Delaware Valley High School

PLANNED INSTRUCTION

A PLANNED COURSE FOR:

Honors Biology

Grade Level: 9, 10

Date of Board Approval: ___2023____

Curriculum Writing Committee: Amanda Pope

Delaware Valley High School

Marking Period Course Grade Weighting

Major Assessments	**45%**
Skills Application	**30%**
Skills Practice	**20%**
Participation	**5%**
Total	**100%**

Curriculum Map

Overview:

This course will provide a deep exploration of major concepts in biology including basic biological principles; biochemistry; cellular structure and function, including homeostasis and transport; bioenergetics, photosynthesis and cellular respiration; cell growth and reproduction; DNA and Mendelian genetics; evolutionary principles; classification and taxonomy of living things; and ecological organization and interactions.

All units presented in the courses are interconnected through significant themes and science practices in biology and aim to stress the importance of the study of life, the continuity of life, and the diversity of life. Students will learn the ways in which living organisms are influenced by their environment and the role that biology plays in their own lives – including an exploration of relevant, present-day scientific issues that exist in society.

While the content of the courses will be consistent at all levels, this curriculum offers an increased pace and depth of knowledge. Content and instruction provided encourages analytical exploration of content, often relying upon the utilization of mathematical applications. This focus allows students the opportunity to apply the principles of scientific inquiry and make robust connections between content. All biology courses are part of the planned science curricula at Delaware Valley High School.

Time/Credit for the Course: One full year, meeting daily for ~46 minutes/ 1 credit

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Goals:

1. **Marking Period One: Over a 45-day period of time, students will aim to understand:**

   UNIT 0: Nature of Science and Basic Biological Principles

   - Scientific Methodology and Experimentation by use of Controlled Experiments
   - Characteristics of Living Things
   - Classification of Living Things – Domains and Kingdoms of life
   - Organization of life – Atom →Molecule→Organelle→Cell→Tissue→Organ→Organ System
   - Utilization of mathematical practices to support scientific understanding, investigation and communication

   UNIT 1: Biochemistry

   - Atomic structure and types of bonds
   - Emergent properties of water
   - Properties of acids and bases
   - Biological Molecules structure and function: carbohydrates, lipids, proteins, nucleic acids

2. **Marking Period Two: Over a 45-day period of time, students will aim to understand:**

   UNIT 2: Cellular Biology and Mechanisms of Transport

   - The Cell Theory
   - Microscopy Skills
   - Cellular Diversity: Prokaryotic and Eukaryotic cells
   - Eukaryotic organelles' structure and function
   - The Cell membrane as a selectively permeable barrier of the cell
   - Mechanisms of Passive and Active Transport in Homeostasis

   UNIT 3: Energy, Enzymes and the Bioenergetic reactions of Photosynthesis and Cellular Respiration

   - Types of Energy and how the First and Second Law of Thermodynamics affect biological processes
   - A comparison of endergonic and exergonic reactions
   - ATP as cellular energy
   - Cells use enzymes to lower activation energy barriers and speed up reactions
   - Chemical Reactions and Energy Transformations involved in Photosynthesis and Cell Respiration

3. Marking Period Three Over a 45-day period of time, students will aim to understand:

UNIT 4: DNA as the Genetic Material: Replication and Protein Synthesis
- Critical experiments to conclude DNA as the genetic material
- DNA's role in storing information for trait expression and protein synthesis
- Semi-conservative Replication of DNA
- Mechanism of Protein Synthesis by transcription and translation
- Gene Expression controls

UNIT 5: Cell Division: Mitosis and Meiosis
- Sexual vs. Asexual Reproduction
- Binary Fission, Cell Cycle, Cell Division, and stages of Mitosis
- Controls of the cell cycle and cancer
- Production of Sex Cells, Meiosis, chromosome analysis, and karyotyping

UNIT 6: Mendelian Genetics, Biotechnology and Bioethics
- Genetics Terminology
- Inheritance Patterns and Probability
- Genetics of Blood Typing
- Pedigree Analysis
- Genetic Engineering
- Considerations of Bioethical Issues

4. **Marking Period Four: Over a 45-day period of time, students will aim to understand:**

UNIT 7: Evolutionary Principles and Natural Selection
- Evolution as a Scientific Law and Scientific Theory
- Genetic support of evolutionary principles
- Significance of common ancestry and examples connected to previous units
- Evidence of Evolution – fossils, anatomical features, molecular similarities, & embryology
- Charles Darwin's contribution and Natural Selection
- Biological Species Concept, Speciation and Reproductive Barriers
- Adaptations and Biodiversity

UNIT 8: Ecology
- Levels of Ecological Study
- Community Level interactions: Symbioses
- Food Chains and Webs: Transference of energy through an ecosystem
- Population Dynamics and Population Growth Curves
- Limiting Factors to population growth
- Biogeochemical Cycling
- Terrestrial and Aquatic Biomes
- Current threats to biological diversity, ecosystem health and biosphere

UNIT 9: Eukaryotic Kingdoms: Diversity, Anatomy and Physiology

- Fungal Kingdom Diversity and Structures
- Protist Kingdom Diversity and Structures
- Plant Kingdom Diversity and Structures
- Animal Kingdom Diversity and Structures

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Big Ideas

Big Idea #1: All organisms are made of cells and can be characterized by common aspects of their structure and functioning.

Big Idea #2: Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment.

Big Idea #3: 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.

Big Idea #4: Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth.

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Textbook and Supplementary Resources

Name of Textbook: *Inspire Biology*

Textbook ISBN#: 978-0-07-688434-6

Textbook Publisher & Year of Publication: McGraw-Hill Education, 2020

Supplemental Resources: *Inspire Biology* website & online resources

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Curriculum Plan

<u>Unit 0</u>: Nature of Science and Basic Biological Principles
<u>Time Range in Days</u>: Approximately 10 days

<u>Standards:</u>PA Keystone Biology Assessment Anchors and Enhanced Standards
3.1.B.A1, 3.1.B.A5, 3.1.B.A6, 3.1.B.C2, 4.1.3.A, 4.1.4.A

<u>2025 Standards:</u>
3.1.9-12.B Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
3.1.9-12.C Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

<u>Anchors</u>:
BIO.A.1.1 Explain the characteristics common to all organisms.
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.

<u>Eligible Content:</u>
BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
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).
BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).
BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.

