RESOURCE ROOM SCIENCE II: CURRICULUM 2016

Unit summary

Unit 1 Introduction to Biology; Structure and Function: The performance expectations in the topic Structure and Function help students formulate an answer to the question: "How do the structures of organisms enable life's functions?" High school students are able to investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. Students demonstrate understanding of how systems of cells function together to support the life processes. Students demonstrate their understanding through critical reading, using models, and conducting investigations. The crosscutting concepts of structure and function, matter and energy, and systems and system models in organisms are called out as organizing concepts. Topics to be covered: Introduction to biology, basic chemistry review, molecular structure, cellular structure and cell physiology

Unit 2 Matter and Energy in Organisms and Ecosystems: The performance expectations in the topic Matter and Energy in Organisms and Ecosystems help students answer the questions: "How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?" High school students can construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They can apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. They can relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science. Students understand organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. In addition, students can utilize the crosscutting concepts of matter and energy and Systems and system models to make sense of ecosystem dynamics.

Unit 3 Interdependent Relationships in Ecosystems:The performance expectations in the topic Interdependent Relationships in Ecosystems help students answer the question, "How do organisms interact with the living and non-living environment to obtain matter and energy?" This topic builds on the other topics as high school students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems. Students can generate mathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems.

Unit 4 Inheritance and Variation of Traits:The performance expectations in the topic Inheritance and Variation of Traits help students in pursuing an answer to the question: "How are the characteristics from one generation related to the previous generation?" High school students demonstrate understanding of the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. Students can determine why individuals of the same species vary in how they look, function, and behave. Students can develop conceptual models for the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science can be described. Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression. Crosscutting concepts of structure and function, patterns, and cause and effect developed in this topic help students to generalize understanding of inheritance of traits to other applications in science.

Unit 5 Natural Selection and Evolution:The performance expectations in the topic Natural Selection and Evolution help students answer the questions: “How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?” High school students can investigate patterns to find the relationship between the environment and natural selection. Students demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. Students can demonstrate an understanding of the processes that change the distribution of traits in a population over time and describe extensive scientific evidence ranging from the fossil record to genetic relationships among species that support the theory of biological evolution. Students can use models, apply statistics, analyze data, and produce scientific communications about evolution. Understanding of the crosscutting concepts of patterns, scale, structure and function, and cause and effect supports the development of a deeper understanding of this topic.

UNIT 1

Unit Title: INTRODUCTION TO BIOLOGY; <u>STRUCTURE AND FUNCTION</u>

<u>ASSOCIATED STANDARDS</u>
Students who demonstrate understanding can:

HS-LS1-2
Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS1-3
Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS-LS1-6
Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

<u>DISCIPLINARY CORE IDEAS</u>

PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

	LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans		

Crosscutting Concepts		
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. **Cause and Effect: Mechanism and Explanation** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.	**Scale, Proportion, and Quantity** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. **Systems and System Models** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.	**Energy and Matter: Flows, Cycles, and Conservation** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. **Structure and Function** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and Change** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

SCIENCE & ENGINEERING PRACITCES

Asking Questions and Defining Problems A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others. **Planning and Carrying Out Investigations** Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are	**Developing and Using Models** A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs. **Constructing Explanations and Designing Solutions** *The products of science are explanations*	**Using Mathematics and Computational Thinking** In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships. **Obtaining, Evaluating, and**

systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions. **Analyzing and Interpreting Data** Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.	*and the products of engineering are solutions.* The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints. **Engaging in Argument from Evidence** *Argumentation is the process by which explanations and solutions are reached.* In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.	**Communicating Information** Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

CONNECTIONS TO CCSS:

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1)

WHST.9-12.2 Write informative/explanatory texts, including the

	narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-2)

LESSON 1 (TITLE): OSMOSIS AND DIFFUSION

# of Periods Required: 1 double period

The student will… determine which substances will pass through a semi-permeable membrane. In the cells of plants and animals, protoplasm is limited or restrained from the environment by the existence of a membrane. These membranes, by necessity, must be relatively permeable to assist in such life processes as respiration and excretion. Membranes must permit some substances to pass through, yet prohibit other substances from doing so. They may allow rapid diffusion of some substances or very slow diffusion of others. Diffusion is the movement of particles from where they are more concentrated to where they are less concentrated.

