Unit 1: The Chemistry of Life

Brief Summary of Unit:

The primary focus of this unit is the development of understanding as related to the chemical basis of life. Classroom activities will begin with the concepts that all living and nonliving things are composed of matter and this matter is composed of atoms.

Further efforts should be devoted to fostering an understanding that all organisms are made of cells and can be characterized by common aspects of their structure and functioning. Students will learn to identify characteristics common to all living things and describe those characteristics that differentiate eukaryotes from prokaryotes.

Through the development and use of models, students will be able to

- Explain the hierarchical structural organization of multicellular organisms in which one system is made of numerous parts and is a component of the next level.
- Relate the composition of atoms and molecules to chemical compounds through the various forms of bonds.
- Apply the use of monomers as it relates to polymerization.
- Analyze evidence of the conservation of matter and energy.
- Experiment with water to determine its unique properties that enable it to support life on earth.

Lastly, students will explore how carbon serves as the backbone for the organic macromolecules: nucleic acids, proteins, carbohydrates, and lipids; and how reactions between these molecules within systems of specialized cells assist organisms in carrying out essential life functions.

Extension activities for accelerated students:

- Research of articles related to topics placed in student portfolio

Differentiation for the non-advanced students:

- Readings with text, study hall remediation, hands on skill to concrete main ideas

Materials and Resources

● CK-12 Biology ○ Chapter 1: What is Biology? Section 1.2 Biology: The Study of Life ○ Chapter 2 Section 2.1 Matter and Organic Compounds Section 2.2 Biochemical Reactions Section 2.3 Water, Acids, Bases	

BIO.A.2 The Chemical Basis for Life

BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).

BIO.A.2.2.3 Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

Overarching Understandings:

- The biomolecule structures of organisms enable life's functions.

Topical Understandings	**Essential Questions**
• The role protons, neutrons and electrons play in an atomic model. • The actions at a subatomic level by which an isotope/radioisotope is formed as a function of atomic structure and its stability. • The processes involved as small molecules are linked together to form macromolecules and how macromolecules are broken down. • The differences and similarities between the various types of chemical bonding.	• What is the structural composition of an atom? • How does the structure of carbohydrates, lipids, proteins, and nucleic acids relate their function? • What are the functional characteristics of the various macromolecules? • How are bonds formed in chemistry?
Knowledge	**Skills**
• Vocabulary: subatomic particles, isotopes, bonding. • The atomic number of an atom is the number of protons found in the nucleus. • Carbohydrates, lipids, proteins, and nucleic acids are the building blocks of living organisms. • Recognize the names and chemical symbols of the most common elements found in living organisms. • Isotopes are two or more atoms with the same number of protons but different number of neutrons. If they are unstable and emit particles or energy in the form of radiation, they are called radioisotopes. • Hydrogen bonds are weak attractions between a hydrogen atom with a slight positive charge and another atom with a slight negative charge • A molecule is a chemical structure held together by covalent bonds. • Covalent bonds occur when electrons are shared between atoms.	• Quantify the relationship between an element's atomic weight and atomic number. • Create models to explain the connection between subatomic particles, isotopes, and bonding. • Generate diagrams that describes a carbon atom's structure and its potential as a bonding agent. • Relate the significance of carbon bonding to the formation of macromolecules. • Use molecular formulas when writing the products and reactants in a chemical equation. • Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

• Ionic bonds form when electrons are transferred between atoms creating oppositely charged ions. • Ionic bonds are the strongest bonds and most difficult to separate. • Know the major types of chemical interactions – covalent bonds, hydrogen bonds, ionic bonds, Van der Waals forces, etc.	

BIO.A.2 The Chemical Basis for Life

BIO.A.2.1 Describe how the unique properties of water support life on Earth.

BIO.A.2.1.1 Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).

Overarching Understandings:

- The interaction of water with other objects or uncontrolled systems to evolve towards more stable states.
- Water supports life on Earth using the concepts of energy transfer, conservation of matter, and molecular bonding.

Topical Understandings	**Essential Questions**
● Water has molecular characteristics that lead to its cohesive and adhesive properties. ● The physical changes in water at a molecular level that causes it to evaporate. ● The role energy transfer plays when water regulates body temperature. ● The role homeostasis plays when transpiration regulates water's movement in vascular plants. ● The benefits of water to life as universal solvent.	● How do the properties of cohesion and adhesion in water support life? ● How does energy transfer allow water to regulate temperature in living organisms? ● How do the properties of water that characterize it as the universal solvent foster survival in living organisms?
Knowledge	**Skills**
● Vocabulary: evaporation, transpiration, cohesion, adhesion, polarity, solution, solute, solvent, mixtures, colloids, capillary action ● Molecular structure of water. ● Properties of water: solvent, buffer, polarity, high specific heat, density ● Acids/Bases/pH Buffers (pH Scale) ● Recognize and label a structural diagram of water.	● Compare and contrast cohesion and adhesion. ● Explain why water is a polar molecule and how that makes it unique. ● Compare and contrast an acidic and basic solution. ● Differentiate between solute and solvent. ● Relate the pH value of a substance to its alkalinity/acidity. ● Describe how water regulates body temperature in living organisms.

BIO.A.2 The Chemical Basis for Life

BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e., atoms, molecules, and macromolecules).

BIO.A.2.2.1 Explain how carbon is uniquely suited to form biological macromolecules.

Overarching Understandings:

- Carbon is uniquely suited in structure and function to form organic molecules needed to support life.

Topical Understandings	**Essential Questions**
● How carbon's electron structure enables it's functions ● How carbon's various bonding patterns leads to the development of biomolecules ● Carbon forms bonds with other atoms	● Why is carbon such a special element? ● Why is carbon the most abundant element in living things? ● What elements bond with carbon to form the essential compounds of life?
Knowledge	**Skills**
● Vocabulary: valence electrons, covalent bond, macromolecule ● Carbon Characteristics: ○ strong covalent bonds ○ four valence electrons ○ four bonds (graphic for Methane) ○ can form single, double or triple covalent bonds ○ forms bonds with other carbon, nitrogen, oxygen, hydrogen, sulfur, and phosphorus atoms ○ contained in most bio-molecules ○ forms large macromolecules	● Describe the electron configuration of carbon. ● Explain how carbon atoms bond with each other and with other elements to form biological macromolecules.

BIO.A.2 The Chemical Basis for Life

BIO.A.2.2 **Describe** and **interpret relationships between** **structure** and **function** at **various** **levels of biochemical organization** (**i.e.**, **atoms, molecules, and macromolecules**).

BIO.A.2.2.2 **Describe how** **biological macromolecules** **form from monomers**.

Overarching Understandings:

- Chemical elements are recombined in different ways to form different biological macromolecules.

Topical Understandings	**Essential Questions**
● The manner in which molecules react chemically to other molecules of the same type to form larger molecules (polymers).	● What is the relationship between monomers and polymers? How are they formed? ● What are dehydration (condensation) synthesis and hydrolysis reactions?
Knowledge	**Skills**
● Vocabulary: monomer, polymer, carbohydrates, monosaccharides, polysaccharide, starch, proteins, amino acids, lipids, glycerol, fatty acids, nucleic acids, nucleotides, dehydration synthesis, hydrolysis ● The process of dehydration and hydrolysis reactions ● The organic structure of the individual monomers and their combinations to form polymers	● Explain how monomers are joined to form polymers through dehydration synthesis. ● Explain how polymers are broken down into monomers through hydrolysis. ● Recognize the organic structures of monomers and polymers.

BIO.A.2 The Chemical Basis for Life

BIO.A.2.3 Explain how enzymes regulate biochemical reactions within a cell.

BIO.A.2.3.1 Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.

Overarching Understandings:

- Enzymes as catalysts regulate biochemical reactions.
- Energy is transferred from one system of interacting molecules to another.

Topical Understandings	**Essential Questions**
● Biological catalysts are specific. ● The structure (shape) of the enzyme determines its function. ● The enzyme-substrate complex is specific and can be explained through the lock and key or induced fit model. ● The relationship between enzymes and activation energy.	● How does an enzyme catalyze a specific biochemical reaction? ● How does form relate to function? ● How are the lock and key and induce fit model used to explain the enzyme-substrate complex?
Knowledge	**Skills**
● Vocabulary: enzyme, catalyst, enzyme-substrate complex, reactants, products, activation energy, endothermic reaction, exothermic reaction ● Enzymes lower the activation energy of a chemical reaction and allow it to proceed more efficiently. ● Most enzymes end in “-ase” ● Through each specific reaction the enzyme is conserved and reused.	● Explain, using the enzyme substrate complex, how an enzyme catalyzes a specific biochemical reaction. ● Predict how changes in the shape of the enzyme will affect their function. ● Models can be used to illustrate the process of enzyme catalysis.