Objectives: (Students will be able to)

1. Identify major themes in biology by describing the characteristics of living things and relating them to real-life examples (DOK 1)
2. State the goals of science (DOK 1)
3. Recall the steps of the scientific method (DOK 1)
4. Evaluate the importance of peer-review in scientific literature (DOK 3)
5. Conduct and/or analyze one or more scientific investigations (DOK 2 and DOK 4)
6. Apply statistical analysis of standard deviation mean, median and mode to data (DOK 4)
7. Consider the utilization of controls for comparison and the importance of placebo and blind-testing for scientific validity and reliability (DOK 3)
8. Create and interpret appropriate graphical representations of data (DOK 4)
9. Explain what a scientific theory is (DOK 3)
10. Distinguish the ways by which life can be studied at different levels (DOK 2)
11. Identify patterns in the sequential organization of living things by recognizing examples in nature. (Atom →Molecule→Organelle→Cell→Tissue→Organ→Organ System) (DOK 2)

12. Cite evidence of how structure relates to function (pertaining to molecules, cells, organs, etc.) (DOK 3)
13. Describe the goals of binomial nomenclature and systematics (DOK 1)
14. Name the six kingdoms of life as they are currently identified (DOK 1)
15. Explain what the tree of life represents (DOK 1)
16. Develop a logical argument that all organisms share common characteristics (DOK 3)

Core Activities and Corresponding Instructional Methods:

1. Complete a Summer Work assignment that focuses on scientific method and graphing skills.
2. Describe the characteristics of living things.
    a. Read from Module 1 in the *Inspire Biology* textbook, Lesson 1, pages 4 - 10, to explore the field of biology and identify eight unifying characteristics of living things and to understand big ideas in biology. Students should compare examples of each of the characteristics and be able to provide their own examples of each characteristic.
    b. Students should identify examples of each of the characteristics in nature.
3. Recall the goals of science and identify examples of observation, inference, hypothesis, principle, fact, scientific theory and scientific law.
    a. Read from Module 1 in the *Inspire Biology* textbook, Lesson 2, pages 11 - 16, which defines the nature of science, science methodology, careers in science, and factors that affect science and society. Expand on the reading by discussing the article on page 17 - “A Shot in the Arm.”
    b. Complete a read-aloud, discussion, and/or assessment pertaining to historical examples of scientific experiments, (example: Redi’s Investigation of Spontaneous Generation) to recall the steps of the scientific method. In doing so, students will gain a deeper understanding of what science is and how certain scientific investigations have helped pave the way for current thinking in science.
    c. Design and perform a lab where students are provided a treatment of caffeine or no caffeine to determine if there is a n effect on a physiological response, such as heart rate
4. Design a controlled scientific experiment.
    a. Review real and relevant experiments to practice identifying the controlled, independent and dependent variables of the experiments.
    b. Evaluate the need for controlled variables to increase validity and reliability.
    c. Have the students perform a lab to practice writing a hypothesis, identifying variables, conducting, and analyzing an investigation.
    d. Alka Seltzer lab or Bubbleology Lab.
    e. Evaluate the importance of placebo effect in controlled scientific experiments.
    f. Calculate mean, median and mode for collected data and indicate statistical deviation on graphical depictions of data
5. Identify the levels of biological study.
    a. Provide examples definitions of each hierarchical level (atomic, molecules, organelle, cell, tissue, organ system,organism, population, community, ecosystem, biome, biosphere) and perform a matching activity with examples of biological studies at each level.
6. Reference the concepts of common ancestry and adaptation to identify organismal similarities and differentiation.

a. Read from Module 16 in the *Inspire Biology* textbook, pages 424 - 445 to understand the history of taxonomy, the goals of binomial nomenclature first presented by Carolus Linnaeus, the modern classification system, domains and kingdoms of life, and the tree of life.
b. Utilize examples and graphic organizers to review taxonomic levels.
c. Practice using a dichotomous key to practice identifying objects using a systematic process.
d. Review characteristics utilized by taxonomists to classify species, including genetic code, physical features and behaviors, reproductive strategies, and habitats.
e. Research an organism to identify unique adaptations and related species based on classification criteria.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Summer Work Assignment: Experimental Design and Graphing Skills
Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Controlled Experimental Design Lab
Common Assessment Unit 0 (Consists of both Multiple Choice and Free Response Questions)

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UNIT 1: Biochemistry
Time Range in Days: Approximately 30 days

Standards (by number): PA Keystone Biology Academic Standards
3.1.B.A2, 3.1.B.A5, 3.1.B.A7, 3.1.B.A8, 3.1.C.A2, 3.1.C.A7, 3.2.C.A2, 4.2.5.C

2025 Standards:
3.1.9-12.F Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules

Anchors:
BIO.A.2.1 Describe how the unique properties of water support life on Earth.
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.2.3 Explain how enzymes regulate biochemical reactions within a cell.
BIO.A.1.1 Explain the characteristics common to all organisms.
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.

Eligible Content:
BIOA.2.1 Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).
BIO.A.2.2.1 Explain how carbon is uniquely suited to form biological macromolecules.
BIO.A.2.2.2 Describe how biological macromolecules form from monomers.
BIO.A.2.2.3 Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.

Objectives: (Students will be able to)
1. Identify and distinguish between the three subatomic particles found in atoms (DOK 1, 2)
2. Describe the properties of polar and nonpolar covalent bonds and identify examples of each based on bonding rules (DOK 3)
3. Differentiate structure and properties of covalent from ionic from hydrogen bonds (DOK 3)
4. Evaluate why different bonds affect the properties of a molecule (DOK 3)
5. Identify the parts of a chemical reaction, including reactants, products, appropriate chemical notation and the use of coefficients for balanced chemical formulas (DOK 1)
6. Identify patterns about the unique properties of water and the molecular basis behind these properties(DOK 2)
7. Differentiate between solutions and suspensions (DOK 3)
8. Compare acidic solutions and basic solutions and explain the molecular basis for these properties. Determine the importance of buffers in biological systems (DOK 3)
9. Relate the properties of carbon to its significance in many different structural and functional characteristics of living things (DOK 2)
10. Compare, contrast and make prediction about the structures and functions of each of the four groups of macromolecules (DOK 3)
11. Describe the four levels of protein structure and how each is determined (DOK 2)
12. Predict the effect on protein function when protein structure is altered (DOK 3)

13. Apply concepts learned when studying proteins to the understanding of metabolic functions (enzymes) (DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Identify and distinguish between the three subatomic particles found in atoms.
   a. Read from Module 6 in the *Inspire Biology* textbook, Lesson 1, pages 127 - 132, which discusses atomic structure, elements, the periodic table, isotopes, and compounds.
   b. Complete a read-aloud, discussion, watch a video, and/or create a model to display understanding of atomic structure.
   c. Ask students to practice drawing electron configurations of common elements found in living organisms.
   d. Practice counting the number of atoms in a chemical formula and the role that subscripts play in the appearance of the chemical formula.

