
- Undertake a design project, engaging in the design cycle, to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
- Specific criteria are limited to amount, time, and temperature of a substance.
- Analyze and interpret data for the amount, time, and temperature of a substance in testing a device that either releases or absorbs thermal energy by chemical processes to determine similarities and differences in findings.
- Develop a model to generate data for testing a device that either releases or absorbs thermal energy by chemical processes, including those representing inputs and outputs of thermal energy.
- Track the transfer of thermal energy as energy flows through a designed system that either releases or absorbs thermal energy by chemical processes.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations

Benchmarks (embedded student proficiencies)

Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan

Students begin by gaining understanding that substances react chemically in very characteristic ways. To develop this understanding, students will follow precisely a multistep procedure when carrying out experiments that involve chemical reactions that release energy and chemical reactions that absorb energy. As part of their data analysis, students will integrate quantitative information about atoms before and after the chemical reaction. The analysis will include translating written information into information that is expressed in a physical model or drawing or in digital forms. Reasoning both quantitatively and abstractly to communicate their understanding of these reactions, students will model the law of conservation of matter.

They will use ratio and rate to demonstrate that the total number of atoms involved in the chemical reactions does not change and therefore mass is conserved. Within this unit, students will develop a model of the reactions they observe to describe how the total number of atoms does not change in a chemical reaction. Examples of models could include physical models, drawings, or digital forms that represent atoms. Student models ideally should have the ability to be manipulated to represent the rearrangement of reactants to products as a way to demonstrate that matter is conserved during chemical processes. Students will show how their model provides evidence that the law of conservation of matter is a mathematical description of what happens in nature.

In prior units of study, students have learned about the behavior of particles of matter during a change of state and about characteristic chemical and physical properties of matter. This unit will leverage that prior learning by having students undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. For example, students could design a device that releases heat in a way similar to how heat is released when powdered laundry detergent is mixed with water to form a paste. Students will need to be able to track energy transfer as heat energy is either released to the environment or absorbed from the environment. Students could also design a device that absorbs and stores heat from the environment.

The design problem has already been identified; therefore, the emphasis is on designing the device, controlling the transfer of energy to the environment, and modifying the device according to factors such as type and concentration of substance. The criteria for a successful design have not been determined; therefore, teachers will need to work with students to determine criteria for a successful design. Before attempting to determine criteria, students will conduct a short research project to familiarize themselves with scientific information they can use when designing the device. Students must draw on several sources and generate additional focused questions that allow for further avenues of exploration.

After completing their research, students will compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from their reading about the design of the device. Students, with the support of the teacher, will then write design criteria.

Students are now at a point where they can begin the design process. Prior to construction, students should develop a probability model and use it as part of the process for testing their device. They will use the probability model to determine which designs have the greatest probability of success.

It is important that students use mathematics appropriately when analyzing their test results. They must apply properties of operations to calculate numerical data with numbers in any form, convert between forms as appropriate, and assess the reasonableness of answers using mental computations and estimation strategies.

Students will collect and analyze these numerical data 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.

Suggested Activity: Do an experiment on the law of conservation of matter. Example: Experiment where you weigh the materials before and after the chemical reaction.; Do an experiment where you heat up or cool down a substance by a reaction. Example: An experiment dissolving ammonium chloride in water.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing tasks related to chemical reactions that release energy and some that store energy.
- Cite specific textual evidence to support analysis of science and technical texts on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance.
- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance.
- Conduct research on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance to answer questions (including a self-generated questions), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- Draw evidence from informational texts to support analysis, reflection, and research on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance.
- Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points on the design and modification of a device that controls the transfer of energy to the environment.

Mathematics

- Integrate quantitative information expressed in words about atoms before and after a chemical process with a version of that information expressed in a physical model or drawing, including digital forms.
- Reason quantitatively and abstractly during communication about melting and boiling points.
- Use mathematics to model the law of conservations of matter.
- Use ratio and rate reasoning to describe how the total number of atoms does not change in a chemical reaction, and thus mass is conserved.
- Reason quantitatively and abstractly: Reason quantitatively using numbers to represent the criteria (amount, time, and temperature of substance) when testing a device that either releases or absorbs thermal energy by chemical process; reason abstractly by assigning labels or symbols.