BIO.A.2 The Chemical Basis for Life

BIO.A.2.3 Explain how enzymes regulate biochemical reactions within a cell.

BIO.A.2.3.2 Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

Overarching Understandings:

- Energy is transferred from one system of interacting molecules to another.

Topical Understandings	**Essential Questions**
● Factors at a cellular level affect enzyme activity.	● How do enzymes regulate biochemical reactions within a cell? ● How is the activation energy altered in the presence of an enzyme? ● How do pH, temperature, and concentration levels affect enzyme function? ● How do changes in structure affect function?
Knowledge	**Skills**
● Changes in enzyme structure will affect function (denaturing). ● Many factors affect enzyme function including: ○ regulation ○ temperature ○ concentration ○ pH	● Recognize the shape (structure) of an enzyme will determine its function. ● Analyze how an enzyme works in terms of induced fit or lock and key models. ● Predict how enzymatic efficiency is affected by changes in pH, temperature and concentration levels. ● Explain how denaturing an enzyme will affect its function.

BIO.A.1 Basic Biological Principles

BIO.A.1.1 Explain the characteristics common to all organisms.

BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.

Overarching Understandings:

- All organisms have the same common characteristics to sustain life.

Topical Understandings	**Essential Questions**
● Prokaryotic and eukaryotic organisms share characteristics that are essential for life.	● What defines life? ● What characteristics are shared by all prokaryotes and eukaryotes?
Knowledge	**Skills**
● Vocabulary: prokaryotic,eukaryotic, cell, organelle, homeostasis, stimulus, metabolism, asexual and sexual reproduction ● Characteristics of life: ○ reproduction ○ made up of cells ○ homeostasis - obtain/use energy ○ universal genetic code ○ growth & development ○ need for materials and energy ○ response to the environment ○ as a group, living things evolve	● Evaluate living and nonliving organisms and determine what is necessary for life to exist. ● Recognize and interpret connections between life processes in prokaryotes and eukaryotes. ● Identify and describe the characteristics of life shared by all living things.

BIO.A.1 Basic Biological Principles

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.

BIO.A.1.2.2 Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).

Overarching Understandings:

- Organization of interacting systems working together provide specific functions within organisms.
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

Topical Understandings	**Essential Questions**
● All organisms are made of cells and can be characterized by common aspects of their structure and function. ● Life is organized	● What hierarchy of organization exists in living organisms? ● How does structure (anatomy) determine function (physiology)? ● How do changes in structure and performance affect a system?
Knowledge	**Skills**
● Vocabulary: cells, tissues, organs, organ systems, and organisms ● List and describe biological hierarchy of organization.	● Analyze the hierarchy of organization of living organisms. ● Make predictions based on relationships between structure and function of various levels of biological organization. ● Evaluate relationships between structures and functions at various levels of biological organization. ● Develop and use models to explain the organization of interacting systems working together to provide specific functions within organisms.

Evidence of Understanding

Performance Tasks
● Talk to the Text--Reading involving chemistry of life-- nutrition, discoveries, research ● Molecular models of Proteins, Carbohydrates, Lipids and Nucleic Acids--Both construction of macromolecules and breakdown into monomers Demos ● Online simulations (ex: explorelearning.com, companion sites from textbook, etc) describing atomic structure and chemical bonding ● Laboratory lab activity testing for components of macromolecules(ex. Benedicts solution for testing of simple sugars) ● Project based assessment of students work as they complete powerpoint, poster boards, wordart on topics from chemistry unit ● Bell ringers or other post class writing assessments on topics discussed during class period. ● Enzyme Kinetics Lab (Catalase)

Integration of ELA Common Core Standards *(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)*

Reading/Writing in Science and Technical Subjects
CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-Literacy.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

CCSS.ELA-Literacy.WHST.9-10.1 Write arguments focused on *discipline-specific content*.

- CCSS.ELA-Literacy.WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
- CCSS.ELA-Literacy.WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- CCSS.ELA-Literacy.WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- CCSS.ELA-Literacy.WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.

CCSS.ELA-Literacy.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- CCSS.ELA-Literacy.WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures,

tables), and multimedia when useful to aiding comprehension.

CCSS.ELA-Literacy.WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

CCSS.ELA-Literacy.WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.

CCSS.ELA-Literacy.WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

CCSS.ELA-Literacy.WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-Literacy.WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

CCSS.ELA-Literacy.WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-Literacy.WHST.9-10.5 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.

CCSS.ELA-Literacy.WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

CCSS.ELA-Literacy.WHST.9-10.7 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.

CCSS.ELA-Literacy.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.
CCSS.ELA-Literacy.WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
● Rubric for assessing student work ● Writing assignments (Do Now/Ticket Out) - correct/incorrect. ● Student centered tasks -posters, projects, powerpoints, etc. ● Student response to demonstrations ● Check for completion of assign work ● Completion of correctly built molecular model	● Analyze text readings for comprehension ● Construct ball and stick models of all life molecules. ● Determine components of macromolecules using identifying chemicals ● Make conclusions regarding how temperature and pH affect enzyme function ● Understanding of key unit terms (macromolecule, dehydration synthesis, enzymes, etc.)

*can be embedded into formative and summative assessments.

Unit 2: Cell Structure and Function

Brief Summary of Unit:

Once the student has an understanding of biochemistry and macromolecules they are prepared to tackle the concepts of cell structure and function. The primary focus of this unit is to investigate the similarities and differences amongst prokaryotic and eukaryotic cells. Students will explore the cell size, location and shape of DNA within each cell and organelles common to both. Further study into the more complex membrane-bound organelles of eukaryotes will lead students to the differentiation of multicellular organisms.

The big idea of structure and function in biology will be explored through the anatomy and physiology of eukaryotic organelles. Connections will be formed between how organelles function and communicate to maintain cell homeostasis and influence cell transport.

Extension activities for accelerated students:

- Build a 3-D model of an organelle with a written detailed description of location, function and type of cells in which they are found
- Research the history of and create a timeline for microscope advancements and discovery of cells and organelles

Differentiation for the non-advanced students:

- Graphic organizers for organelle structure and function
- Venn Diagram comparing Prokaryotic vs. Eukaryotic cells
- Venn Diagram comparing Plant vs. Animal Cell Organelles

Materials and Resources

● CK-12 Biology ○ Chapter 3 Cell Structure and Function Section 3.1: Introduction to Cells Section 3.2: Cell Structures Section 3.3: Cell Transport and Homeostasis	● Materials necessary to complete the performance tasks.

Unit 2: Cellular Structure and Function **Section 1**

BIO.A.1 Basic Biological Principles

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.

BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.

Overarching Understandings:

- Prokaryotic and eukaryotic cells contain specialized structures whose design determines their specific functions.

Topical Understandings	**Essential Questions**
● The relationship of functions of prokaryotic and eukaryotic cells based on structure. ● The mechanisms of a cell's shape that determines its function. ● The structural and functional reasons cells are microscopic in size.	● How is structure of an organelle related to its function? ● What are the structures in a prokaryote? ● What are the structures in a eukaryote? ● What characteristics are shared between eukaryotes and prokaryotes? ● Why are cells so small in size? ● How does surface area and cell size relate to one another? ● How do plant and animal cells compare/contrast to one another? ● What is the function of all cellular organelles?
Knowledge	**Skills**
● The three parts of the cell theory: 1 All living things are made of cells. 2 Cells are the smallest structural and functional unit of an organism. 3 All cells come from preexisting cells. ● Bacteria are prokaryotes. ● Plant and animal cells are eukaryotes. ● The structural/functional differences between eukaryotic and prokaryotic cells. ● The structure and function of all cell organelles: ○ nucleus ○ cytoplasm ○ cell/plasma membrane ○ ribosomes ○ mitochondria cell wall vesicles cytoskeleton lysosome nucleolus	● Describe the levels of organization from atom to organism. ● Identify the organelles common to all eukaryotic cell structures and those unique to either plant or animal cells. ● Compare and contrast a eukaryote and a prokaryote. ● Compare and contrast cellular organelles between plants and animals. ● Develop models to explain the relationships between the function and structure of both prokaryotic and eukaryotic cells. ● Use a compound light microscope to analyze and predict functions of cells based on structure.

○ Smooth endoplasmic reticulum nuclear membrane ○ Rough endoplasmic reticulum chloroplast ○ golgi apparatus centrioles ○ central vacuole peroxisome ○ chromoplast leucoplasts	

BIO.A.4 Homeostasis and Transport

BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.

BIO.A.4.1.1 Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.

Overarching Understandings:

- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range.