2. Describe and compare Polar Covalent, Non-Polar Covalent, Ionic and Hydrogen Bonds
   a. Read from Module 6 in the *Inspire Biology* textbook, Lesson 1, pages 133 - 136, to identify the characteristics of chemical bonds, including covalent and ionic bonds.
   b. Complete a read-aloud, discussion, watch a video, act out, and/or create a model to display understanding of chemical bonding.
   c. Predict the types of bonds in molecules based on electronegativities of constituent elements.

3. Identify the parts of a chemical reaction, including reactants, products, appropriate symbols and accurate coefficients for a balanced chemical formula .
   a. Read from Module 6 in the *Inspire Biology* textbook, Lesson 2, pages 137 - 140, to understand the parts of chemical reactions.
   b. Practice identifying parts of chemical reactions using common examples in biology.
   c. Demonstrate balancing equations and the importance of the number of atoms being consistent on both sides of the equation.

4. Identify patterns about the unique properties of water including its polar composition, hydrogen bonding, cohesion, adhesion, capillary action, high specific heat, and states of matter.
   a. Read from Module 6 in the *Inspire Biology* textbook, Lesson 3, pages 144 - 147, to understand the properties of water.
   b. Practice drawing water molecules to exhibit its polar nature.
   c. Use water molecule models to demonstrate hydrogen bonding.
   d. Provide biotic examples to depict the significance of cohesion, adhesion, capillary action and temperature modification as emergent properties of water.

5. Differentiate between solutions and suspensions and compare acidic solutions and basic solutions
   a. Read from Module 6 in the *Inspire Biology* textbook, Lesson 3, pages 148 - 150, to understand mixtures with water, solutions, suspensions, solutes, solvents, acids, and bases.
   b. Have students complete a lab activity that exhibits different examples of solutions, suspensions, and testing for acids and bases using litmus paper or other indicators.
   c. Relate acidic and basic solutions to examples of homeostasis.

d. Calculate the pH of solutions based on hydrogen ion and hydroxide ion concentrations.
e. Evaluate or collect data to determine whether a substance is an acid, base, neutral and/or buffer.

6. Relate the properties of carbon to its significance in many different structural and functional characteristics of living things, particularly the four groups of macromolecules - carbohydrates, lipids, proteins, and nucleic acids.

a. Read from Module 6 in the *Inspire Biology* textbook, Lesson 4, pages 151 - 157, to define organic chemistry, understand how carbon's structure has titled it to be the "backbone of life" and the basis for biological molecules, and distinguishing between the 5 classes of macromolecules.
b. Have students practice drawing the carbon atom to understand how its valence electrons allow for versatility in creating life molecules.
c. Have students create or fill in a graphic organizer or reference cards that distinguish the structural and functional features that exist between and among carbohydrates, lipids, proteins, and nucleic acids.
d. Have students create visible/tangible displays of macromolecules to reinforce the relationship between monomer and polymer.
e. Have students perform a lab activity to identify macromolecules in an unknown substance using chemical properties (Stomach Contents Investigation Lab).
f. Use tubers or other manipulatives, such as fold.it to demonstrate levels of protein folding.
g. Explore the role of proteins as enzymes by observing the effect of catalase on hydrogen peroxide. Generate predictions of the effect of environmental factors such as temperature and pH on enzymatic activity. Create graphs to depict data collected.
h. Use the website https://cdn.rcsb.org/pdb101/molecular-machinery/ to determine structure and function of extracellular, membrane-bound, cytoplasmic and nuclear proteins
i. Provide real-life examples of macromolecules such as in nutrition, everyday human body functions/composition, relevance in nature (ex. Oil harvested from whales; Chronic Waste Disease in ungulates) - refer to page 158 "Balancing your Plate" in textbook.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Inorganic Chemistry and Properties of Water Common Assessment (Consists of both Multiple Choice and Free Response Questions)

Organic Chemistry Common Assessment (Consists of both Multiple Choice and Free Response Questions)

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UNIT 2: Cellular Biology and Mechanisms of Transport
Time Range in Days: Approximately 25 days

Standards (by number): PA Keystone Biology Academic Standards
3.1.B.A9, 3.1.B.B6., 3.1.B.C4., 4.1.10.F., 4.2.10.D., 4.4.10.E., 3.1.10.A2, 3.1.10.A5, 3.1.10.A6., 3.1B.A1., 3.1.B.A5

2025 Standards:
3.1.6-8.A Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.
3.1.6-8.B Develop and use a model to describe the function of a cell as a whole and the ways that parts of cells contribute to the function.
3.1.6-8.C Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells

Anchors:
BIO.A.1.1 Explain the characteristics common to all organisms.
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.
BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

Eligible Content:
BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
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).
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.
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).
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.
BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Objectives: (Students will be able to):

1. State the three parts of the cell theory (All living things are made of cells; cells are the basic structure and function of living things; all cells come from pre-existing cells) and be able to apply each part to an example in nature (DOK 1, 4)
2. List and arrange the cellular organization of living things (cells→tissues→organs→organ systems→organism) (DOK 1)
3. Make connections of diversity and specialization of cells to real-life examples (DOK 4)

4. Differentiate between the variety of cells that exist in the 3 domains of life (DOK 3)
5. Compare and contrast prokaryotic and eukaryotic cells (DOK 2)
6. List organelles found in eukaryotic cells (DOK 1)
7. Classify structural features of eukaryotic cell organelle and relate the structural features with the organelle's function (DOK 2)
8. Describe the pathway, including relationship and function of each portion of the endomembrane system, used to generate, modify and distribute proteins in and out of the cell (DOK 3)
9. Compare and contrast major features and organelles of plant and animal cells (DOK 2)
10. Identify structure and function of components in the cell membrane (DOK 1)
11. Predict the ability of a molecule to passively cross a cell membrane based on general features and types of bonds (DOK 4)
12. Distinguish between Active and Passive Transport and describe examples of each (DOK 2)
13. Apply knowledge of concentration gradients in order to explain the mechanisms by which materials move across the cell membrane (DOK 4)
14. Recall the energy requirements that apply to different types of cell transport (DOK 1)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Define Scientific Theory and review the three parts of the Cell Theory.
    a. Read from Module 7 in the *Inspire Biology* textbook, Lesson 1, pages 162-163 which discusses the discovery of the cell and the Cell Theory.
    b. Hold a class discussion about the value of a scientific theory and how the Cell Theory is applied in biological study.
3. Review the three Domains of Life and compare Prokaryotic and Eukaryotic Cells.
    a. Read from Module 7 in the *Inspire Biology* textbook, Lesson 1, pages 167-168, to identify the characteristics of prokaryotic and eukaryotic cells and review the kingdoms included in each domain.
    b. Create a Venn Diagram or other graphic organizer to compare and contrast Prokaryotic and Eukaryotic cells. This could become a classroom visual that can be added to throughout the year with additional learned details to distinguish these two major cell types.
4. Utilize Compound Light Microscopes to visualize cells.
    a. Perform a lab to learn the features and functions of a light microscope and how to use them appropriately.
    b. View prepared slides and create wet-mount slides of cells from onion skin.
5. Review the organelles of the eukaryotic cell.
    a. Read from Module 7 the *Inspire Biology* textbook, Lesson4, pages 181-193, to identify the structure and function of eukaryotic cells.
    b. Apply knowledge of these organelles in the form of an analogy to a city or school.
    c. Perform research on a specific eukaryotic cell type and write a report or create a descriptive model to share with class.
    d. Distinguish between the organelles in a plant and animal cell by analyzing images of each type. Compare these eukaryotic images to images of prokaryotic cells.