ACTIVITY: Students will place a semi-permeable membrane containing equal amounts of glucose solution and liquid starch solution into a plastic cup filled with water to which 30 drops of Lugol's solution has been added. After 10 minutes, students will try to determine which substances passed through the membrane tube through observation and by performing a test for glucose. Liquid starch will turn blue –black in the presence of Lugol's solution. A glucose testing strip will turn green in the

presence of glucose. Students will come to conclude that the only way these substances could make contact with one another was to pass through the membrane tube. Being that only the Lugol's solution and glucose solution were able to do so will lead students to realize that the membrane tube is permeable to Lugol's solution and permeable to glucose, but impermeable to starch. Students will come to realize that the cell membrane behaves the same way.

MATERIALS: 1 semi-permeable membrane, 1 plastic cup, 2 Glucose testing strips, Lugol's solution, liquid starch solution, glucose solution, water, stirrer

ASSESSMENT: Lab report, Worksheets, Quiz, Test, Final Exam

LESSON 2 (TITLE): <u>FLOWER CARNATION ACTIVITY</u>

# of Periods Required: <u>2 single periods plus 24 hour wait time.</u>

Where does the water really go when a plant is watered?

With this experiment, you can discover for yourself how essential the functions of stems are to plant growth. As the colored water is absorbed, you will be able to see how it moves into the flower and will be amazed when the petals of a white carnation change color.

ACTIVITY: Before placing any of the flowers in water, cut about 4" off of each stem. Use a knife and cut at an angle. Keep all the flower stems in plain water for now. (Many gardeners and florists even cut stems under water so no air bubbles can get in to break the tube of water and cause wilting. It's important that the stem tubes always be filled with water. If air gets into the tube, water may not be able to move up the stem to the flower. If the student has difficulty using a sharp knife then your teacher will slit the stems of three of the flowers straight down the middle. Keep them in the plain water for now. Fill five of the cups with different colors of water. Fill the other two with uncolored water. This step is often called "Split Ends." Place each half of a stem into a cup of different colored water. For example, position the red and blue cups next to each other and put a stem half into each color. Use a color with one of the cups of uncolored water, too. Make a few predictions: Which color will be soaked up? Will the colors mix to make a new color in the petals or will the color in the flower be divided in half? Place the last white carnation into the remaining cup of uncolored water. This one is your control flower. Let all the flowers sit and soak for several days. As you wait to see the results, make some more predictions: How will the carnation in the plain water compare to the carnations in the colored water? Which color will be soaked up first? How long will it take? Which color will create the darkest shade in a flower? Which color will create the lightest shade in a flower? Which color might not be absorbed?

How Does It Work: Most plants "drink" water from the ground through their roots. The water travels up the stem of the plant into the leaves and flowers where it makes food and helps keep the plant rigid. When a flower is cut off the plant, it no longer has its roots but the stem of the flower still "drinks" up the water and provides it to the leaves and flowers. How does this happen? There are two things that combine to move water through plants — transpiration and cohesion. Water evaporating from the leaves, buds, and petals (transpiration) pulls water up the stem of the plant. This works sort of like you sucking on a straw. Water that evaporates from the leaves "pulls up" other water molecules behind it to fill the space it left, this process is called osmosis. Instead of a mouth providing the suction, it is due to the evaporating water. This can happen because water sticks to itself (cohesion) and because the tubes in the plant stem are very tiny. This water movement process through tiny tubes is called capillary action. Coloring the water with food coloring does not harm the plant but it allows you to see the movement of water into the flower. Splitting the stem simply proves that the tiny tubes in the stem run all the way through the stem from the water to the petals of the flowers. Our unofficial tests indicated that the blue food color went up the carnations the fastest, followed by the red and then the green food colors.