Topical Understandings	**Essential Questions**
● Concentration levels affect transport of molecules through a membrane. ● The relationship between structure of the cell membrane to the transport across the membrane.	● How is the fluid mosaic model used to explain transport across a semipermeable membrane? ● What is the composition of the plasma membrane? ● How are the phospholipids arranged in the membrane and why?
Knowledge	**Skills**
Vocabulary: homeostasis,hydrophobic, hydrophilic,lipids,protein channel, phospholipid,fluid mosaic,and protein pump. ● Concentration gradients are related to movement through the cell ● The structure of the phospholipid bilayer - proteins, carbohydrates, lipids ● Components of the cell membrane (fluid mosaic model)	● Identify the parts (integral proteins, embedded proteins, protein channel, protein pumps, phospholipids, etc…) ● Describe the function: transport & regulation ● Describe the fluid mosaic model. ● Relate the structure of the cell membrane to the transport across the membrane. ● Use modeling to explain the function of positive and negative feedback mechanisms in maintaining homeostasis that is essential for organisms. ● Create an authentic scenario modeling how the cell membrane maintains homeostasis. ● Analyze and predict movement across the plasma membrane based on the structure.

BIO.A.4 Homeostasis and Transport

BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.

BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).

Overarching Understandings:

- Various mechanisms exist in order to transport materials across the cell membrane.

Topical Understandings	**Essential Questions**
● The cell membrane structure along with concentration gradients influence movement of material across the cell membrane.	● What does energy have to do with the transport of materials through the cell? ● What is passive transport? ● What is active transport?
Knowledge	**Skills**
Vocabulary: osmosis, diffusion, facilitated diffusion, vacuole, exocytosis, endocytosis, equilibrium, protein channel, protein pump, phagocytosis, pinocytosis,hypotonic,and hypertonic.	● Identify concentration gradients ● Distinguish between passive and active transport ● Classify various forms of movement through a membrane ● Analyze why particles move a certain way through the membrane ● Make predictions on how a cell behaves depending on the situation it is placed. ● Explain practical applications and examples (i.e. phagocytosis involving ameba and food vacuole, muscle contraction, etc.) ● Simulate the movement of molecules across a semi-permeable membrane using dialysis tubing (starch-iodine lab)

BIO.A.4 Homeostasis and Transport

BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Overarching Understandings:

- Feedback mechanisms maintain the stable environment in living organisms.

Topical Understandings	**Essential Questions**
● Living things remain alive and functional even as external conditions change within some range.	● How do organisms function even as conditions change both externally and internally? ● What mechanisms do organisms have to maintain homeostasis?
Knowledge	**Skills**
Vocabulary: Diffusion, osmosis, hypothermia, hyperthermia, regulation ● Sweating/shivering ● Heat Stroke ● Heat exhaustion	● Explain the function of positive and negative feedback mechanisms in maintaining homeostasis which is essential to life. ● Give specific examples of various feedback mechanisms in a variety of organisms. ● Analyze how organisms use feedback and response mechanisms to maintain homeostasis. ● Recognize and interpret connections between life processes such as homeostasis and cell transport.

BIO.A.4 Homeostasis and Transport

BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.

BIO.A.4.1.3 Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.

Overarching Understandings:

- Cells contain specialized structures designed for their specific function.

Topical Understandings	**Essential Questions**
• Proteins and other organic molecules are synthesized and packaged in the cell to be transported into other cells.	• What are the components of the intermembrane system? • How does the intermembrane system contribute to movement of materials into, out of, and throughout the cell? • How are proteins transported through a cell?
Knowledge	**Skills**
Vocabulary: Golgi, Endoplasmic Reticulum, vesicle, membrane • Structure and function of Golgi, ER • Consistency of plasma membranes (with cell parts?) • Smooth ER • Rough ER • Transport vesicles purpose and formation	• Explain the function of the Golgi apparatus. • Distinguish between the smooth and rough endoplasmic reticulum. • Evaluate how organic molecules are packaged and transported within and between cells through vesicles. • Describe the movement of a protein through a cell starting with the manufacturing of the protein and conclude with its movement out of the cell. • Analyze and predict how cell structures transport material into, out of, and within a cell.

Evidence of Understanding

Performance Tasks

Other Evidence of Understanding	Assessment Tasks

Evidence of Understanding

Performance Tasks

Integration of ELA Common Core Standards ***(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)***

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the findings support or contradict previous explanations or accounts.
CCSS.ELA-Literacy.WHST.9-10.1 Write arguments focused on *discipline-specific content*.

- CCSS.ELA-Literacy.WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
- CCSS.ELA-Literacy.WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- CCSS.ELA-Literacy.WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- CCSS.ELA-Literacy.WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.

CCSS.ELA-Literacy.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- CCSS.ELA-Literacy.WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- CCSS.ELA-Literacy.WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- CCSS.ELA-Literacy.WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
- CCSS.ELA-Literacy.WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

CCSS.ELA-Literacy.WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-Literacy.WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

CCSS.ELA-Literacy.WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-Literacy.WHST.9-10.5 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.

CCSS.ELA-Literacy.WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

CCSS.ELA-Literacy.WHST.9-10.7 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.

CCSS.ELA-Literacy.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

CCSS.ELA-Literacy.WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks

*can be embedded into formative and summative assessments.

Unit 2: Cell Structure and Function

Brief Summary of Unit:

Once the student has an understanding of biochemistry and macromolecules they are prepared to tackle the concepts of cell structure and function. The primary focus of this unit is to investigate the similarities and differences amongst prokaryotic and eukaryotic cells. Students will explore the cell size, location and shape of DNA within each cell and organelles common to both. Further study into the more complex membrane-bound organelles of eukaryotes will lead students to the differentiation of multicellular organisms.

The big idea of structure and function in biology will be explored through the anatomy and physiology of eukaryotic organelles. Connections will be formed between how organelles function and communicate to maintain cell homeostasis and influence cell transport.

Extension activities for accelerated students:

- Build a 3-D model of an organelle with a written detailed description of location, function and type of cells in which they are found
- Research the history of and create a timeline for microscope advancements and discovery of cells and organelles

Differentiation for the non-advanced students:

- Graphic organizers for organelle structure and function
- Venn Diagram comparing Prokaryotic vs. Eukaryotic cells
- Venn Diagram comparing Plant vs. Animal Cell Organelles

Materials and Resources

● CK-12 Biology ○ Chapter 3 Cell Structure and Function Section 3.1: Introduction to Cells Section 3.2: Cell Structures Section 3.3: Cell Transport and Homeostasis	● Materials necessary to complete the performance tasks.

Unit 2: Cellular Structure and Function **Section 1**

BIO.A.1 Basic Biological Principles

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.

BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.

Overarching Understandings:

- Prokaryotic and eukaryotic cells contain specialized structures whose design determines their specific functions.

Topical Understandings	**Essential Questions**
● The relationship of functions of prokaryotic and eukaryotic cells based on structure. ● The mechanisms of a cell's shape that determines its function. ● The structural and functional reasons cells are microscopic in size.	● How is structure of an organelle related to its function? ● What are the structures in a prokaryote? ● What are the structures in a eukaryote? ● What characteristics are shared between eukaryotes and prokaryotes? ● Why are cells so small in size? ● How does surface area and cell size relate to one another? ● How do plant and animal cells compare/contrast to one another? ● What is the function of all cellular organelles?
Knowledge	**Skills**
● The three parts of the cell theory: 4 All living things are made of cells. 5 Cells are the smallest structural and functional unit of an organism. 6 All cells come from preexisting cells. ● Bacteria are prokaryotes. ● Plant and animal cells are eukaryotes. ● The structural/functional differences between eukaryotic and prokaryotic cells. ● The structure and function of all cell organelles: ○ nucleus ○ cytoplasm ○ cell/plasma membrane ○ ribosomes ○ mitochondria cell wall vesicles cytoskeleton lysosome nucleolus	● Describe the levels of organization from atom to organism. ● Identify the organelles common to all eukaryotic cell structures and those unique to either plant or animal cells. ● Compare and contrast a eukaryote and a prokaryote. ● Compare and contrast cellular organelles between plants and animals. ● Develop models to explain the relationships between the function and structure of both prokaryotic and eukaryotic cells. ● Use a compound light microscope to analyze and predict functions of cells based on structure.

○ Smooth endoplasmic reticulum nuclear membrane ○ Rough endoplasmic reticulum chloroplast ○ golgi apparatus centrioles ○ central vacuole peroxisome ○ chromoplast leucoplasts	

BIO.A.4 Homeostasis and Transport

BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.

BIO.A.4.1.1 Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.

Overarching Understandings:

- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range.