   e. Read an article on the Endosymbiotic Theory to create evolutionary connections to cell organelle structure.
   f. Use learn.genetics.utah.edu Mystery Cell activity to predict cell types based on structures, embedded proteins and organelle functions
6. Investigate the structures and functions of the components of the Cell Membrane.
   a. Read from Module 7 in the *Inspire Biology* textbook, Lesson 2, pages 169-172, to identify the characteristics of the components of the cell membrane.
   b. Create a painting to represent the components of the cell membrane.
7. Review types of cell transport.
   a. Read from Module 7 in the *Inspire Biology* textbook, Lesson 3, pages 173-180, to compare and contrast Active and Passive Transport.
   b. Perform diffusion and osmosis labs to demonstrate and measure cellular transport with eggs or dialysis tubing.
   c. Perform a lab to generate and graph data to determine solute concentrations of unknown solutions based on osmotic flow
   d. Analyze images to distinguish major features of transport.
   e. Read and analyze case studies to determine cause and effects of osmosis in biological systems.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Cell Analogy Project or Cell Type Research Project
Diffusion/Osmosis Lab
Common Assessment Unit 2 (Consists of both Multiple Choice and Free Response Questions)

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<u>UNIT 3:</u> **Energy, Enzymes, and the Bioenergetic Reactions of Photosynthesis and Cellular Respiration**
<u>Time Range in Days</u>: Approximately 20 days

<u>Standards (by number):</u> PA Keystone Biology Academic Standards
3.1.B.A.7, 3.1.C.A2, 3.1.C.A2, 3.3.10A, 3.1.C.A1, 3.3.10B, 3.4.10A, 3.1.B.A2, 3.1.B.A2, 3.1.B.A5, 3.1.B.A7, 4.1.10.C

<u>2025 Standards:</u>
3.1.9-12.G Matter and Energy in Organisms and Ecosystems Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
3.1.9-12.E Matter and Energy in Organisms and Ecosystems Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
3.1.9-12.J Matter and Energy in Organisms and Ecosystems Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

<u>Anchors:</u>
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.2.3 Explain how enzymes regulate biochemical reactions within a cell.
BIO.A.3.1 Identify and describe the cell structures involved in processing energy.
BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.

<u>Eligible Content:</u>
BIO.A.2.3.1 Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
BIO.A.2.3.2 Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.
BIO.A.3.1.1 Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.
BIO.A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.
BIO.A.3.2.2 Describe the role of ATP in biochemical reactions.

Objectives: (Students will be able to)
1. State and apply the First and Second Laws of Thermodynamics to biological systems (DOK 1, 4)
2. State the properties of endergonic and exergonic reactions. (DOK1)
3. Predict if a reaction is exergonic or endergonic and connect the ideas of spontaneous. Nonspontaneous, anabolic and catabolic to this concept(DOK4)
4. Identify the structure of ATP and explain its role in cellular work. (DOK2)
5. Explain the effect of enzymes in lowering activation energy to catalyze reactions. (DOK2)
6. Predict the effect of environmental factors on enzyme dynamics (DOK 4)
7. Apply the concepts of a reduction-oxidation (redox) reaction in photosynthesis and cellular

respiration to determine which reactants are converted into which products (DOK3)
8. Recognize that light and pigments are necessary components of photosynthesis (DOK 1)
9. Identify and explain the role of electron carrier molecules in photosynthesis (DOK 1, 3)
10. Write the chemical equation for photosynthesis, including both reactants and products (DOK 1)
11. Distinguish between the light-dependent reactions and the light-independent reactions/Calvin Cycle in photosynthesis (DOK 2)
12. Draw and label the general structure of a chloroplast (DOK 1)
13. Compare the different factors that affect the rate at which photosynthesis occurs(DOK 3)
14. Apply concepts of autotrophy and heterotrophy to energy demands and biochemical energetic reactions (DOK 3)
15. Label a cross-section of a leaf and distinguish which tissues are involved in photosynthesis (DOK 1, 2)
16. Compare the evolutionary adaptations such as C3, C4 and CAM plants, stomatal control and cuticle thickness for water loss reduction (DOK3)
17. Explain the general purpose of cell respiration (DOK 1)
18. Write the chemical equation for cellular respiration, including reactants and products (DOK 1)
19. Draw and label the general structure of a mitochondrion (DOK 1)
20. Recognize what happens during glycolysis (DOK 1)
21. Summarize what happens during the Krebs cycle (DOK 2)
22. Recognize how high-energy electrons are used by the electron transport chain (DOK 1)
23. Compare and contrast aerobic and anaerobic respiration (DOK 2)
24. Describe different types of anaerobic respiration (alcohol fermentation and lactic acid fermentation) (DOK 1)
25. Analyze the net production of ATP that is generated by both anaerobic and aerobic respiration (DOK 4)
26. Predict and evaluate the influence of toxins, inhibitors, and treatments that affect cell respiration mechanisms or concentrations of red blood cell (DOK 4)
27. Assess the relationship that exists in ecosystems between the processes of photosynthesis and cellular respiration (DOK 3)
28. Identify which types of cells undergo photosynthesis and cell respiration (DOK 1)
29. Apply prior understanding of autotrophs and heterotrophs to the processes of photosynthesis and cell respiration (DOK 4)
30. Connect prior knowledge of enzymatic reactions and how they affect chemical reactions (DOK 4)
31. Apply concepts learned when studying biochemistry to the transformations that occur between molecules in photosynthesis and cellular respiration (DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Distinguish types of energy-absorbing and energy-releasing reactions.
    a. Read from Module 3 in the *Inspire Biology* textbook, Lesson 2, pages 137-140, to learn about endergonic and exergonic reactions.

   b. Present vocabulary and concepts in a way that students can use as a study tool and mastery of the main ideas and terminology.
   c. Provide everyday examples of both types of reactions.
   d. Make connections between these reactions and the First and Second Laws of Thermodynamics.