MATERIALS: 3 white carnations, food coloring (blue, red, green) test tube or container, water, knife

ASSESSMENT: Lab Worksheets, Quiz, Test, Final Exam

LESSON 3 (TITLE): <u>BEET LAB ACTIVITY</u>
# of Periods Required: <u>1 double period</u>

The student will… determine the effect of an isotonic solution, a hypotonic solution, and a hypertonic solution on a slice of potato. Molecules will move from an area of greater concentration to an area of lesser concentration. This is called diffusion. The diffusion of water molecules is called osmosis. Molecules pass through the cell membrane seeking out the area of lesser concentration. When cells are placed into an isotonic solution, the concentration is the same both inside and outside of the cell. Therefore, there is no net flow of water. When cells are placed into a hypotonic solution, the concentration of water is higher outside of the cell. Therefore, water will move into the cell causing it to swell. If cells are placed into a hypertonic solution, the concentration of water is higher inside of the cell compared to outside the cell and therefore water will flow out of the cell causing it to shrink.

ACTIVITY: Students will observe chemical movement through cells by two processes called osmosis and diffusion. Materials move through the cell membrane by osmosis and then spread to areas of lower concentration by diffusion. Students will use 3 petri dishes labeled (A: 5m acid, B: 5M base and C : 5M water) Three small pieces of beet. Students will record the beet color before placing in solution. Students will place one piece of beet in each petri dish A, B, and C. After 20 minutes students will observe the color of the beets in the petri dishes and record their observations on a lab chart.

Students should observe that the beet in the acid will have less color because the color has moved out of the beet and into the outside liquid. The base dish will show the movement of liquid in as well as color outside to prove equilibrium and the water dish will show little change. Beet cells are good to use because they have a dark color that fades due to osmosis.

MATERIALS: beet slices of equal size, 3 petri dishes, tap water, acid and base

ASSESSMENT: Lab report, worksheet, quiz, test

LESSON 4 (TITLE): <u>HONEY BEE KEEPING</u>

# of Periods Required: <u>On Going throughout the School Year</u>

The Honey Bee Education Program is dedicated towards the preservation of our most important pollinator, the honey bee. As part of this project students will learn the science behind honey and its importance through history to the human race. Students will get down and sticky with the chemistry behind how bees make honey. Honey is the only food consumed by humans that is produced by insects. Honey is the sweet, viscous fluid produced by honeybees from the nectar of flowers. Honey is a rich source of carbohydrates, mainly fructose and glucose. Honey contains small amounts of a wide array of vitamins, minerals and amino acids as well as several compounds which function as antioxidants. Throughout history, honey has been enjoyed for its sweetness as well as its healing properties. To finalize this project, students will participate in the extraction and bottling process. Students will continue to enhance this project by passing on their knowledge to others through the sales of their "Bees Gold" -extracted honey. * Students will learn the chemistry behind honey production.

Activities:

*** Students will research the uses of honey by humans throughout history.**

*** Students will learn that the source of nectar influences the color and flavor of honey.**

*** Students will describe the process of honey production.**

*** Students will demonstrate the honey extraction process.**

ASSESSMENT: Lab Worksheets AND Reports, Hands on Activities and Verbal Discussion, Test, Quiz

DIFFERENTIATION / MODIFICATIONS

1. **Modify assignments to ability level (Homework, Tests etc)**
2. **Priority/Preferential Seating/Work with Peer**
3. **Provide Individual Assistance/Direct Instruction**
4. **Provide Frequent Opportunities to Respond/Request Questions**

5. **Provide signals/cues to communicate and support**
6. **Highlight Important Information**
7. **Extended time for tests, assignments, experiences**
8. **Read tests, directions, information aloud – If needed test in small groups**
9. **Provide tactile, visual manipulative to assist in understanding**
10. **Provide study guides, copies of notes, and content information**
11. **Redirect to keep focused**
12. **Provide breaks when frustration levels rise or as needed**
13. **Re-teach lesson using small group instruction**
14. **Monitor progress during lessons**
15. **Shorten "chunk" assignments to focus on mastery of key info**
16. **Provide word banks, graphic organizers, use of organizational materials**
17. **Repetition of newly introduced subjects/content**
18. **Verbal prompts**
19. **Read written information aloud**
20. **Pair written directions with oral directions**
21. **Allow to ask questions and allow student to reinforce directions**