Topical Understandings	**Essential Questions**
● Concentration levels affect transport of molecules through a membrane. ● The relationship between structure of the cell membrane to the transport across the membrane.	● How is the fluid mosaic model used to explain transport across a semipermeable membrane? ● What is the composition of the plasma membrane? ● How are the phospholipids arranged in the membrane and why?
Knowledge	**Skills**
Vocabulary: homeostasis,hydrophobic, hydrophilic,lipids,protein channel, phospholipid,fluid mosaic,and protein pump. ● Concentration gradients are related to movement through the cell ● The structure of the phospholipid bilayer - proteins, carbohydrates, lipids ● Components of the cell membrane (fluid mosaic model)	● Identify the parts (integral proteins, embedded proteins, protein channel, protein pumps, phospholipids, etc…) ● Describe the function: transport & regulation ● Describe the fluid mosaic model. ● Relate the structure of the cell membrane to the transport across the membrane. ● Use modeling to explain the function of positive and negative feedback mechanisms in maintaining homeostasis that is essential for organisms. ● Create an authentic scenario modeling how the cell membrane maintains homeostasis. ● Analyze and predict movement across the plasma membrane based on the structure.

BIO.A.4 Homeostasis and Transport

BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.

BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).

Overarching Understandings:

- Various mechanisms exist in order to transport materials across the cell membrane.

Topical Understandings	**Essential Questions**
● The cell membrane structure along with concentration gradients influence movement of material across the cell membrane.	● What does energy have to do with the transport of materials through the cell? ● What is passive transport? ● What is active transport?
Knowledge	**Skills**
Vocabulary: osmosis, diffusion, facilitated diffusion, vacuole, exocytosis, endocytosis, equilibrium, protein channel, protein pump, phagocytosis, pinocytosis,hypotonic,and hypertonic.	● Identify concentration gradients ● Distinguish between passive and active transport ● Classify various forms of movement through a membrane ● Analyze why particles move a certain way through the membrane ● Make predictions on how a cell behaves depending on the situation it is placed. ● Explain practical applications and examples (i.e. phagocytosis involving ameba and food vacuole, muscle contraction, etc.) ● Simulate the movement of molecules across a semi-permeable membrane using dialysis tubing (starch-iodine lab)

BIO.A.4 Homeostasis and Transport

BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Overarching Understandings:

- Feedback mechanisms maintain the stable environment in living organisms.

Topical Understandings	**Essential Questions**
● Living things remain alive and functional even as external conditions change within some range.	● How do organisms function even as conditions change both externally and internally? ● What mechanisms do organisms have to maintain homeostasis?
Knowledge	**Skills**
Vocabulary: Diffusion, osmosis, hypothermia, hyperthermia, regulation ● Sweating/shivering ● Heat Stroke ● Heat exhaustion	● Explain the function of positive and negative feedback mechanisms in maintaining homeostasis which is essential to life. ● Give specific examples of various feedback mechanisms in a variety of organisms. ● Analyze how organisms use feedback and response mechanisms to maintain homeostasis. ● Recognize and interpret connections between life processes such as homeostasis and cell transport.

BIO.A.4 Homeostasis and Transport

BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.

BIO.A.4.1.3 Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.

Overarching Understandings:

- Cells contain specialized structures designed for their specific function.

Topical Understandings	**Essential Questions**
• Proteins and other organic molecules are synthesized and packaged in the cell to be transported into other cells.	• What are the components of the intermembrane system? • How does the intermembrane system contribute to movement of materials into, out of, and throughout the cell? • How are proteins transported through a cell?
Knowledge	**Skills**
Vocabulary: Golgi, Endoplasmic Reticulum, vesicle, membrane • Structure and function of Golgi, ER • Consistency of plasma membranes (with cell parts?) • Smooth ER • Rough ER • Transport vesicles purpose and formation	• Explain the function of the Golgi apparatus. • Distinguish between the smooth and rough endoplasmic reticulum. • Evaluate how organic molecules are packaged and transported within and between cells through vesicles. • Describe the movement of a protein through a cell starting with the manufacturing of the protein and conclude with its movement out of the cell. • Analyze and predict how cell structures transport material into, out of, and within a cell.

Evidence of Understanding

Performance Tasks

Other Evidence of Understanding	Assessment Tasks

Evidence of Understanding

Performance Tasks

Integration of ELA Common Core Standards ***(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)***

Reading/Writing in Science and Technical Subjects
CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. ● <enter tasks here - use this similar format for each task> CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to*grades 9–10 texts and topics*. CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-Literacy.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when

the findings support or contradict previous explanations or accounts.
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- CCSS.ELA-Literacy.WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- CCSS.ELA-Literacy.WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
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- CCSS.ELA-Literacy.WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- CCSS.ELA-Literacy.WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
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Other Evidence of Understanding*

Assessment Measures	Assessment Tasks

*can be embedded into formative and summative assessments.

Unit 3: Cellular Energy

Brief Summary of Unit:

Once the student has an understanding of how a cell is the basic unit of life and the processes that occur at the cellular level, they are prepared to study cellular energy. The primary focus of the unit is to learn about the processes of photosynthesis and cellular respiration. ATP structure and purpose in living organisms will be examined and applied to photosynthesis and cellular respiration.

Extension activities for accelerated students:

- Research Nobel prize winning scientists in the field of photosynthesis.
- In relation to O_2, show the value in conserving the great rain forests of the world.
- Investigate one of the processes in which fermentation is used in the production of food or a beverage.

Differentiation for the non-advanced students:

- Research Nobel prize winning scientists in the field of cellular energy.
- Complete a Concept Map for photosynthesis.
- Complete a Concept Map for cellular respiration.

Materials and Resources

● CK-12 Biology ○ Chapter 4 Section 4.1 Energy for Life Section 4.2 Photosynthesis: Sugar as Food Section 4.3 Powering the Cell: Cellular Respiration	● Materials necessary to complete the performance tasks will be added by instructor.

Unit 3: Cellular Energy **Section 1**

BIO.A.3 Bioenergetics

BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.

BIO.A.3.2.2 Describe the role of ATP in biochemical reactions.

Overarching Understanding:

- Organisms ability to obtain and transform energy.

Topical Understandings	**Essential Questions**
• The structure and function of ATP in cellular activities.	• Why is ATP useful to cells? • How is the energy of ATP utilized? • When is ATP used?
Knowledge	**Skills**
Vocabulary: adenosine triphosphate (ATP), adenosine diphosphate (ADP), phosphate, heterotroph, autotroph • The structure and function of ATP.	• Draw the structure of ATP. • Describe and simulate high energy bonds in ATP. • Predict how ATP is used in the cell.

Unit 3: Cellular Energy **Section 2**

BIO.A.3 Bioenergetics

BIO.A.3.1 Identify and describe the cell structures involved in processing energy.

BIO.A.3.1.1 Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.

***Overarching Understanding*:**

- Organisms ability to obtain and transform energy.

Topical Understandings	**Essential Questions**
● Photosynthetic organisms (plants, algae) capture energy from the sun. ● Structure and functions of chloroplasts and mitochondria are related. ● The role of light and pigments in photosynthesis.	● What are the structures and functions of chloroplasts and mitochondria? ● What role do pigments play in the role of photosynthesis? ● How do electron carrier molecules function?
Knowledge	**Skills**
Vocabulary: chloroplast, mitochondria, cristae, pigment, chlorophyll, thylakoid, and stroma. ● Energy capturing in a chloroplast. ● Sites of energy reactions in a mitochondria.	● Connect the roles and relationships of a chloroplast and a mitochondria in energy transformation. ● Create a model of a chloroplast and mitochondrion. ● Form a hypothesis related to the effects of a natural disaster on the relationship of the chloroplast and mitochondria.

BIO.A.3 Bioenergetics

BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.

BIO.A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.

Overarching Understanding:

- In order to grow and reproduce, organisms must transform "food" into energy and store and use this energy through various processes (i.e.; cell respiration and photosynthesis).