- Collect and analyze numerical data from tests of a device that either releases or absorbs thermal energy by chemical processes. 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. Pose problems with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate the numerical data with numbers in any form, convert between forms as appropriate, and assess the reasonableness of answers using mental computations and estimation strategies.
- Develop a probability model and use it as part of an interactive process for testing to find the probability that a promising design solution will lead to an optimal solution. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy in order to ultimately develop an optimal design.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

Unit 4 - Structure and Function

Scope and Sequence
Time: Approximately 18 days

In this unit of study, students demonstrate age appropriate abilities to plan and carry out investigations to develop evidence that living organisms are made of cells. Students gather information to support explanations of the relationship between structure and function in cells. They are able to communicate an understanding of cell theory and understand that all organisms are made of cells. Students understand that special structures are responsible for particular functions in organisms. They then are able to use their understanding of cell theory to develop and use physical and conceptual models of cells.

Corresponds to Module B in textbook

Stage 1: Desired Results

Content Standards
MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Essential Questions
How do cells contribute to the functioning of an organism?

Enduring Understandings
- Distinguish between living and nonliving things.
- Cells are the smallest unit of life that can be said to be alive.
- All living things are made up of cells, either one cell or many different numbers and types of cells.
- Organisms may consist of one single cell (unicellular).
- Nonliving things can be composed of cells.
- Organisms may consist of many different numbers and types of cells (multicellular).
- Cells that can be observed at one scale may not be observable at another scale.
- Engineering advances have led to important discoveries in the field of cell biology, and scientific discoveries have led to the development of entire industries and engineered systems.
- The cell functions as a whole system.
- Identify parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.
- Within cells, the cell membrane forms the boundary that controls what enters and leaves the cell.
- Complex and microscopic structures and systems in cells can be visualized, modeled, and used to describe how the function of the cell depends on the relationships among its parts.
- Complex natural structures/systems can be analyzed to determine how they function.
- A model can be used to describe the function of a cell as a whole.
- A model can be used to describe how parts of cells contribute to the cell's function.
- The structure of the cell wall and cell membrane are related to their function.

Knowledge and Skills (SWBAT embedded course proficiencies)
Students who understand the concepts are able to:

- Conduct an investigation to produce data that provides evidence distinguishing between living and nonliving things.
- Conduct an investigation to produce data supporting the concept that living things may be made of one cell or many and varied cells.
- Distinguish between living and nonliving things.
- Observe different types of cells that can be found in the makeup of living things.
- Develop and use a model to describe the function of a cell as a whole.
- Develop and use a model to describe how parts of cells contribute to the cell's function.
- Develop and use models to describe the relationship between the structure and function of the cell wall and cell membrane.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations
Benchmarks (embedded student proficiencies)
Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan
This unit of study begins with students distinguishing between living and nonliving things. Students will conduct investigations examining both living and nonliving things and using the data they collect as evidence for making this distinction. During this investigation, students will study living things that are made of cells, either one cell or many different numbers and types of cells.
Students will also study nonliving things, some of which are made up of cells. Students will understand that life is a quality that distinguishes living things—composed of living cells—from once-living things that have died or things that never lived. Emphasis is on students beginning to understand the cell theory by developing evidence that living things are made of cells, distinguishing between living and nonliving things, and understanding that living things may be made of one cell or many and varied cells.
Students will pose a question drawn from their investigations and draw on several sources to generate additional related, focused questions that allow for multiple avenues of exploration. They will conduct a short research project to collect evidence to develop and support their answers to the questions they generate. The report created from their research will integrate multimedia and visual displays of cells and specific cell parts into a presentation that will clarify the answers to their questions. Students will include in their reports variables representing two quantities, such as the number of cells that makes up an organism and units representing the size or type of the organism, and their conclusion about the relationship between these two variables. They will write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Students will analyze the relationship between the dependent and independent variables using graphs and tables and relate the graphs and tables to the equation.
As a continuation of their study of the cell, students will study the structure of the cell. This study begins with thinking of the cell as a system that is made up of parts, each of which has a function that contributes to the overall function of the cell. Students will learn that within cells, special structures—such as the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall—are responsible for particular functions. It is important to remember that students are required only to study the functions of these organelles in terms of how they contribute to the overall function of the cell, not in terms of their biochemical functions.
As part of their learning about the structure of the cell, students use models as a way of visualizing and representing structures that are microscopic. Students will develop and use a model to describe the function of the cell as a whole and the ways parts of the cell contribute to the cell's function. Models can be made of a variety of materials, including student-generated drawings, digital representations, or 3-D structures.