UNIT 2

Unit Title: <u>MATTER AND ENERGY</u>

<u>ASSOCIATED STANDARDS</u>

HS-LS1-5
Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-7
Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

HS-LS2-3
Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

HS-LS2-4
Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5
Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

<u>DISCIPLINARY CORE IDEAS</u>

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	LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans		

Crosscutting Concepts		
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SCIENCE & ENGINEERING PRACITCES

Asking Questions and Defining Problems A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to	**Developing and Using Models** A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems;	**Using Mathematics and Computational Thinking** In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others. **Planning and Carrying Out Investigations** Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions. **Analyzing and Interpreting Data** Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.	and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs. **Constructing Explanations and Designing Solutions** *The products of science are explanations and the products of engineering are solutions.* The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints. **Engaging in Argument from Evidence** *Argumentation is the process by which explanations and solutions are reached.* In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.	Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships. **Obtaining, Evaluating, and Communicating Information** Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

CONNECTIONS TO CCSS:

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-6),(HS-LS2-3)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6),(HS-LS2-3)
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6),(HS-LS2-3)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-5),(HS-LS1-7)

LESSON 1 (TITLE): PHOTOSYNTHESIS LAB
# of Periods Required: 1 double period

The student will…determine the rate of photosynthesis in a plant by analyzing and interpreting data obtained through a laboratory investigation. Students will determine that the bubbles released by the plant are bubbles of oxygen gas and that the plant produced those bubbles as a waste product as a result of the process of photosynthesis. The air that we breathe is 21% oxygen. After we breathe in oxygen we exhale carbon dioxide. Carbon dioxide is needed by plants for them to live. In these experiments about plants you will see how a leaf creates oxygen that we breathe from sunlight.

ACTIVITY: Students will use a green spinach leaf or cut a green leaf off of a plant and fill a glass with water. Place the leaf in the glass and put glass containing the leaf in a sunny location. Make a

prediction what you will see in an hour. Write down your prediction on a piece of paper. After an hour carefully look at the leaf and side of the glass. You should be able to see lots of tiny bubbles that have formed on the edges of the plant and on the side of the glass. If you are having a hard time seeing the bubbles you might get a small hand lens to observe the edges of the leaf.

1. **Leave the plant in the sunlight for several more hours. Do the bubbles increase or decrease.**
2. **Take two glasses of water and place a fresh leaf in each one. Place one leaf in a dark area and the other in sunlight for two hours and then observe how much oxygen each leaf produced.**

Science behind the experiment: The bubbles you observed on the leaf and sides of the glass were oxygen. Leaves take in carbon dioxide and through the process of photosynthesis they create food for the plant. Oxygen is a byproduct of this and goes into the air. The we breathe contains 21% oxygen produced by plants. Without plants we not have enough oxygen to live.

MATERIALS: Green leaf, Clear Glass, Water, Sunlight or Lamp, Small Hand Lens
ASSESSMENT: Lab report, Worksheet, homework, quiz, test,

LESSON 2 (TITLE): <u>Yeast Respiration Lab</u>
# of Periods Required: <u>1 double period</u>

The student will… observe the rate at which yeast can ferment solutions of sucrose by analyzing and interpreting data. The student will understand that yeast is alive and will break down sucrose sugar into glucose which they will use to sustain themselves. They have the ability to do this through anaerobic respiration. Carbon dioxide will be given off as a waste product which can be measured as the gas accumulates in the vile.

ACTIVITY: Students will prepare a 10% sucrose solution which will be transferred to a small vial containing 10 ml of a yeast suspension. A larger vial will be lowered over the small vial and the apparatus will be inverted. Students will observe and measure the length of the gas column as it begins to form at the top of the inner small vial. Measurements will be recorded in a data chart and results will be graphed to determine the rate of fermentation by yeast cells.