Topical Understandings	**Essential Questions**
• Organisms store energy, the process by which this is accomplished is determined by the structure and function of the organism. • Photosynthetic organisms convert the sun's energy into chemical energy. • The aerobic process of the release of energy from food in the presence of oxygen. • As compared to aerobic cellular respiration, anaerobic (without oxygen) cellular respiration follows a different and less efficient chemical pathway to provide energy in cells.	• What happens during the process of photosynthesis? • What factors affect photosynthesis? • What is cell respiration? • What is the relationship between cell respiration and photosynthesis? • What is the generation of ATP dependent upon? • How do organisms generate energy when oxygen is not available?
Knowledge	**Skills**
Vocabulary: photosynthesis, light-dependent reactions, light-independent reactions, photosystem, electron transport chain, ATP synthase, Calvin Cycle, chemiosmosis, calorie, cell respiration, aerobic, anaerobic, glycolysis, Krebs cycle, matrix, $NADP^+$, NADPH, NADH, NAD^+ FAD^+, and $FADH_2$	• Define photosynthesis. • What are the reactants and products of photosynthesis? • Compare and contrast the light dependent and light independent reactions of photosynthesis. • Explain the role of light and pigments in photosynthesis. • Explain the role of each of the electron carriers. • Define cellular respiration. • Distinguish which organisms undergo the process of cell respiration. • Describe what happens during glycolysis. • Describe what happens during the Krebs cycle. • Explain how high-energy electrons are used by the electron transport chain. • Identify how much ATP cellular respiration generates. • Compare photosynthesis and cellular respiration.

	● Show the overall equations for photosynthesis and cell respiration and demonstrate how they are linked biochemical equations. ● Explain how organisms get energy in the absence of oxygen.

Evidence of Understanding

Performance Tasks
Energy: Analyze Data: Sample Problem: Use a data table that lists composition of common foods. Given the fact that walking at a moderate pace consumes around 300 Calories per hour, calculate how many minutes you would have to walk to burn the Calories in a specific food item. http://www.learner.org/workshops/chemistry/support/act6_d1.pdf (Burning Peanuts Lab) Photosynthesis Labs http://www.elbiology.com/labtools/Leafdisk.html (Floating Disk Leaf Assay) http://www.citrus.k12.fl.us/ims/macginnisk/Stomata%20in%20Leaves.html (Lettuce leaf stomata lab) http://mypages.iit.edu/~smile/bi9201.html (Elodea rate of photosynthesis lab) Cell Respiration Labs http://employee.heartland.ed http://mypages.iit.edu/~smile/bi9201.htmlu/hfei/Labs/CellularRespirationProtocol.pdf (Cellular Respiration in Yeast)

Integration of ELA Common Core Standards *(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)*

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10 texts and topics.
CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

- **Read excerpts from the textbook and be able to explain the photosynthesis and cell respiration.**
  CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
  CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
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CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

- **<Read excerpts from the textbook and be able to explain the cell cycle.>**

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CCSS.ELA-Literacy.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical

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CCSS.ELA-Literacy.WHST.9-10.7 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.

CCSS.ELA-Literacy.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

- **Conduct or design experiments, analyze data and form conclusions.**
- **Produce clear and coherent lab reports and research reports.**

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
Suggested labs Rubric driven and traditional tests/quizzes Class discussion Web based simulations and activities	Explanation of structure and function of important cellular components involved in energy production and transfer. Measurement and analysis of processes demonstrating cellular activities consistent with energy production and transfer.

*can be embedded into formative and summative assessments.

Biology **Designed by: Luzerne Intermediate Unit Biology Teachers**

Unit 4: The Cell Cycle

Brief Summary of Unit:

Once the student has an understanding of how a cell is the basic unit of structure and function of organisms, they are prepared to study the cell cycle. The primary focus of the unit will investigate the stages of cell growth and reproduction. The students will investigate DNA's role in inheritance prior to exploring the events occurring in the cell cycle, including interphase, meiotic and mitotic nuclear divisions and cytokinesis.

Extension activities for accelerated students:

- Students will write a memoir as if they were a dividing cell by answering questions like: "Why did you divide?" and "What signals did you receive telling you it was time to divide?"
- Students will investigate new advances in stem cell research within the past two years.

Differentiation for the non-advanced students:

- Students will construct a model of the stages of mitosis.
- Students will illustrate all stages of the cell cycle.

Materials and Resources

● CK-12 Biology ○ Chapter 5 Section 5.1 Cell Division and the Cell Cycle Section 5.2 Chromosomes and Mitosis Section 5.3 Reproduction and Meiosis	● Materials necessary to complete the performance tasks.

BIO.B.1 Cell Growth and Reproduction

BIO.B.1.2 Explain how genetic information is inherited.

BIO.B.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.

Overarching Understandings:

- Organisms contain various genetic traits, based on DNA, and these traits are thereby inherited by the organism's offspring.

Topical Understandings	**Essential Questions**
• Chromosomes are organized packages of DNA that contain the instructions that code for the formation of proteins. • Genes are certain regions of DNA that make up chromosomes.	• What is DNA? • What is a gene? • What are alleles? • What is a chromosome?
Knowledge	**Skills**
Vocabulary: DNA, genes, alleles, chromosomes, histones	• Describe relationships between and among the components of genetic material. • Compare the functional relationships between the components of genetic material. • Construct a karyotype.

BIO.B.1 Cell Growth and Reproduction

BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.

BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.

Overarching Understandings:

- In multicellular organisms individual cells grow and then divide successively to produce many cells, with each parent cell passing identical genetic material to both daughter cells.

Topical Understandings	**Essential Questions**
● Before a cell divides, all of its genetic machinery is duplicated in a process known as Interphase. ● Nuclear division occurs in the process of mitosis. ● Cytokinesis completes cell division by dividing the cytoplasm into two complete daughter cells.	● How does a cell produce a new cell? ● Why do cells divide? ● How do cells divide? ● How does a single undifferentiated cell lead to a complex multi-cellular organism?
Knowledge	**Skills**
Vocabulary: chromosome, chromatin, cell cycle, interphase (G1, S, G2), mitosis, cytokinesis, centromere, chromatid, centriole, metaphase, anaphase, telophase, and meiosis. ● The main events in the cell cycle: interphase, nuclear division, cytokinesis ● The process of cytokinesis. ● The processes that occur during the phases of mitosis.	● Describe the main events in the cell cycle: interphase, nuclear division, cytokinesis ● Explain what happens during the phases of mitosis. ● Explain the process of cytokinesis. ● Explain the major stages of the cell cycle. ● Investigate how cell division helps a cell efficiently organize and transfer genetic information to its daughter cells.

BIO.B.1 Cell Growth and Reproduction

BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.

BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.

Overarching Understandings:

- A specialized type of cell division called meiosis occurs that results in the production of the sex cells.

Topical Understandings	**Essential Questions**
• Meiosis involves a two-step nuclear division reducing the number of chromosomes in half. • During the process of meiosis genetic recombinations may occur contributing to variability within a population.	• How are the end products of mitosis different from those of meiosis? • What are the main characteristics of spermatogenesis and oogenesis? • What are the mechanisms for genetic recombination?
Knowledge	**Skills**
Vocabulary: diploid (2n), haploid (n), synapsis, homologous pairs, gametes, zygote, oogenesis, oocyte, spermatogenesis, spermatocyte, and meiosis I and II. • Mitosis results in the formation of two identical daughter cells.	• Compare the outcomes of mitotic and meiotic nuclear divisions. • Explain the similarities and differences between mitosis and meiosis. • Use a practice quiz to determine acquisition of knowledge of mitosis: http://www.biologycorner.com/quiz/qz_mitosis.html

Evidence of Understanding

Performance Tasks
Mitosis Lab: Examine onion root tips. Determine the stages of cell cycle and calculate the amount of time in each stage. Sample labs and activities: http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html http://bio.rutgers.edu/~gb101/lab2_mitosis/index2.html http://www.biologycorner.com/worksheets/mitosis_onion.html See Onion Root Tip Lab document **Data Analysis Activity**: Examine data and determine the difference between cancerous and noncancerous cells in terms of mitosis. Document will be scanned and sent. **Planaria Regeneration Lab**: Students design experiments to show how mitosis is active in a regenerating planaria. See sample Planarian Lab document.

Integration of ELA Common Core Standards ***(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)***

Reading/Writing in Science and Technical Subjects
CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in

which they are writing.

- **<Read excerpts from the textbook and be able to explain the cell cycle.>**

CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

CCSS.ELA-Literacy.WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.

CCSS.ELA-Literacy.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical
CCSS.ELA-Literacy.WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

CCSS.ELA-Literacy.WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

CCSS.ELA-Literacy.WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-Literacy.WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

CCSS.ELA-Literacy.WHST.9-10.4 Produce clear and coherent writing

in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-Literacy.WHST.9-10.7 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.
CCSS.ELA-Literacy.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

- **<Conduct or design experiments, analyze data and form conclusions.**
- **Produce clear and coherent lab reports and research reports.>**

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks

*can be embedded into formative and summative assessments.

Biology **Designed by: Luzerne Intermediate Unit**

Unit 5: DNA

Brief Summary of Unit:

Once the student has grasped that DNA is the universal code for life and it enables an organism to transmit hereditary information, they will be prepared to explore the primary focus of the unit: to understand the structure and function of DNA. In addition, students will develop an understanding of how the information in DNA is used to direct protein synthesis and influence an organism's characteristics. The students will interpret the roles of organelles in protein synthesis and protein excretion from the cell. Mutations will be examined as per their effect on the DNA sequence, genotype and phenotype.