Students will examine the structure and function relationship of the cell membrane and the cell wall. They will learn that the structure of the cell membrane makes it possible for it to form the boundary that controls what enters and leaves the cell. They will also learn that the structure of the cell wall makes it possible for it to serve its function. This study of the relationship between structure and function will be limited to the cell wall and cell membrane. Students will use variables to represent two quantities that describe some attribute of at least one structure of the cell—for example, how the surface area of a cell changes in relation to a change in the volume cell's volume. Students will write an equation to express the dependent variable in terms of the independent variable, and they will analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation.

Suggested Activity: Make a model showing different parts of a cell. Example: Make a 3D model using a styrofoam ball that shows each part of the cell.; Do an experiment showing that all living things have cells. Example: an experiment showing a plant cell from a blade of grass.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Conduct a short research project collecting evidence that living things are made of cells to answer a questions (including a self-generated question). Draw on several sources and generate additional related, focused questions that allow for multiple avenues of exploration.
- Integrate multimedia and visual displays of cells and specific cell parts into presentations to clarify information, strengthen claims and evidence, and add interest.

Mathematics

- Use variables to represent two quantities, such as the number of cells that makes up an organism and units representing the size or type of the organism, and determine the relationship between these two variables.
- Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
- Use variables to represent two quantities in a real-world problem that change in relationship to one another - for example, determining the ratio of a cell's surface area to its volume. Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

<u>Unit 5 - Body System</u>

<u>Scope and Sequence</u>
<u>Time:</u> Approximately 18 days

In this unit of study, students develop a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organisms. Students will construct explanations for the interactions of systems in cells and organisms. Students understand that special structures are responsible for particular functions in organisms for the interactions of systems in cells and organisms and for how organisms gather and use information from the environment.

Corresponds to Module B in textbook

<u>Stage 1: Desired Results</u>

<u>Content Standards</u>
<u>MS-LS1-3:</u> Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
<u>MS-LS1-8:</u> Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

<u>Essential Questions</u>
What are humans made of?

<u>Enduring Understandings</u>
- In multicellular organisms, the body is a system of multiple, interacting subsystems.
- Subsystems are groups of tissues that work together to form tissues.
- Organs are groups of tissues that work together to perform a particular body function.
- Tissues and organs are specialized for particular body functions.
- Systems may interact with other systems.
- Systems may have subsystems and be part of larger complex systems.
- Interactions are limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.
- Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.
- Sense receptors respond to different inputs (electromagnetic, mechanical, chemical).
- Sense receptors transmit responses as signals that travel along nerve cells to the brain.
- Signals are then processed in the brain.
- Brain processing results in immediate behaviors or memories.
- Cause-and-effect relationships may be used to predict response stimuli in natural systems.