MATERIALS: large vial, small vial, sucrose solution, yeast suspension, graduated cylinder, beaker, stirring rod, metric ruler, teaspoon

ASSESSMENT: lab report, worksheet, quiz, test

DIFFERENTIATION / MODIFICATIONS

1. Modify assignments to ability level (Homework, Tests etc)
2. Priority/Preferential Seating/Work with Peer
3. Provide Individual Assistance/Direct Instruction
4. Provide Frequent Opportunities to Respond/Request Questions
6. Highlight Important Information
7. Allow students to verbalize before writing
8. Use computer, calculator
9. Extended time
10. Provide tactile, visual manipulative to assist in understanding
11. Redirect to keep focused
12. Provide breaks when frustration levels rise or as needed
13. Reteach lesson using small group instruction
14. Monitor progress during lessons
18. Shorten "chunk" assignments to focus on mastery of key info
20 .Provide word banks, graphic organizers, use of organizational materials
21. Read written information aloud
22. Pair written directions with oral directions

UNIT 3

Unit Title: INTERDEPENDENT RELATONSHIPS IN ECOSYSTEMS

ASSOCIATED STANDARDS

HS-LS2-6

Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7

Design, evaluate, and refine a solution or simulation for reducing the impacts of human activities on the environment and biodiversity.

HS-LS2-A

Illustrate how interactions among living systems and with their environment result in the movement of matter and energy.

HS-LS2-D

Provide examples of adaptations that have evolved in prey populations due to selective pressures over long periods of time.

DISCIPLINARY CORE IDEAS

PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	

Crosscutting Concepts		
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. **Cause and Effect: Mechanism and Explanation** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.	**Scale, Proportion, and Quantity** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. **Systems and System Models** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.	**Energy and Matter: Flows, Cycles, and Conservation** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. **Structure and Function** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and Change** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

SCIENCE & ENGINEERING PRACITCES

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world.

Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.

Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions.

The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories.

The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.

In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits.

Scientists and engineers engage in

Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions.

Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

	argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.	

CONNECTIONS TO CCSS:

RST.9-10.8
RST.11-12.1
RST.11-12.7
RST.11-12.8
WHST.9-12.2
WHST.9-12.5
WHST.9-12.7

LESSON 1 (TITLE): Investigating an Aquarium Ecosystem
# of Periods Required: Months of May and June

- **The student will…set up and maintain an aquarium tank**

ACTIVITY: Ecosystems are interactions among different organisms with each other and their environment. Ecosystems vary, depending on their location, climate, and other factors. However, all ecosystems have some producers and some consumers. These members of an ecosystem depend on each other. In this activity, you will make an aquarium. You will use the aquarium to study how organisms in an ecosystem depend on each other. You will also learn about the quality of water and how aquatic organisms depend on clean water for their survival.

MATERIALS: Safety goggles; Beta Fish; ½ gallon plastic plastic tank; water plant – Elodia; clam shell; fresh water snail; aquarium gravel; water; water conditioner; fish food; aquarium water test kits – (Dissolved oxygen, Ph, Ammonia, Nitrates)

PROCEDURES: Students will wash and wipe out the tank. Choose a location for your aquarium. It should be in indirect sunlight. Put aquarium gravel in the bottom of the tank. The gravel should be about 1 inch deep. Bury the roots of the Elodia plant in the gravel. Place a shell in the gravel – The shell will add calcium to the water. Fill the tank with water to about 1 inch from the top. Add 1 small capful of water conditioner to the tank. Put the snail in the water. – Snails help remove algae from the tank walls. Put the Beta Fish in the water. Do Not Feed your fish the first day – Day 2 feed your fish a small pinch of food and on Fridays give him a small pinch of blood worms. – Do not put too much food in the aquarium. Follow the directions on the package. Observe the aquarium daily for 4 weeks. Write your observations and chemical tests in your lab note book. * Replace water that has evaporated with water that has been left standing for three days or more. Remove any dead plants or snail or change and clean the tank water when needed.