Extension activities for accelerated students:

- Visual display showing analogies for the relationships between DNA and RNA.

- Compare and discuss prokaryotic and eukaryotic gene regulation.

Differentiation for the non-advanced students:

- Compare a normal DNA sequence to mutated sequences to classify type of mutation and generate the new amino acid sequence that results.
- Build a model of DNA with all parts labeled.

Materials and Resources

● CK-12 Biology ○ Chapter 7 Section 7.1 DNA and RNA Section 7.2 Protein Synthesis Section 7.3 Mutation	● Materials necessary to complete the performance tasks.

BIO.B.1 Cell Growth and Reproduction

BIO.B.1.2 Explain how genetic information is inherited.

BIO.B.1.2.1 Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.

Overarching Understandings:

- DNA is the molecular basis for the transfer of biological characteristics from one generation to the next.

Topical Understandings	**Essential Questions**
● DNA is responsible for storing, copying, and transmitting genetic information. ● Discovery of the basic structure of DNA. ● DNA copies itself and ensure accuracy.	● What led to the discovery of DNA? ● How does cellular information pass from one generation to another? ● How does an organism pass its characteristics on to its offspring?
Knowledge	**Skills**
Vocabulary: DNA, semi-conservative replication, nucleotides (phosphate, sugar, bases), purines, pyrimidines, helicase, polymerase, ligase, double helix, and telomeres. ● Describe the basic structure of DNA and the relationship among DNA, chromosomes and genes ● Describe the function of DNA in heredity	● Identify and summarize the major events that led to the discovery of DNA. ● Represent in words and diagrams DNA replication. ● Develop a scientific model of DNA structure and replication. ● Prove that DNA replication is semi-conservative.

BIO.B.2 Genetics

BIO.B.2.2 Explain the process of protein synthesis (i.e., transcription, translation, and protein modification).

BIO.B.2.2.1 Describe how the processes of transcription and translation are similar in all organisms.

Overarching Understandings:

- Fundamental processes in molecular biology drive the flow of genetic information into proteins.

Topical Understandings	**Essential Questions**
● The processes of transcription and translation in prokaryotic and eukaryotic cells. ● The structure of DNA has the genetic code for making proteins. ● The basic flow of information from DNA to protein through RNA. ● RNA is translated into an amino acid sequence depending on the base codons of mRNA.	● How do cells make proteins? ● What organelles are involved in protein synthesis?
Knowledge	**Skills**
Vocabulary: RNA, messenger RNA, ribosomal RNA, transfer RNA, transcription, RNA polymerase, polypeptide, peptide bonds, genetic code, codon, amino acids, translation, anticodon, and gene expression. ● Proteins can be synthesized as a result of processing genetic information. ● DNA is first transcribed to RNA in the nucleus.	● Compare RNA and DNA. ● Define the process of transcription. ● Compare mRNA, tRNA and rRNA ● Construct models of mRNA, tRNA and rRNA. ● Analyze the genetic code and explain how it is read. ● Investigate the process of translation. ● Cite evidence to substantiate the “central dogma” of molecular biology.

BIO.B.2 Genetics

BIO.B.2.2 Explain the process of protein synthesis (i.e., transcription, translation, and protein modification).

BIO.B.2.2.2 Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.

Overarching Understanding:

- The role of organelles in the production and processing of specific proteins.

Topical Understandings	**Essential Questions**
• Protein processing and transport. • The genetic code of DNA and its relationship with RNA in building a specific amino acid sequence.	• How do cell structures enable a cell to carry out the basic life process of protein synthesis? • How are cell structures adapted to their functions regarding protein synthesis? • How do various cellular components work together to insure protein exportation out of the cell?
Knowledge	**Skills**
Vocabulary: cytoplasm, organelle, vesicle, nucleus, ribosome, endoplasmic reticulum (smooth and rough), and Golgi apparatus. • The process of protein synthesis including transcription and translation. • The process of protein modification.	• Identify the role of ribosomes, endoplasmic reticulum, and Golgi apparatus in transporting proteins. • Design a model to demonstrate protein modification. • Synthesize a protein and explain its journey from development to exportation.

BIO.B.2 Genetics

BIO.B.2.3 Explain how genetic information is expressed.

BIO.B.2.3.1 Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frameshift).

Overarching Understandings:

- Errors do occur in DNA replication and result in mutations, which are also a source of genetic variation.

Topical Understandings	**Essential Questions**
● DNA changes the impact of information flow. ● Codon sequences affect the type of amino acid. ● The effects mutations can have on genes.	● What happens when a cell's DNA changes? ● How do various mutations affect phenotype?
Knowledge	**Skills**
Vocabulary: mutation, point mutation, frameshift mutation, mutagen, polyploidy, and phenotype	● Describe how mutation effect phenotypes ● Define mutations and describe the different types of mutations.

Evidence of Understanding

Performance Tasks
Sample labs: DNA Extraction Lab: http://www.accessexcellence.org/MTC/96PT/Share/windham.php (Note: other items can be substituted for the calf thymus) http://learn.genetics.utah.edu/content/labs/extraction/ (Virtual Lab) Gel Electrophoresis http://learn.genetics.utah.edu/content/labs/gel/ (Virtual Lab) Human Genome Project: http://www.ornl.gov/sci/techresources/Human_Genome/posters/chromosome/chooser.shtml Use this site to demonstrate the relationship between DNA and chromosomes

Integration of ELA Common Core Standards *(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)*

Reading/Writing in Science and Technical Subjects
CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

- **<Read excerpts from the textbook and be able to explain protein synthesis.>**

CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
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CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

- **<Conduct or design experiments, analyze data and form conclusions.**
- **Produce clear and coherent lab reports and research reports.>**

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
Suggested labs Rubric driven tests/quizzes Class discussion Web based simulations and activities	

*can be embedded into formative and summative assessments.

Biology **Designed by: Luzerne Intermediate Unit**

Unit 6: Inheritance

Brief Summary of Unit:

Once students have a basic understanding of DNA (structure, replication, function, role in protein synthesis) and the cell cycle, they are ready to explore genetic concepts.

The primary focus of this unit is to explore genetics through Mendelian and non-Mendelian inheritance patterns. This can be accomplished through mastering mechanisms of inheritance, mutations and the impact of genetic engineering on allele frequency. Students will construct and analyze Punnett Squares as a method to predict the results of a genetic cross. Then the students will calculate the probability of various genotype and phenotypes that result. Furthermore, the students, using traits of desired offspring, will predict possible parent genotypes. Genetic engineering will be explored through its impact in medicine, forensics and agriculture.

Extension activities for accelerated students:

- The Bioethics of Gene Therapy, http://teach.genetics.utah.edu/content/tech/genetherapy/bioethics.html
- Exploring Gene Therapy, http://teach.genetics.utah.edu/content/tech/genetherapy/exploring.html
- Meeting in Mutantville, http://teach.genetics.utah.edu/content/tech/stemcells/mutantville.html

Differentiation for the struggling students:

- Dragon Genetics, http://serendip.brynmawr.edu/sci_edu/waldron/pdf/DragonGenetics2Protocol.pdf
- The Bioethics of Human Cloning, http://teach.genetics.utah.edu/content/tech/cloning/Cloning%20Bioethics.pdf
- Let's Clone a Mouse, Mouse, Mouse, http://teach.genetics.utah.edu/content/tech/cloning/Lets%20Clone%20a%20Mouse.pdf
- Generations of Traits online activity, http://teach.genetics.utah.edu/content/begin/traits/generations.html

Materials and Resources

• CK-12 Biology
  ○ Chapter 6
  Section 6.1 Mendel's Investigations
  Section 6.2 Mendelian Inheritance
  ○ Chapter 8
  Section 8.1 Human Chromosomes and Genes
  Section 8.2 Human Inheritance
  Section 8.3 Biotechnology
	• Materials necessary to complete the performance tasks.

Unit 6: Inheritance **Section 1**

BIO.B.2 Genetics

BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.

BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).

Overarching Understandings:

- Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents.