<u>Knowledge and Skills</u> (SWBAT embedded course proficiencies)
Students who understand the concepts are able to:
- Use an oral and written argument supported by evidence to Support or refute an explanation or a model of how the body is a system of interacting subsystems composed of groups of cells.
- Gather, read, and synthesize information from multiple appropriate sources about sensory receptors' response to stimuli.
- Assess the credibility, accuracy, and possible bias of each publication and methods used.
- Describe how publications and methods used are supported or not supported by evidence.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations
Benchmarks (embedded student proficiencies)
Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan
Within this unit, students will use informational text and models to support their understanding that the body is a system of interacting subsystems. Instruction should begin with students understanding that the cell is a specialized structure that is a functioning system. Students will need to understand that different types of cells have different functions; therefore, each cell system is specialized to perform its particular function. Building on this understanding, students learn that different types of cells serve as subsystems for larger systems called tissues. Groups of specialized tissues serve as subsystems for organs that then serve as subsystems for body systems such as the circulatory, excretory, digestive, respiratory, muscular, and nervous systems. Students need to understand how each body system interacts with other body systems. Emphasis is on the conceptual understanding that each system and subsystem is specialized for particular body functions; it does not include the mechanisms of one body system independent of others.
As part of their investigation of how body systems are interrelated, students should use variables to represent two quantities that describe how the inputs or outputs of one system change in relationship to another. They should write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable; analyze the relationship using graphs and tables; and relate these to the equation. For example, students can find the relationship between increased activity of the muscular system and the related increase in the activity of the circulatory or respiratory system and express this relationship as an equation.
Students will demonstrate their understanding of this concept by writing an argument, supported by evidence, to support an explanation of how the body is a system of interacting subsystems. As part of their preparation for this written argument, students will read science resources and analyze the evidence used to support arguments in these resources. While gathering evidence, it is important that students connect to the nature of science by demonstrating scientific habits. They should be sure to display intellectual honesty by ensuring that whenever they cite specific textual information and quote or paraphrase the data and conclusions of others, they avoid plagiarism and provide basic bibliographic information for sources.
Students will deepen their understanding of subsystems by gathering and synthesizing information about sensory receptors. Students will understand that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. Each sensory receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. Each response can be examined as a cause-and-effect relationship that can be used to predict response to stimuli in natural systems. Each step in the stimulus/response pathway can be connected to students' previous study of systems and subsystems. For example, the nervous system includes receptors that are subsystems that respond to stimuli by sending messages to the brain.
Using multiple appropriate sources, students will read and synthesize information and will assess the credibility, accuracy, and possible bias of publications and methods used, and describe how the information they read is or is not supported by evidence. For example, students could participate in class discussions in which they can investigate whether information they have read in publications agree with scientific findings or seem to be biased in order to advertise a product or support a position.
Suggested Activity: Discuss how our bodies consist of systems that consist of cells. Example: Discuss one of the body systems and how it is composed of cells.; Do an experiment showing how the brain responds to stimulation by sending a message to the brain for behavior and memory. Example: An experiment showing reaction time to catching a ruler.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Cite specific textual evidence to support analysis of science and technical texts that provide evidence for how the body is a system of interacting subsystems composed of cells.
- Trace and evaluate a text's argument that the body system of interacting subsystems composed of cells, distinguishing claims that are supported by reasons and evidence from claims that are not.
- Write arguments, supported by evidence, for how the body is a system of interacting subsystems composed of groups of cells.
- Gather relevant information concerning how sensory receptors function by responding to stimuli, then sending messages to the brain, which responds immediately through some form of behavior or by storing the messages as memory. Quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

Mathematics

- Use order of magnitude thinking, write and solve equations, analyze data, and use concepts of probability.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

Unit 6 - Inheritance and Variation of Traits

Scope and Sequence
Time: Approximately 23 days

Corresponds to Module B in textbook

Stage 1: Desired Results

Content Standards
MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure of the organism.
MS-LS3-2: Develop and use a model to describe why sexual reproduction results in offspring with identical genetic information and sexual reproduction in offspring with genetic variation.

Essential Questions
Why do kids look similar to their parents?

Enduring Understandings
- Complex and microscopic structures and systems, such as genes located on chromosomes, can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among the parts ofthe system; therefore, complex natural structures/systems can be analyzed to determine how they function.
- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes.
- Each distinct gene chiefly controls the production of specific proteins, which in turn affect the traits of the individual.
- In addition to variations that arise from sexual reproduction, genetic information can be altered due to mutations.
- Some changes to genetic material are beneficial, others harmful, and some neutral to those organism.
- Changes in genetic material may result in the production of different proteins.
- Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
- Structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- Though rare, mutations may result in changes to the structure and function of proteins.
- Organisms reproduce either sexually or asexually and transfer their genetic information to their offspring.
- Asexual reproduction results in offspring with identical genetic information.
- Sexual reproduction results in offspring with genetic variation.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring.
- Individuals have two of each chromosomes and hence two alleles of each gene, one acquired from each parent. These variations may be identical or may differ from each other.
- Punnett squares, diagrams, and simulations can be used to describe the cause-and-effect relationship of gene transmission from parent (s) to offspring and resulting genetic variation.