ASSESSMENT: lab report, question and answer discussions, Worksheets, test

LESSON 2 (TITLE): <u>LIFE IN A DROP OF POND WATER</u>

# of Periods Required: 1 <u>double period</u>

The student will… examine a variety of living organisms in a drop of pond water to explore the characteristics and relationships of organisms living in a pond water ecosystem.

ACTIVITY: Students will examine a drop of pond water under the microscope. Characteristics of living things will be discovered as well as levels of organization in the biosphere.

MATERIALS: microscope, slide, cover slides, dropper, lens paper, pond water

ASSESSMENT: lab report, question and answer, homework, quiz, test, state bio exam

LESSON 3 (TITLE): Cape May Point and Douglass Park Ecology Trip
# of Periods Required: Full Day Activity

Students will conduct scientific experiments and investigations around the parks, observing animal and plant life as well as water quality testing and the ocean and bay ecosystems by seining for living organisms.

ACTIVITY: Students will spend the day between Cape May State Park and Douglas Park at the Bay. Students will investigate and observe plant and animal life around the parks. They will compile their observations and scientific tests onto a scientific field experience packet.

MATERIALS: Field Packet, clip board, pencil, water test kits, seining net, buckets, dissecting trays, tweezers, hand lens

ASSESSMENT: lab Field Packet

DIFFERENTIATION / MODIFICATIONS

1. **Priority/Preferential Seating/Work with Peer**
2. **Provide Individual Assistance/Direct Instruction**
3. **Provide Frequent Opportunities to Respond/Request Questions**
4. **Highlight Important Information**
5. **Read tests, directions, information aloud – If needed test in small groups**
6. **Restate, reword, clarify and or have students do the same**
7. **Provide tactile, visual manipulative to assist in understanding**
8. **Redirect to keep focused**
9. **Reteach lesson using small group instruction**
10. **Monitor progress during lessons**
11. **Provide word banks, graphic organizers, use of organizational materials**
12. **Read written information aloud**
13. **Pair written directions with oral directions**
14. **Allow to ask questions and allow student to reinforce directions**

UNIT 4

Unit Title: INHERITANCE AND VARIATION OF TRAITS

HS-LS1-4
Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS3-1
Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-2
Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS3-3
Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS-LS1-1
Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

DISCIPLINARY CORE IDEAS

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	Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.	

CONNECTIONS TO CCSS:

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS3-1),(HS-LS3-2)
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)
WHST.9-12.1	Write arguments focused on discipline-specific content. (HS-LS3-2)

LESSON 1 (TITLE): MATING TRAITS LAB
# of Periods Required: 3 class periods

The student will…use the principle of probability to predict the outcome of genetic crosses involving human traits controlled by a single pair of genes.

ACTIVITY: Students will mate their traits with the traits of a partner using Punnett Squares to predict the genotypes and phenotypes of their offspring. Human genetic traits controlled by a single pair of genes will be used as examples.

MATERIALS: Students and their traits, paper

ASSESSMENT: Lab report, homework, quizzes, test, state bio exam

LESSON 2 (TITLE): DNA EXTRACTION – STRAWBERRY
# of Periods Required: 1 double period

The long thick fibers of DNA store the information for the functioning of the chemistry of life. DNA is present in every cell of plants and animals. The DNA found in strawberry cells can be extracted using common, everyday materials. The students will use an extraction buffer containing salt to break up protein chains that bind around the nucleic acids, and dish soap to dissolve the lipid (fat) part of the strawberry cell wall and nuclear membrane. The extraction buffer will help provide access to the DNA inside the cells.

ACTIVITY: Place one strawberry in a Ziploc bag. Smash / grind up the strawberry. Add the extraction buffer. Knead the strawberry in the bag again. Assemble the filtration apparatus. Pour the strawberry slurry into the filtration apparatus and let it drip directly into the test tube. Slowly pour cold ethanol into the tube and observe. Dip the glass rod into the tube where the strawberry extract and ethonal layers come into contact with each other and slowly lift. Students should swirl and lift very slowly to bring the DNA thread up out of the slurry.