2. Identify the role of Enzymes in catalyzing reactions .
   a. Read from Module 3 in the *Inspire Biology* textbook, Lesson 2, pages 141-143, to understand how enzymes reduce activation energy.

3. Identify the effects of temperature, pH, enzyme and substrate concentration on reaction rate.
   a. Read from Module 3 in the *Inspire Biology* textbook, Lesson 2, pages 141-143, to understand how enzymes are affected by environmental conditions.
   b. Demonstrate or perform a lab that demonstrates enzyme activity. This lab may be the effect of catalase on hydrogen peroxide or the effect of amylase on starch digestion .
   c. Investigate the effect of variables on enzymatic activity – “Toothpickase lab”. Graph the data collected in the lab to determine rates of reaction and describe the effect of substrate concentration, enzyme concentration and environmental variables, such as cold to rate.
   d. Demonstrate the effects of temperature and pH by denaturing milk to create cheese curd.
   e. Use the Jon Darkow data website to determine the optimal pH and temperatures of specific enzymes

4. Review the Laws of Thermodynamics and the role of ATP when cells do work.
   a. Read from Module 8 in the *Inspire Biology* textbook, Lesson 1, pages 198-201, to review the laws and label ATP structure.
   b. Apply the concepts of the Second Law of Thermodynamics to predict if a reaction is endergonic or exergonic.

5. Investigate the role of pigments in photosynthesis, stages, reactants and products of photosynthesis.
   a. Read from Module 8 in the *Inspire Biology* textbook, Lesson 2, pages 202-208, to learn about the stages of photosynthesis.
   b. Perform paper chromatography to separate and identify pigments in spinach leaves.

6. Create connections between physiological processes such as heart rate and breathing rate and energy demand and oxygen availability during Cellular Respiration and fermentation
   a. Read from Module 8 in the *Inspire Biology* textbook, Lesson 3, pages 209-213 to learn about cellular respiration and the relationship between cellular respiration and photosynthesis.
   b. Perform the BTB Exercise lab to collect data on the amount of carbon dioxide released when students are exercising.
   c. Perform a lab with Vernier Software and Pea seeds to determine the effect of temperature and germination on cellular respiration. Calculate rate of respiration and compare variables.
   d. Perform a yeast fermentation lab to determine the effects of pH and temperature on carbon dioxide production.
   e. Use the Jon Darkow data website to determine the stages of aerobic and anaerobic cellular respiration based on ATP production.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities/scenarios
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Energy, Enzymes and ATP Assessment (Consists of both Multiple Choice and Free Response Questions)
Photosynthesis Assessment (Consists of both Multiple Choice and Free Response Questions)
Cellular Respiration Assessment (Consists of both Multiple Choice and Free Response Questions)

Delaware Valley High School

<u>Unit 4</u>: DNA Structure, Replication, Transcription, and Translation
<u>Time Range in Days</u>: Approximately 15 days

<u>Standards (by number):</u> PA Keystone Biology Academic Standards
3.1.B.A5, 3.1.B.B1, 3.1.B.B3, 3.1.B.B5, 3.1.B.C2, 3.1.C.B3, 3.1.C.C2

<u>2025 Standards:</u>
3.1.9-12.A Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
3.1.9-12.P Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
3.1.9-12.Q Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
3.1.9-12.R Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

<u>Anchors:</u>
BIO.B.2.2 Explain the process of protein synthesis (i.e., transcription, translation, and protein modification).
BIOB.2.3 Explain how genetic information is expressed.

<u>Eligible Content:</u>
BIO.B.2.2.1 Describe how the processes of transcription and translation are similar in all organisms
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.
BIO.B.2.3.1 Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame-shift).

Objectives: (Students will be able to)
1. Identify the role of DNA in heredity (DOK 1)
2. Draw the nucleotides are the molecular subunits of DNA discussed in Unit 1 (DOK 1)
3. Label a nucleotide monomer of a nucleic acid with a labeling of the carbons on the pentose sugar (DOK 1)
4. Illustrate the double helix structure of DNA and describe the antiparallel nature of the molecule with reference to the carbons on the pentose sugar (DOK 1)
5. Explain the experiments of Griffith, Avery. Hershey & Chase, Chargaff and Franklin that led to the determination of the double helix structure of DNA (DOK 2)
6. Summarize the events in DNA replication, including the enzymatic activity (DOK 2)
7. Identify the evaluate the contribution of the enzymes involved in DNA replication (DOK 3)
8. Determine the leading and lagging strand at a replication fork (DOK 3)
9. Identify DNA replication as a repeating pattern that occurs in an organism's lifetime (DOK 2)
10. Compare and contrast major features of DNA and DNA replication in prokaryotes and eukaryotes (DOK 3)

11. Compare and contrast the structure of DNA to that of RNA (DOK 2)
12. List the 3 types of RNA (DOK 1)
13. Explain why DNA must make mRNA in order to successfully produce proteins (DOK 1)
14. Summarize the process of transcription, including the enzymatic activity (DOK 2)
15. Describe and label the process of mRNA splicing, which is unique to eukaryotic cells (DOK 2)
16. Recall that amino acids are the subunits of proteins (DOK 1)
17. Make connections to show how mRNA codons, that were transcribed from a DNA blueprint, are then translated into a code of amino acids (DOK 4)
18. Summarize the process of protein synthesis (translation), including the role of DNA, mRNA, tRNA, and rRNA (DOK 2)
19. Compare and contrast the process of protein synthesis in prokaryotic and eukaryotic cells (DOK 3)
20. Recognize that mutations may occur during DNA replication and protein synthesis and may or may not have observable effects (DOK 2)
21. Describe demonstrate different types of point mutations, as seen both in DNA code (substitution, deletion and insertion (frameshift)) and amino acid sequence (silent, missense, nonsense) (DOK4)
22. Create an analogy for the process of protein synthesis (DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Identify the role of DNA in heredity and be able to recall and illustrate the structure of the nucleotide as the subunit/monomer that gives rise to the DNA double helix.
    a. Read from Module 11 in the *Inspire Biology* textbook, Lesson 1, pages 288 - 291, to learn about the historical events that lead to the discovery of DNA as the genetic material in cells.
    b. Read from Module 11 in the *Inspire Biology* textbook, Lesson 1, pages 291 - 295, to review the structure of the DNA double helix, and the scientific collaboration that led to its discovery.
    c. Have students watch a guided video featuring DNA structure and function such as PBS NOVA's "DNA: The Secret of Life."
    d. Have students perform a DNA extraction from a chosen source such as strawberries, bananas, spinach, etc.
    e. Have the students create, draw, or color a model of the DNA double helix indicating monomers, antiparallel directionality and contribution of covalent and hydrogen bonds.