Knowledge and Skills (SWBAT embedded course proficiencies)
Students who understand the concepts are able to:

- Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information.
- Develop and use a model to descry why sexual reproduction results in offspring with genetic variation.
- Use models such as Punnett squares, diagrams, and simulations to describe the cause-and-effect-relationship to gene transmission from parent (s) to offspring and resulting genetic variation.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations
Benchmarks (embedded student proficiencies)
Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan
Using models, such as electronic simulations, physical models, or drawings, students will learn that genes are located in the chromosomes of cells and each chromosome pair contains two variants of each gene. Students will need to make distinctions between chromosomes and genes and understand the connections between them. DNA will be introduced in high school. Students will learn that chromosomes are the genetic material that is found in the nucleus of the cell and that chromosomes are made up of genes. They will also learn that each gene chiefly controls the production of specific proteins, which in turn affect the traits of the individual.
Students should be given opportunities to use student-developed conceptual models to visualize how a mutation of genetic material could have positive, negative, or neutral impact on the expression of traits in organisms. Emphasis in this unit is on conceptual understanding that mutations of the genetic material may result in making different proteins; therefore, models and activities that focus on the expression of genetic traits, rather than on the molecular-level mechanisms for protein synthesis or specific types of mutations, are important for this unit of study. For example, models that assign genetic information to specific segments of model chromosomes could be used. Students could add, remove, or exchange genes located on the chromosomes and see that changing or altering a gene can result in a change in gene expression (proteins and therefore traits).
Students will continue this unit of study by describing two of the most common sources of genetic variation, sexual and asexual reproduction. Students will be able to show that in sexual reproduction, each parent contributes half of the genes acquired by offspring, whereas in asexual reproduction, a single parent contributes the genetic makeup of offspring. Using models such as Punnett squares, diagrams, and simulations, students will describe the cause-and-effect relationship between gene transmission from parents(s) to offspring and the resulting genetic variation. Using symbols to represent the two alleles of a gene, one acquired from each parent, students can use Punnett squares to model how sexual reproduction results in offspring that may or may not have a genetic makeup that is different from either parent. Students can observe the same mixing of genetic information using colored counters or electronic simulations. Using other models, students can show that asexual reproduction results in offspring with the same combination of genetic information as the parents.
Students can summarize the numerical data they collect during these activities as part of their description of why asexual reproduction results in offspring with identical genetic combinations and sexual reproduction results in offspring with genetic variations. As a culmination of this unit of study, students could make multimedia presentations to demonstrate their understanding of the key concepts. Students could participate in a short research project and cite the specific textual evidence used to support the analysis of any scientific information they gather. They could integrate quantitative or technical information as part of their presentation. For example, students can take data collected during investigations of genetic mutations and provide a narrative description of their results. They could use data collected during their investigation of sexual and asexual reproduction. They could also include diagrams, graphs, or tables to clarify their data.

<u>Suggested</u> <u>Activity:</u> Make a model to describe how genes change and how they can be good, bad, or have not effect. Example: Do research to show how allergies affect some students bodies.; Make a model showing how offspring from one parent differ from offspring in two parents. Example: A punnett square on eye color.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Cite specific textual evidence to support analysis of science and technical texts about structural changes to genes (mutations) located on chromosomes that may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- Determine the meaning of symbols, key terms, and other domain-specific phrases as they are used to describe shy structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial or neutral effects to the structure and function of the organism.
- Integrate quantitative or technical information about why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism that is expressed in words with a version of the information expressed visually in a flowchart, diagram, model, graph, or table.
- Include multimedia components and visual displays in presentations about structural changes to genes (mutations) located on chromosomes that may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism to clarify claims and findings and emphasize salient points.
- Cite specific textual evidence for why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation to support analysis of science and technical texts.
- Determine the meaning of symbols, key terms, and other domain-specific phrases as they are used to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
- Integrate quantitative or technical information that describes why asexaul reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation that is expressed in words with a version of that information that is expressed visually in a flowchart, diagram, model, graph, or table.
- Include multimedia components and visual displays in presentations that describe why asexaul reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation to clarify claims and findings and emphasize salient points.