MATERIALS: heavy duty zip lock bag, 1 strawberry, 10ml DNA extract buffer, funnel, cheesecloth, 50ml test tube, glass rod, 20ml ethanol

ASSESSMENT: Lab report, quizzes, test

LESSON 3 (TITLE): Bunny Biology - Breeding Bunnies
# of Periods Required: On Going Program throughout the School Year

"Bunny Biology" is a curriculum enhancement activity in the resource room science II class. This activity was created as part of a "Pets in the Classroom" project. Kids benefit from exposure to pets in the classroom in ways that help to shape their lives for years to come. Pets encourage nurturing, help build self esteem and teach responsibility. Even kids with no exposure to animals or nature in their home environment can see, feel, touch and make connections to the wide world of animals. Observing and caring for an animal instills a sense of responsibility and respect for life. A pet brings increased sensitivity and awareness of the feelings and needs of others – both animals and humans. Kids learn that all living things need more than just food and water for survival. Students will see directly how their behavior and actions affect others. Studies have shown that the presence of animals in the classroom tends to reduce student tension. Through the use of rabbits, the goal of "Bunny Biology" is to enhance the study of genetics in the resource room science classroom.

- **Students will use rabbits for various genetics activities', including "Punnett Squares" related to coat color, fur texture, ear length and shape.**
- **Students will participate in discussion groups and identify rabbit genetic disorders and benefits related to breeding in nature as well as captivity.**

- **Students in partner groups are responsible for weakly cage cleaning, feeding and watering, as well as handling.**
- **Students will participate in baby bunny rearing if teacher should decide to breed rabbit parents'.**

ACTIVITIES:

Video - "The Essential Guide to Caring For Your Rabbit" from the Pet Video Library.

- **Supplies Needed**
- **Rabbit History and Breeds**
- **Proper Diet**
- **Handling and Caring**
- **Living With A Rabbit**

1. **Punnett Squares – Problem solving, Probability of Genotypes and Phenotypes for coat color, fur texture and ear shape and length (Using the rabbits in the classroom)**
2. **Breeding Bunnies Lab activity. Looking at the genetic traits that allow rabbits to survive in the wild. Vocabulary used: Allele, Dominant, Recessive, Homozygous, Heterozygous, Genotype, Gene frequency**
3. **Bunny Babies Inherited Traits Craft Activity – Making Easter Egg Bunnies**
4. **Mini – Symposium on Genetic Disorders. Students research genetic disorders related to rabbits as well as humans. Students gather information and deliver a comprehensive, concise, and complete oral presentation to the class.**

ASSESSMENT: Lab Activities and Reports, Worksheets, Hands on Activity and Verbal Discussion, Test

DIFFERENTIATION / MODIFICATIONS

1. **Modify assignments to ability level (Homework, Tests etc)**
2. **Priority/Preferential Seating/Work with Peer**
3. **Provide Individual Assistance/Direct Instruction**
4. **Provide Frequent Opportunities to Respond/Request Questions**
5. **Highlight Important Information**
6. **Allow students to verbalize before writing**
7. **Use computer, calculator, audio materials where necessary**
8. **Extended time for tests, assignments, experiences**
9. **Read tests, directions, information aloud – If needed test in small groups**
10. **Restate, reword, clarify and or have students do the same**
11. **Provide tactile, visual manipulative to assist in understanding**
12. **Provide study guides, copies of notes, and content information**
13. **Redirect to keep focused**
14. **Provide breaks when frustration levels rise or as needed**
15. **Reteach lesson using small group instruction**
16. **Monitor progress during lessons**

17. **Shorten "chunk" assignments to focus on mastery of key info**
18. **Provide word banks, graphic organizers, use of organizational materials**
19. **Verbal prompts**
20. **Read written information aloud**
21. **Pair written directions with oral directions**
22. **Allow to ask questions and allow student to reinforce directions**