2. Summarize the events in DNA replication, including the enzymatic activity and identify DNA replication as a repeating pattern that occurs in an organism's lifetime.
    a. Read from Module 11 in the *Inspire Biology* textbook, Lesson 2, pages 296 - 298, to understand the process of DNA replication, including its necessity for cell division, the role that enzymes play in the process.
    b. Watch an animation featuring DNA replication.

c. Use a simulation, hands-on manipulative, or cut-n-paste type of activity to allow students to practice base-pairing for DNA replication.

3. Compare and contrast the structure of DNA to that of RNA, list the 3 types of RNA, and understand the necessity of MRNA for the successful production of proteins.

a. Read from Module 11 in the *Inspire Biology* textbook, Lesson 3, pages 299 - 301, to understand the process of DNA transcription and translation, including the role of the three types of mRNA and enzymes in the production of proteins.

b. Create an analogy for the students about the roles of DNA, mRNA, rRNA, tRNA and the production of proteins (DNA = Captain of ship; mRNA = first mate; rRNA = the ship deck; tRNA = the crew members doing the heavy lifting) or have the students create their own analogy for protein synthesis.

4. Recall that amino acids are the subunits of proteins and describe the manner in which mRNA codons are translated into a code of amino acids; summarize the processes of DNA translation and its role in Protein Synthesis.

a. Read from Module 11 in the *Inspire Biology* textbook, Lesson 3, pages 301 - 305, to learn about mRNA codons, translation, and the way in which genes code for proteins.

b. Use a classroom model, video, or manipulative to allow students to visualize/demonstrate protein synthesis.

c. Complete the CHNOPS activity to create traits of a fictitious organism based on genetic sequences. Determine appropriate DNA code for another student to transcribe and translate to make a new CHNOP organism.

5. Recognize that mutations may occur during DNA replication and protein synthesis; Differentiate between types of genetic mutations .

a. Read from Module 11 in the *Inspire Biology* textbook, Lesson 4, pages 306 - 314 to learn about gene regulations and mutations.

b. Have students practice scenarios in which mutations can occur and discuss the differences in outcomes for mutations occurring during DNA replication prior to mitosis and those that occur prior to meiosis.

c. Analyze DNA and protein transcripts to determine mutations and predict the impact on the protein functionality

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities/scenarios
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

DNA Structure and Function Assessment

Delaware Valley High School

RNA, Transcription, Translation & Protein Synthesis Assessment

Delaware Valley High School

Unit 5: Cell Division: Mitosis and Meiosis
Time Range in Days: Approximately 15 days

Standards: PA Keystone Biology Assessment Anchors and Enhanced Standards
3.1.B.A4, 3.1.B.A5, 3.1.B.B1, 3.1.B.B2, 3.1.B.B3, 3.1.B.B5, 3.1.B.C2, 3.1.C.C2

2025 Standards:
3.1.6-8.N Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
3.1.9-12.D Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
3.1.9-12.P Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
3.1.9-12.Q Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Anchors:
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis
BIO.B.1.2 Explain how genetic information is inherited.

Eligible Content:
BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.
BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.
BIO.B.1.2.1 Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.
BIO.B.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.

Objectives: (Students will be able to)

1. Recognize that cell size is limited because of growth, DNA overload, and surface to volume ratio (DOK 1)
2. Identify different forms of DNA and how it should appear at different stages of the cell cycle (molecular, chromatin, chromosome) (DOK 1)
3. Explain the role of DNA and chromosomes in cell division (DOK 1)
4. Summarize the stages of the cell cycle (DOK 2)
5. Recognize that DNA must be copied before cell division can occur (DOK 1)
6. Describe the specific events of the four phases of mitosis (DOK 2)
7. Describe the process of cytokinesis (DOK 1)
8. Distinguish between cytokinesis in animal cells and in plant cells (DOK 2)
9. Cite evidence of how the cell cycle is regulated (DOK 1)
10. Identify three specific cell cycle checkpoints and what each is checking for (DOK 2)
11. Distinguish between cancer cells and healthy cells (DOK 2)
12. Relate the onset of cancer to the control of the cell cycle (DOK 2)
13. Differentiate between diploid (2n) and haploid (n) cells (DOK 3)

14. Differentiate between asexual and sexual reproduction and evaluate evolutionary advantages of each (DOK 3)
15. Compare and contrast a somatic cell and a gamete (DOK 2)
16. Summarize the events of meiosis (DOK 2)
17. Describe the processes of independent assortment and crossing over (DOK 2)
18. Compare and contrast meiosis and mitosis (DOK 3)
19. Identify three specific events in meiosis and fertilization that contribute to genetic variation in offspring (DOK 3)
20. Provide examples to illustrate and evaluate the benefit of variation in a population (DOK 4)
21. Apply an understanding of cells to the processes of mitosis and meiosis (DOK 4)
22. Explain what a karyotype is and why it is used (DOK 1)
23. Create and analyze a karyotype in order to recognize chromosomal defects that may occur during meiosis as a result of nondisjunction(DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Recognize that cell size is limited because of growth, DNA overload, and surface to volume ratio and recall that cells must divide in order to maintain their size.
    a. Read from Module 9 in the *Inspire Biology* textbook, Lesson 1, pages 220 - 221, which discusses limitations to cell size.
    b. Have students brainstorm analogies to better understand surface to volume ratio (in relation to exchange of materials/communication) and DNA overload.
3. Identify different forms of DNA and how it should appear at different stages of the cell cycle (molecular, chromatin, chromosome) and explain the role of DNA and chromosomes in cell division.
    a. Read from Module 9 in the *Inspire Biology* textbook, Lesson 1, pages 222, to understand the different forms of DNA - Chromatin vs. Chromosome.
    b. Have students brainstorm analogies for chromatin vs. chromosomes (ex. Spaghetti vs. lasagna strands).
4. Summarize the stages of the cell cycle, including mitotic division and cytokinesis (and the differences between animal and plant cells), and recognize that DNA must be copied before cell division can occur.
    a. Read from Module 9 in the *Inspire Biology* textbook, Lesson 1, pages 223 - 227, to learn about the stages of the cell cycle, including the 3 important events that occur in Interphase - growth, DNA synthesis, and preparation for division.
    b. Have students draw, sort, or use an interactive simulation to understand the events that take place in mitosis and cytokinesis.
    c. Watch educational videos or animations that highlight the events that occur in the cell cycle - interphase, mitosis, and cytokinesis.
5. Cite evidence of how the cell cycle is regulated and in doing so, distinguish between cancer cells and healthy cells, and understand how cancer is related to the control of the cell cycle.
    a. Read from Module 9 in the *Inspire Biology* textbook, Lesson 1, pages 228 - 230, to learn about cell cycle regulation, apoptosis, and patterns in abnormal cell cycle regulation that leads to cancer.

b. Read a related article about the types, causes, and treatments of cancer.
c. Read HHMI article *Errors in Division* to relate aneuploidy to loss of cell cycle controls.
d. Complete the Nobel Prize Cell Cycle Control game to review the three checkpoints in the cell cycle.