Mathematics

- Summarize numerical data sets that describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation in relation to their context.
- Use mathematics to model why sexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

Unit 7 Organization for Matter and Energy Flow in Organisms

Scope and Sequence
Time: Approximately 18 days

In this unit of study, students provide a mechanistic account for how cells provide a structure for the plant process of photosynthesis in the movement of matter and energy needed for the cell. Students use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They construct specific scientific explanations for the cycling of matter in organisms and the interactions of organisms to obtain matter and energy from an ecosystem to survive and grow. They understand that sustaining life requires substantial energy and matter inputs, and that the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy.

Corresponds to Module B in textbook

Stage 1: Desired Results

Content Standards
MS-LS1-6: 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-LS1-7: 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.

Essential Questions
How do some organisms turn electromagnetic radiation into matter and energy?

Enduring Understandings
- Photosynthesis has a role in the cycling of matter and flow of energy into and out of organisms.
- The flow of energy and cycling of matter can be traced.
- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon based organic molecules and release oxygen.
- 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.
- Sugars produced by plants can be used immediately or stored for growth or later use.
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter.
- Food is rearranged through chemical reactions, forming new molecules that support growth.
- Food is rearranged through chemical reactions, forming new molecules that release energy as this matter moves through an organism.
- Molecules are broken apart and put back together to form new substances, and in this process, energy is released.
- Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy.

Knowledge and Skills (SWBAT embedded course proficiencies)
Students who understand the concepts are able to:

- Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on valid and reliable evidence obtained from sources (including the students' own experiments).
- Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on 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.
- Develop and use a model to describe how food is rearranged through chemical reactions.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations
Benchmarks (embedded student proficiencies)
Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan
Students will construct explanations about the role of photosynthesis using evidence obtained from sources, including the students' own experiments or outside sources. Student-constructed informative/explanatory responses will cite specific textual evidence, determine the central ideas to support their analysis, and provide an accurate summary distinct from their own prior knowledge or opinions. Some experiments could include observing elodea releasing oxygen, depriving a plant of sunlight or water, or using glucose test strips. In this unit of study, emphasis is on the transfer of energy that drives the motion and/or cycling of matter.
Students can represent the matter and energy involved in the process of photosynthesis using the equation for this reaction. Using this equation, students can build ball-and-stick models to show how carbon dioxide and water are rearranged to form glucose. Students can also draw conclusions about the cycling of matter and the flow of energy by observing plants such as elodea. By contrasting elodea plants in a variety of controlled environments, students can draw conclusions about how carbon dioxide and oxygen enter and leave organisms.
Students could also perform investigations where the input of light energy is manipulated. In these investigations, students can observe that even if the matter required for photosynthesis is present, the process will not proceed if light energy is not available. If light is available, students will be able to test the leaves of certain plants for the presence of stored sugar in the form of starch. If light is not available, students will observe that the sugars are not stored as starch in the leaves. This will emphasize that the transfer of light energy drives the cycling of matter into chemical energy. Students can also trace the flow of energy using models such as energy pyramids.
Using the data collected during their investigations and observations of simulations, students construct an explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. They could participate in s short research project in which they will use textual evidence to support their analysis. As part of their research, students will provide an accurate summary of the text they use and determine the central ideas or conclusions of the text. They can they write informative or explanatory texts to explain the process. As a result of their research, students should be able to observe that the information they gather through research supports their scientific observations. They could then make predictions about the impact of different environmental changes on the cycling of matter and flow of energy. For example, students could make predictions about the impact that volcanic eruptions that produce massive clouds of sunlight- blocking ash that linger long periods of time could have on life in the affected area.

Student learning will progress to developing and using models to describe how food is rearranged through chemical reactions. These reactions form new molecules that support growth and/or release energy as the matter moves through an organism. Students can integrate multimedia and visual displays into models to clarify information, strengthen claims and evidence, and add interest. Emphasis is on describing that molecules are broken apart and reassembled and that in this process, energy is released. Student models will demonstrate that matter is conserved in cell respiration. Models can be created using materials similar to those used in students' photosynthesis models, thereby emphasizing the complementary nature of photosynthesis and cellular respiration. Students can also act out the roles of variables within the chemical-reaction rearrangement to deepen their understanding.
Suggested Activity: Starch Test (betterlessons.com)

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Cite specific textual evidence to support analysis of science and technical texts about the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- Determine the central ideas about the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinion.
- Write informative/explanatory texts to examine the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms, and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- Draw evidence from informational texts to support analysis, reflection, and research about the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- Integrate multimedia and visual displays into presentations about how food in rearranged through chemical reactions to form new molecules that support growth and/or release energy as the matter moves through an organism to clarify information, strengthen claims and evidence and add interest.