UNIT 5

Unit Title: <u>NATURAL SELECTION AND EVOLUTION</u>

<u>ASSOCIATED STANDARDS</u>

Students who demonstrate understanding can:

HS-LS4-1

Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-2

Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS-LS4-4

Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS4-5

Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

<u>DISCIPLINARY CORE IDEAS</u>

PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

Radiation PS4.C: Information Technologies and Instrumentation	and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	

Crosscutting Concepts		
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. **Cause and Effect: Mechanism and Explanation** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.	**Scale, Proportion, and Quantity** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. **Systems and System Models** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.	**Energy and Matter: Flows, Cycles, and Conservation** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations. **Structure and Function** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and Change** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

SCIENCE & ENGINEERING PRACITCES

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world.

Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.

Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions.

The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories.

The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.

In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits.

Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions.

Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

	Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.	

CONNECTIONS TO CCSS:

RST-11.12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)
RST-11.12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5)

LESSON 1 (TITLE): <u>OBSERVING MUSCLES AND BONES</u>
# of Periods Required: <u>2 double periods</u>

The student will… observe and understand homologous structures by examining the structure and function of the skeletal and muscular systems of a chicken wing. Structures that are similar in structure and different in function in different organisms are known as homologous structures. These structures provide evidence of a common ancestor thus suggesting that evolution has occurred.

ACTIVITY: Students will dissect a chicken wing. Removing the skin will reveal the muscular structure that is present in the wing of a chicken. Students will learn that muscles are attached to bones by structures called tendons and bones are connected at a joint by structures called ligaments. By manipulating the upper and lower parts of the wing, students will come to understand that the joint is the same kind of joint in the human arm. They will understand that the muscular structure in the chicken wing is the same muscular structure in the human arm. Students will then carefully remove the muscles from the bones. They will see that the bone structure of a chicken wing is very similar to the bone structure of the human arm. These similarities are known as homologous structures and suggest to scientists that there was a common ancestor. Evidence of a common ancestor suggests to scientists that evolution has occurred.

MATERIALS: chicken wing, dissecting pan, scissors, forceps, scalpel

ASSESSMENT: Lab report, question and answer, homework, quiz, test, bio state exam

LESSON 2 (TITLE) <u>Studying Variations within a Species</u>
# of Periods Required: <u>1 double period</u>

One of the main ideas of Darwin's theory of natural selection is that there are variations in a species. Having variations means that the members of a species are somewhat different from each other.

ACTIVITY: Students will study string beans to show that there are variations among members of a species. Students will examine length, mass, and number of beans in each pod.

MATERIALS: 12 string beans, marker, metric ruler, balance

ASSESSMENT: Lab Worksheet, question and answer, graphing, quiz, test

DIFFERENTIATION / MODIFICATIONS

1. **Modify assignments to ability level (Homework, Tests etc)**
2. **Priority/Preferential Seating/Work with Peer**
3. **Provide Individual Assistance/Direct Instruction**
4. **Provide Frequent Opportunities to Respond/Request Questions**
5. **Provide signals/cues to communicate and support**
6. **Highlight Important Information**
7. **Allow students to verbalize before writing**
8. **Use computer, calculator, audio materials where necessary**
9. **Extended time for tests, assignments, experiences**
10. **Read tests, directions, information aloud – If needed test in small groups**
11. **Restate, reword, clarify and or have students do the same**
12. **Provide tactile, visual manipulative to assist in understanding**
13. **Provide study guides, copies of notes, and content information**
14. **Redirect to keep focused**
15. **Provide breaks when frustration levels rise or as needed**
16. **Reteach lesson using small group instruction**
17. **Monitor progress during lessons**
18. **Shorten “chunk” assignments to focus on mastery of key info**
19. **Provide word banks, graphic organizers, use of organizational materials**
20. **Repetition of newly introduced subjects/content**
21. **Verbal prompts**
22. **Read written information aloud**
23. **Pair written directions with oral directions**
24. **Allow to ask questions and allow student to reinforce directions**