5. Recall the differences between asexual and sexual reproduction as a lead into a discussion of the events that occur in meiosis and the production of gametes (sex cells). Distinguish between diploid body cells and haploid gametes and identify similarities and differences between the processes of mitosis and meiosis.
   a. Read from Module 9 in the *Inspire Biology* textbook, Lesson 2, pages 231 -238 , to learn about meiosis, chromosomes, mitosis vs. meiosis, and sexual vs. axesual reproduction.
   b. Have students draw, sort, or use an interactive simulation to understand the events that take place in meiosis.

6. Explain what a karyotype is and why it is used and practice creating and/or analyzing a karyotype in order to recognize chromosomal defects that may occur during meiosis as a result of nondisjunction.
   a. Read from Module 9 in the *Inspire Biology* textbook, Lesson 2, pages 239 -241, to learn about karyotyping and nondisjunction, autosomes vs. sex chromosomes and examples of genetic conditions that result from chromosomal abnormalities.
   b. Complete and annotate a karyotype using the University of Arizona website.
   c. Research genetic disorders that distinguish between those that are the result of DNA mutations versus those that are the result of chromosomal abnormalities.

7. For further discussion, read/analyze the Module Wrap-up on Page 247 titled, “Why do some cells look so different from each other?”

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Chromosome Visuals Lab for the processes of Mitosis and Meiosis
Mitosis and Meiosis Common Assessment (Consists of both Multiple Choice and Free Response Questions)

Delaware Valley High School

<u>Unit 6</u>: Genetic Inheritance
<u>Time Range in Days</u>: Approximately 15 days

<u>Standards:</u> PA Keystone Biology Assessment Anchors and Enhanced Standards
3.1.B.B1, 3.1.B.B2, 3.1.B.B3, 3.1.B.B5, 3.1.C.B3, 3.1.C.C2

<u>2025 Standards:</u>
3.1.6-8.M Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
3.1.9-12.P Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
3.1.9-12.Q Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

<u>Anchors</u>:
BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.
BIO.B.2.4 Apply scientific thinking, processes, tools, and technologies in the study of genetics.

<u>Eligible Content:</u>
BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, codominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).
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).
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).

<u>Objectives:</u>

1. Apply concepts from DNA and cell division to the understanding of heredity (DOK 4)
2. Describe geneticist Gregor Mendel's studies and conclusions about inheritance how Mendel's principles apply to all organisms (DOK 1)
3. Recall what happens during segregation in meiosis and the principle of independent assortment, genetic recombination, and gene linkage as they apply to chromosome distribution in sex cells (DOK 3)
4. Display how geneticists use the principles of probability to predict genetic crosses by setting up and analyzing Punnett Squares (DOK 2, 4)
5. Explain the differences between Mendelian (complete dominance) and non-Mendelian (codominance, incomplete dominance, sex-linked traits) and predict offspring genotypes and phenotypes based on parent genotype (DOK 4)
6. Define codominance and apply the ABO blood typing system as a model of codominance and apply the concepts of immune response to determine safe transfusions (DOK 1, 4)
7. Predict the multiplicative effects of inheritance of multiple different traits at the same time (dihybrid inheritance patterns.) (DOK 3)

8. Identify examples of applied genetics such as selective breeding, hybridization, inbreeding, and test crosses (DOK 1)
9. Recognize patterns of inheritance of human traits by analyzing pedigree charts (DOK 4)
10. Cite evidence for the causes of genetic disorders—distinguish between small changes in DNA; errors occurring in meiosis; and chromosomal abnormalities (DOK 2, 3)
11. Show the cause and effect relationship between gene expression and the environment (DOK 2)
12. Analyze a pedigree chart to better understand how geneticists can study inheritance patterns (DOK 4)
13. Cite evidence for the causes of genetic disorders—distinguish between small changes in DNA; errors occurring in meiosis; and chromosomal abnormalities (DOK 2, 3)
14. Explain epigenetics and how it affects gene expression (DOK2)
15. Determine if genes are linked (On the same chromosome) (DOK3)
16. Identify examples of biotechnology and genetic engineering (DOK 1)
17. Evaluate and apply ethical reasoning to the effect of new biotechnologies (such as CRISPR-Cas 9) in society (DOK4)
18. Connect examples of biotechnology, genetic engineering, gene splicing to the students' understanding of the principles of DNA and how it can be applied to techniques for gene therapy and genetically modified organisms (DOK 4)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Apply concepts from previous lessons on DNA and meiosis to the understanding of heredity as explained through Grengor Mendel's genetic studies.
    a. Read from Module 10 in the *Inspire Biology* textbook, Lesson 1, pages 252 - 254, to learn about knowledge of essential vocabulary terms including genetics, allele, dominant, recessive, homozygous, heterozygous, phenotype, and genotype.
    b. Ask students to reinforce the vocabulary in a way that will lead to mastery.
3. Recall what happens during segregation in meiosis and the principle of independent assortment, genetic recombination, and gene linkage as they apply to chromosome distribution in sex cells.
    a. Read from Module 10 in the *Inspire Biology* textbook, Lesson 1, pages 255 - 256, to understand Mendel's laws of segregation and independent assortment.
    b. Read from Module 10 in the *Inspire Biology* textbook, Lesson 2, pages 260 - 262, to understand genetic recombination and gene linkage.
4. Display how geneticists use the principles of probability to predict genetic crosses by setting up and analyzing Punnett Squares.
    a. Read from Module 10 in the *Inspire Biology* textbook, Lesson 1, pages 257 - 259, to learn about Punnett Squares, monohybrid and dihybrid crosses and the probability of genes being passed from one generation to the next through fertilization. Mendel's laws of segregation and independent assortment.
    b. Have students practice numerous examples of interpreting genotypes and phenotypes of organisms, setting up, and solving Punnett squares to be able to find the probability of traits being passed from one generation to the next.