Mathematics

- Use variables to represent two quantities involved in the process whereby photosynthesis plays a part in the cycling of matter and energy into and out of organisms. Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

Unit 8 Earth Systems

Scope and Sequence
Time: Approximately 33 days

In this unit of study, students examine geoscience data in order to understand processes and events in Earth's history. Important crosscutting concepts in this unit are scale, proportion and quantity, stability and change, and patterns in relation to the different ways geologic processes operate over geologic time. An important aspect of the history of Earth is that geologic events and conditions have affected the evolution of life, but different life forms have also played important roles in altering Earth's systems. Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data.

Corresponds to Module F in textbook

Stage 1: Desired Results

Content Standards
MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history.
MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Essential Questions
If no one was there, how do we know the Earth's history?
What provides the forces that drive Earth's systems?

Enduring Understandings
- The geologic time scale is used to organize Earth's 4.6-billion-year-old history.
- Rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history.
- The geologic time scale interpreted from rock strata provides a way to organize Earth's history.
- Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
- Energy drives the process that results in the cycling of Earth's materials.
- The process of melting, crystallization, weathering, deformation, and sedimentation act together to form minerals and rocks through the cycling of Earth's materials.
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems.
- Energy flowing and matter cycling within and among the planet's systems derive from the sun and Earth's hot interior.

- Energy that flows and matter the cycles produce chemical and physical changes in Earth's materials and living organisms.
- Explanations of stability and change in Earth's natural systems can be constructed by examining the changes over time and processes at different scales, including atomic scale.

Knowledge and Skills (SWBAT embedded course proficiencies)
Students who understand the concepts are able to:
- Construct a scientific explanation based on valid and reliable evidence from rock strata obtained from sources (including the students' own experiments)
- Construct a scientific explanation based on rock strata 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.
- Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Stage 2: Evidence of Understanding, Learning Objectives and Expectations
Benchmarks (embedded student proficiencies)
Assessment Methods (formative, summative, other evidence and/or student self- assessment)

Stage 3: Learning Plan
Within this unit, students will use the geologic time scale to organize Earth's 4.6-billion-year-old history. They will cite specific textual evidence from science and technical texts to support analysis of rock strata to show how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. They will use analysis of rock formations and the fossils they contain to establish relative ages of major events in Earth's history. Examples of Earth's major events could include the Ice Age or the earliest fossils of Homo sapiens, or the formation of Earth and the earliest evidence of life. Emphasis should be on analyses of rock strata providing only relative dates, not an absolute scale. Students can use variables to represent numbers or quantities and write expressions when solving problems while constructing their explanations. Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions. *[Note: Assessment does not include recalling the names of specific periods or epochs and events within them.]*
Students will develop and use models to describe the cycling of Earth materials and the flow of energy that drives this process. This energy comes from the heat of the core of the Earth, which is transferred to the mantle. Convection currents within the mantle then drive the movement of tectonic plates. Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Students can generate models to demonstrate the rock cycle, with specific focus on the processes causing change. Students can analyze pictures and rock samples that demonstrate various processes of melting, crystallization, weathering, deformation, and sedimentation. *[Note: Students are not identifying and naming minerals within this unit].*
Students will construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions). Further emphasis is on how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Students can gather data and plot volcanoes and earthquakes in order to collect evidence to support the idea that these interactions among Earth's systems have shaped Earth's history and will determine its future. Additional examples can include changes on Earth's surface from weathering and deposition by the movements of water, ice, and wind. Emphasis is also on geoscience processes that shape local geographic features, such as New Jersey's Ridge and Valley Province, Highlands, Piedmont, and Coastal Plain.

Students convey ideas, concepts, and information through the selection, organization, and analysis of relevant content, and they may use multimedia components and visual displays. Students can also compare and contrast the information gained from experiments, simulations, video, or multimedia sources showing evidence of past plate motion with that gained by reading a text on the same topic. They use informative/explanatory texts to examine evidence for how geoscience processes have changed and reason abstractly and quantitatively when analyzing this evidence. They may integrate quantitative or technical information expressed in a flowchart, diagram, model, graph, or table. They can also use variables to represent numbers or quantities and write expressions when solving problems while constructing their explanations.