Topical Understandings	**Essential Questions**
• Traits are inherited according to specific patterns in all forms of life. • Mendelian and non-Mendelian inheritance patterns predict offspring.	• How does a Punnett Square predict inheritance patterns? • What are the inheritance patterns that can be used to predict offspring? • How can offspring for a particular parental cross be predicted based on observed patterns of inheritance?
Knowledge	**Skills**
• Vocabulary: dominant, recessive, codominant, incomplete dominance, sex-linked, polygenic and multiple alleles, homozygous, heterozygous, phenotype and genotype. • Setup and describe parts of a Punnett Square (ie. Parent and offspring alleles) • Distinguish between Mendelian and non-Mendelian genetics	• Predict the results of a genetic cross using a word problem; construct and analyze a Punnett square. • Match alleles properly to represent genotypes of parents and offspring. • Design and analyze monohybrid and dihybrid crosses. • Calculate probability of types of offspring based each type of inheritance pattern. • Identify, analyze and predict inheritance patterns using Mendelian and non-Mendelian genetics.

BIO.B.2 Genetics

BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.

BIO.B.2.1.2 Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion).

Overarching Understandings:

- Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents.

Topical Understandings	**Essential Questions**
● Mutations can result in changes in an organism. ● Not all mutations are negative. ● Chromosome mutations have various effects on an organism producing more genetic variations within a species. ● Chromosomal mutations occur in different ways.	● What are the positive or negative effects of a chromosomal mutation? ● What are the various ways chromosomal mutations can occur?
Knowledge	**Skills**
● Vocabulary: crossing over, nondisjunction, duplication, translocation, deletion, insertion and inversion ● Chromosomes can sometimes swap sections during cell division and result in creating new genetic variations.	● Categorize various chromosomal mutations based on diagram provided: crossing over, nondisjunction, duplication, translocation, deletion, insertion and inversion. ● Summarize the processes of chromosomal mutations. ● Construct models of each type of chromosomal mutation.

BIO.B.2 Genetics

BIO.B.2.4 Apply scientific thinking, processes, tools, and technologies in the study of genetics.

BIO.B.2.4.1 Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).

Overarching Understandings:

- Genetic engineering impacts everyone.

Topical Understandings	**Essential Questions**
● Ethical implications are abundant in genetic engineering research. ● Genetic engineering has had an impact on the fields of medicine, agriculture and forensics. ● Genetically Modified Organisms are becoming more common practice in the fields of agriculture and medicine.	● How does genetic engineering affect modern life?
Knowledge	**Skills**
● Vocabulary: gene splicing, gel electrophoresis, genetic engineering, cloning, gene therapy, GMO's, transformation, DNA fingerprint ● Processes involved in genetic engineering (gene splicing, gel electrophoresis, isolation of DNA, transformation, etc.) ● Ethical concerns of genetic engineering are continually growing.	● Employ the process of electrophoresis to the analysis of DNA. ● Read and analyze a DNA fingerprint. ● Interpret and examine the effect of genetic engineering on the fields of medicine, forensics and agriculture. ● Explain how specific real life examples of genetic engineering impact agriculture, medicine and forensics.

Evidence of Understanding

Performance Tasks

Integration of ELA Common Core Standards ***(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)***

Reading/Writing in Science and Technical Subjects
CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. ● <enter tasks here - use this similar format for each task> CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-Literacy.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to*grades 9–10 texts and topics*. CCSS.ELA-Literacy.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). CCSS.ELA-Literacy.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-Literacy.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CCSS.ELA-Literacy.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when

the findings support or contradict previous explanations or accounts.
CCSS.ELA-Literacy.WHST.9-10.1 Write arguments focused on *discipline-specific content*.

- CCSS.ELA-Literacy.WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
- CCSS.ELA-Literacy.WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- CCSS.ELA-Literacy.WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- CCSS.ELA-Literacy.WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- CCSS.ELA-Literacy.WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.

CCSS.ELA-Literacy.WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

- CCSS.ELA-Literacy.WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- CCSS.ELA-Literacy.WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- CCSS.ELA-Literacy.WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
- CCSS.ELA-Literacy.WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

CCSS.ELA-Literacy.WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-Literacy.WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

CCSS.ELA-Literacy.WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-Literacy.WHST.9-10.5 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.

CCSS.ELA-Literacy.WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

CCSS.ELA-Literacy.WHST.9-10.7 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.

CCSS.ELA-Literacy.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

CCSS.ELA-Literacy.WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
Correct/Incorrect (Tests and Quizzes) Punnett Square Analysis	

*can be embedded into formative and summative assessments.

Biology **Designed by: Luzerne Intermediate Unit**

Unit 7: Theory of Evolution

Brief Summary of Unit:

Once the student has completed genetics and has an accurate understanding of the roles of DNA in the production of the phenotype of an organism they are prepared to gain an understanding of the theory of evolution. In addition skills regarding the scientific process should be reviewed to encourage greater success in understanding evolutionary concepts.

The primary focus of this unit is to develop an understanding of the theory of evolution. This will be accomplished through mastering mechanisms of evolution including natural selection, biochemistry, anatomical features, population genetics, and genetic mutations. Furthermore students will gain an understanding of new species development.

Further efforts should be devoted to fostering student understanding regarding evolution specific vocabulary and concepts.

Extension activities including current evolutionary changes are encouraged to deepen understanding and promote real world application of the knowledge being learned.

Extension activities for accelerated students:

- Stickle back fish http://learn.genetics.utah.edu/content/variation/stickleback/ online lab
- Old genes new tricks http://learn.genetics.utah.edu/content/variation/newtricks/ online activity
- Chapter 9 Section 1 in CK-12 Biology-How Earth forms and life begins

Differentiation for the non-advanced students:

- Evolution by Natural Selection http://serendip.brynmawr.edu/sci_edu/waldron/pdf/NaturalSelectionProtocol.pdf
- Interpret graphs and charts related to population genetics and natural selection

Materials and Resources

• CK-12 Biology
  ○ Chapter 10 Theory of Evolution
	• Materials necessary to complete the performance tasks.
	  • “How Did Life Start?”

Section 10.1 Darwin and the Theory of Evolution Section 10.2 Evidence for Evolution Section 10.3 Microevolution and the Genetics of Populations Section 10.4 Macroevolution and the Origin of Species	discovermagazine.com/1992/nov/howdidlifestart153 ● examples of anatomical structures of different species for comparative anatomy lab

Unit 7: Theory of Evolution **Section 1**

BIO.B.3 Theory of Evolution

BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.

BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.

Overarching Understandings:

- Scientific theories are developed to provide explanations about the nature of particular phenomena, predicting future events, or making inferences about past events.

Topical Understandings	**Essential Questions**
● Studying patterns of evolution require the use of logical scientific thought processes. ● Scientific Inquiry is applied while studying the evolutionary process.	● How are scientific theories developed? ● How do you determine the credibility, reliability and validity of resources and data?
Knowledge	**Skills**
● Vocabulary: hypothesis, inference, law, theory, principle, fact, observation ● Scientific thinking can guide your understanding of evolutionary concepts ● The steps of the Scientific Method ● The word “theory” used scientifically and publically	● Formulate a hypothesis using the if/then format. ● Distinguish between personal belief and scientific evidence. ● Critique the validity of resources. ● Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions. ● Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis. ● Read interpret and examine the credibility and validity of scientific articles, advertisements, or media stories. ● Recognize the steps in the scientific method.

BIO.B.3 Theory of Evolution

BIO.B.3.2 Analyze the sources of evidence for biological evolution.

BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).

Overarching Understandings:

- Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth.

Topical Understandings	**Essential Questions**
● Evidence obtained from new technologies support multiple lines of descent in evolution. ● Genetic information and the fossil record provide evidence of evolution. ● There are many sources of evidence that support biological evolution.	● What sources of evidence exist and how does each source of evidence support common ancestry?
Knowledge	**Skills**
● Vocabulary: Fossil record,universal genetic code, anatomical evidence, physiological evidence, embryological development, molecular clocks ● Evolution is supported by connecting all various types of scientific evidence as a whole.	● Define and describe the theory of evolution. ● Analyze the evidence which supports the theory of evolution (fossil record, embryological, anatomical, physiological, biochemical, universal genetic code). ● Investigate examples of evidence which support the theory of evolution and explain how the evidence can be interpreted.

BIO.B.3 Theory of Evolution

BIO.B.3.1 Explain the mechanisms of evolution.

BIO.B.3.1.1 Explain how natural selection can impact allele frequencies of a population.

Overarching Understandings:

- Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth.

Topical Understandings	**Essential Questions**
• Natural and human changes in the physical environment can lead to the expansion of existing species, the emergence of distinct species and the decline, and even extinction, of species. • Recognize how a change in allele frequencies of population can bring about evolution of a species. • Explain evolution of a new species using allele frequencies.	• How can a change in allele frequencies bring about evolution of a new species? • What justifies the evolution of a new species?
Knowledge	**Skills**
• Vocabulary: natural selection, allele frequencies, population, species, adaptation • Steps of Natural Selection - overproduction, variation, selection, change over time • Variation within a species is necessary for natural selection to occur.	• Predict how changes in allele frequencies will affect a population. • Analyze how current environmental factors could affect future allele frequencies. • Identify mechanisms of Darwin's theory of natural selection.

BIO.B.3 Theory of Evolution

BIO.B.3.1 Explain the mechanisms of evolution.

BIO.B.3.1.2 Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).

Overarching Understandings:

- Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth.

Topical Understandings	**Essential Questions**
• Environmental changes in any population are on-going and all species need to adapt to these changes to survive • The distributions of traits within a population can change when conditions change • If members of a species cannot adjust to quick or drastic changes, the opportunity for the species to evolve is no longer available	• What are factors that contribute to the development of a new species? • How does each isolating mechanism occur? • What factors determine the mechanisms that leads to the development of a new species?
Knowledge	**Skill**
• Define vocabulary related to evolution: genetic drift, founder effect, migration, evolution, behavioral isolation, geographic isolation, temporal isolation • Human influence on the environment changes speciation rates	• Analyze examples to determine the existence of a temporal, behavioral or geographic isolating mechanism. • Recognize and identify examples to distinguish between genetic drift, founder effect, and migration. • Compare and contrast isolating mechanisms (behavioral, geographic and temporal). • Evaluate mechanisms of evolution leading to the development of new species.

Unit 7: Theory of Evolution **Section 5**

BIO.B.3 Theory of Evolution

BIO.B.3.1 Explain the mechanisms of evolution.

BIO.B.3.1.3 Explain how genetic mutations may result in genotypic and phenotypic variations within a population.

Overarching Understandings:

- Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents.

Topical Understandings	**Essential Questions**
• Changes in a gene sequence lead to changes in gene expression • Both environmental and inherited factors can lead to changes in genetic information	• How do mutations lead to genotypic and phenotypic variations in a population? • What are environmental or inherited factors that can lead to changes in genetic information?
Knowledge	**Skills**
• Vocabulary: genotypic variation, phenotypic variation,genetic mutation • Genetic mutations lead to variations within a population.	• Identify a mutation which resulted in an advantageous adaptation. • Use examples of mutations to predict variations within a population. • Analyze how genetic mutations can have a positive and/or negative impact within a population.

Evidence of Understanding

Performance Tasks
• Evolution Comic Book: This activity has students predict the results of speciation following a mass extinction event. • Comparative Anatomy Activity where students explore anatomy of related species to observe the similarities of structure.

Integration of ELA Common Core Standards ***(The tasks below are meant to serve as sample activities regarding the integration of the standard listed. Related up-to-date material can be substituted)***

Reading/Writing in Science and Technical Subjects
• Students will read and make notes from the text in sections appropriate to the theory of evolution.Chapter 10 Section 1 of CK-12 Biology "The Voyage of the Beagle". Follow his voyage and investigative links provided in the text to write a summary describing how events on his voyage funneled his thought process towards the mechanism of natural selection. CCSS.ELA-Literacy.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-Literacy.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. • Students read the article, "How did Life Start?" Discover, discovermagazine.com/1992/nov/howdidlifestart153 Once they have read and made notes on the article they then choose one of the scientific theories of how life started. From this choice students research another source and support their choice in a brief writing assignment. CCSS.ELA-Literacy.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research. CCSS.ELA-Literacy.WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. CCSS.ELA-Literacy.WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented. CCSS.ELA-Literacy.WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented

Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
● Correct/Incorrect model (Tests, quizzes) ● Rubric for presentations, models, activities or open ended scenarios ● Writing rubric	● Use a scenario to apply evolutionary concepts. ● Display concept knowledge of evolutionary vocabulary. ● Predict results of speciation after a mass extinction event. ● "How Did Life Start?" reading/writing assignment ● "Voyage of the Beagle" reading/writing assignment

*can be embedded into formative and summative assessments.

Biology **Designed by: Luzerne Intermediate Unit**

Unit 7: Theory of Evolution

Brief Summary of Unit:

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Differentiation for the non-advanced students:

- Evolution by Natural Selection http://serendip.brynmawr.edu/sci_edu/waldron/pdf/NaturalSelectionProtocol.pdf
- Interpret graphs and charts related to population genetics and natural selection

Materials and Resources

● CK-12 Biology ○ Chapter 10 Theory of Evolution Section 10.1 Darwin and the Theory of Evolution Section 10.2 Evidence for Evolution Section 10.3 Microevolution and the Genetics of Populations Section 10.4 Macroevolution and the Origin of Species	● Materials necessary to complete the performance tasks. ● "How Did Life Start?" discovermagazine.com/1992/nov/howdidlifestart153 ● examples of anatomical structures of different species for comparative anatomy lab

Unit 7: Theory of Evolution **Section 1**

BIO.B.3 Theory of Evolution

BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.

BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.

Overarching Understandings:

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Topical Understandings	Essential Questions
● Studying patterns of evolution require the use of logical scientific thought processes. ● Scientific Inquiry is applied while studying the evolutionary process.	● How are scientific theories developed? ● How do you determine the credibility, reliability and validity of resources and data?

Knowledge	Skills
● Vocabulary: hypothesis, inference, law, theory, principle, fact, observation ● Scientific thinking can guide your understanding of evolutionary concepts ● The steps of the Scientific Method ● The word “theory” used scientifically and publically	● Formulate a hypothesis using the if/then format. ● Distinguish between personal belief and scientific evidence. ● Critique the validity of resources. ● Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions. ● Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis. ● Read interpret and examine the credibility and validity of scientific articles, advertisements, or media stories. ● Recognize the steps in the scientific method.

BIO.B.3 Theory of Evolution

BIO.B.3.2 Analyze the sources of evidence for biological evolution.

BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).

Overarching Understandings:

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Knowledge	**Skills**
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BIO.B.3 Theory of Evolution

BIO.B.3.1 Explain the mechanisms of evolution.

BIO.B.3.1.1 Explain how natural selection can impact allele frequencies of a population.

Overarching Understandings:

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Topical Understandings	**Essential Questions**
• Natural and human changes in the physical environment can lead to the expansion of existing species, the emergence of distinct species and the decline, and even extinction, of species. • Recognize how a change in allele frequencies of population can bring about evolution of a species. • Explain evolution of a new species using allele frequencies.	• How can a change in allele frequencies bring about evolution of a new species? • What justifies the evolution of a new species?
Knowledge	**Skills**
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BIO.B.3 Theory of Evolution

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Topical Understandings	**Essential Questions**
• Environmental changes in any population are on-going and all species need to adapt to these changes to survive • The distributions of traits within a population can change when conditions change • If members of a species cannot adjust to quick or drastic changes, the opportunity for the species to evolve is no longer available	• What are factors that contribute to the development of a new species? • How does each isolating mechanism occur? • What factors determine the mechanisms that leads to the development of a new species?
Knowledge	**Skill**
• Define vocabulary related to evolution: genetic drift, founder effect, migration, evolution, behavioral isolation, geographic isolation, temporal isolation • Human influence on the environment changes speciation rates	• Analyze examples to determine the existence of a temporal, behavioral or geographic isolating mechanism. • Recognize and identify examples to distinguish between genetic drift, founder effect, and migration. • Compare and contrast isolating mechanisms (behavioral, geographic and temporal). • Evaluate mechanisms of evolution leading to the development of new species.

Unit 7: Theory of Evolution **Section 5**

BIO.B.3 Theory of Evolution

BIO.B.3.1 Explain the mechanisms of evolution.

BIO.B.3.1.3 Explain how genetic mutations may result in genotypic and phenotypic variations within a population.

Overarching Understandings:

- Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents.

Topical Understandings	**Essential Questions**
• Changes in a gene sequence lead to changes in gene expression • Both environmental and inherited factors can lead to changes in genetic information	• How do mutations lead to genotypic and phenotypic variations in a population? • What are environmental or inherited factors that can lead to changes in genetic information?
Knowledge	**Skills**
• Vocabulary: genotypic variation, phenotypic variation,genetic mutation • Genetic mutations lead to variations within a population.	• Identify a mutation which resulted in an advantageous adaptation. • Use examples of mutations to predict variations within a population. • Analyze how genetic mutations can have a positive and/or negative impact within a population.

Evidence of Understanding

Performance Tasks
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Other Evidence of Understanding*

Assessment Measures	Assessment Tasks
● Correct/Incorrect model (Tests, quizzes) ● Rubric for presentations, models, activities or open ended scenarios ● Writing rubric	● Use a scenario to apply evolutionary concepts. ● Display concept knowledge of evolutionary vocabulary. ● Predict results of speciation after a mass extinction event. ● “How Did Life Start?” reading/writing assignment ● “Voyage of the Beagle” reading/writing assignment

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