Students will analyze and interpret data on the distribution of fossils and rocks, and they will look at the continental shapes and seafloor structures to provide evidence of past plate motions. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. Examples of the data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches). Students may use numerical relationships, symbols, and words while analyzing patterns in rates of change on Earth's crust. Students can use variables to represent numerical data and write expressions or construct simple equations and inequalities when solving a problems involved in the analysis of data about past plate motions. Applying interpreted data on the distribution of fossils and rocks, continental shapes, and seafloor structures, students can provide evidence of past plate motions. *[Note: Students are not analyzing paleomagnetic anomalies in oceanic and continental crust in this unit]*.

Suggested Activity: Make a timeline showing how rock formation have changed over earth's history.; Make a model showing the Earth's patterns and how energy flows through it. Example: Design a rock cycle comic strip that shows a rock transformation from Metamorphic to Igneous to Sedimentary.; Discuss how the Earth's surface has changed over time. Examples: Lecture on plate motions or landslides.; Discuss information on fossils, rocks and tectonic plates. Example: Show students Pangea and how the continents have separated into their present day continents.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

- Cite specific textual evidence based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history to support analysis of science and technical texts.
- Write formative/explanatory texts to examine evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- Cite specific textual evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales to support analysis of science and technical texts.
- Use informative/explanatory texts to examine evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- Include multimedia components and visual displays in presentations about evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales to clarify claims and findings and emphasize salient points.
- Cite specific textual evidence of past plate motion to support analysis of science texts.
- Integrate quantitative or technical information about evidence of past plate motions expressed in words in a text with a version of that information expressed in a flowchart, diagram, model, graph, or table.
- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources showing evidence of past plate motion with that gained from reading a text on the same topic.

Mathematics

- Use variables to represent numbers and write expressions when solving problems while constructing explanations from evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history; understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specific set.
- Use variables to represent quantities in real-world or mathematical problem when solving problems while constructing explanations from evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
- Reason abstractly and quantitatively when analyzing evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- Use variables to represent numbers and write expressions when solving real-world or mathematical problem involving evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specified set.
- Use variables to represent quantities in a real-world or mathematical problems involving evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales, and construct simple equations and inequalities to solve problems by reasoning about quantities.
- Use numbers, symbols, and words while analyzing and interpreting data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.
- Use variables to represent numerical data and write expressions when solving problems involved in the analysis of data about past plate motions. Understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specified set.
- Use variables to represent quantities when analyzing data about past plate motions and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Modifications:

- Provide students with multiple choices of how they can represent their understandings
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena
- Structure the learning around explaining or solving a social or community-based issue.

Resources

- District approved science textbook
- Websites
- Videos
- Nonfiction/fiction sources

New Jersey Core Curriculum and Common Core Content Standards

http://www.state.nj.us/education/cccs/

Integration of 21st Century Theme(s)

The following websites are sources for the following 21st Century Themes and Skills:
http://www.nj.gov/education/code/current/title6a/chap8.pdf
http://www.p21.org/about-us/p21-framework .
http://www.state.nj.us/education/cccs/standards/9/index.html

21st Century Interdisciplinary Themes (into core subjects)

- **Global Awareness**
- **Financial, Economic, Business and Entrepreneurial Literacy**
- **Civic Literacy**
- **Health Literacy**
- **Environmental Literacy**

Learning and Innovation Skills

- **Creativity and Innovation**
- **Critical Thinking and Problem Solving**
- **Communication and Collaboration**

Information, Media and Technology Skills

- **Information Literacy**
- **Media Literacy**
- **ICT (Information, Communications and Technology) Literacy**

Life and Career Skills

- **Flexibility and Adaptability**
- **Initiative and Self-Direction**
- **Social and Cross-Cultural Skills**
- **Productivity and Accountability**
- **Leadership and Responsibility**

Integration of Digital Tools

- **Classroom computers/laptops/Chromebooks**
- **Technology Lab**
- **Voice amplification device**
- **Other software programs**