5. Identify examples of applied genetics such as selective breeding, hybridization, inbreeding, and test crosses.
    a. Read from Module 10 in the *Inspire Biology* textbook, Lesson 3, pages 263 - 265, to identify ways in which breeding patterns can impact the inheritance patterns of certain populations of species.
    b. Have the students watch the *National Geographic* documentary “Science of Dogs” (or something comparable) to witness a well-known, relatable example of selective breeding.
6. Recognize patterns of inheritance of human traits by analyzing pedigree charts, identifying gene expression as influenced by environmental factors, and citing evidence for the causes of genetic disorders—distinguish between small changes in DNA; errors occurring in meiosis; and chromosomal abnormalities.
    a. Read from Module 10 in the *Inspire Biology* textbook, Lesson 4, pages 266 - 272, to understand how pedigree analysis can be used to predict or analyze inheritance patterns of traits among families.
    b. Have students identify types of genetic disorders that can be inherited through specific genes vs. those that are caused by DNA mutations, or chromosomal abnormalities.
    c. Complete the Karyotyping lab from arizona.edu to create, annotate and analyze human karyotypes.
    d. Read from Module 10 in the *Inspire Biology* textbook, Lesson 5, pages 279 - 282, which features inheritance patterns such as sex-linked traits, polygenic traits, and environmental influences on gene expression.
7. Compare Mendelian (complete dominance) and non-Mendelian genetics (codominance, incomplete dominance, sex-linked traits) and predict offspring genotypes and phenotypes based on parent genotype --while doing so, apply the ABO blood typing system as a model of codominance.
    a. Read from Module 10 in the *Inspire Biology* textbook, Lesson 5, pages 273 - 276, which features incomplete dominance, codominance, and multiple alleles.
    b. Have students read or watch a video about the ABO blood typing system and how it applies to multiple alleles and codominance. Use a graphic organizer to highlight the way in which the ABO alleles are expressed.
    c. Ask students to solve Punnett Squares using the proper ABO blood typing alleles.
    d. For enrichment, perform a demonstration of or have students complete the blood simulation lab to demonstrate the ABO blood typing system and the inability to mix different types of blood together.
    e. Play the Nobel Prize Blood Typing game to identify blood types and determine safe transfusions.
8. Connect examples of biotechnology, genetic engineering, gene splicing to the students' understanding of the principles of DNA and how it can be applied to techniques for gene therapy and genetically modified organisms, while identifying examples of and applying ethical reasoning to such new biotechnologies for appropriate uses.
    a. Review different types of questions (scientific, cultural/religious, legal and ethical) to distinguish between them. Evaluate types of questions and develop ethical questions regarding biotechnologies.

b. Have students read scientific articles or watch credible videos that highlight advancements in biotechnology - allow for a discussion of the pros and cons of the procedures, such as genetically modified organisms.
c. Read "A Question of Ethics" on page 315 in *Inspire Biology*, which references the story of Henrietta Lacks and her HeLa cells.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Genetic Disorder Research Assignment
Bioethical Evaluation of Biotechnology
Genetics Common Assessment (Consists of both Multiple Choice and Free Response Questions)

Delaware Valley High School

Unit 7: Evolution and Natural Selection
Time Range in Days: Approximately 15 days

Standards: PA Keystone Biology Assessment Anchors and Enhanced Standards
3.1.B.A9, 3.1.B.B3, 3.1.B.C1, 3.1.B.C3, 3.3.10.C, 3.3.10.D, 4.7.10.C, 4.8.10.A, 4.8.10.C, 4.8.10.D

2025 Standards:
3.1.6-8.O Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
3.1.6-8.P Apply scientific ideas to construct an explanation for anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
3.1.6-8.Q Analyze displays of pictorial data to compare patterns of similarities in anatomical structures across multiple species to identify relationships not evident in the fully formed anatomy.
3.1.6-8.R Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
3.1.6-8.S Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
3.1.9-12.R Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
3.1.9-12.S Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
3.1.9-12.T Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
3.1.9-12.U Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
3.1.9-12.W Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
3.1.9-12.X Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Anchors:
BIO.B.3.1 Explain the mechanisms of evolution.
BIO.B.3.2 Analyze the sources of evidence for biological evolution.
BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.

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

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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).
BIO.B.3.1.3 Explain how genetic mutations may result in genotypic and phenotypic variations within a population.
BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).
BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.

Objectives:

1. Define evolution (DOK 1)
2. Summarize Charles Darwin's journey on the HMS Beagle (DOK 2)
3. Explain Darwin's theory of natural selection and how it has affected changes in populations over time, or how it may affect future changes in populations (DOK 3)
4. Identify the patterns of biodiversity that were observed by Darwin (DOK 2)
5. Distinguish between the conclusions drawn by James Hutton and Charles Lyell about the Earth's history (DOK 2)
6. Compare Jean-Baptiste Lamarck's hypothesis of evolution with that of Darwin's (DOK 2)
7. Report on Thomas Malthus' view of human population growth (DOK 1)
8. Differentiate between the research of Hutton, Lyell, Lamarck, Malthus, and Wallace and cite evidence of how it influenced Darwin's research (DOK 3)
9. Explain the role of inherited variation in artificial selection (DOK 1)
10. Identify the conditions under which natural selection occurs and the three types of selection (stabilizing, descriptive and directional) (DOK 1)
11. Cite evidence of adaptations in nature (DOK 3)
12. Define fitness in the context of success of passing on one's DNA (DOK 1)
13. Explain the principle of common descent (DOK 2)
14. Compare how geologic distribution of species relates to their evolutionary history (DOK 2)
15. Explain how fossils and the fossil record provide evidence of the descent of modern species from ancient ancestors (DOK 1)
16. Draw conclusions of what homologous structures, analogous structures, vestigial structures, and embryology suggest about the process of evolutionary change (DOK 3)
17. Apply the idea that DNA is molecular evidence that can be used to trace the process of evolution (DOK 4)
18. Interpret and create phylogenetic trees to depict evolutionary relatedness between species (DOK 4)
19. Describe how genetics plays a role in evolutionary change (DOK 1)
20. Make connections about mutations and genetic variation in a population (DOK 4)
21. Identify ways in which genetic recombination in sexual reproduction plays a role in evolution (DOK 1)
22. Apply the Hardy Weinberg Theorem to mathematically demonstrate allele frequency changes to demonstrate population evolution (DOK 3)
23. Describe genetic drift (DOK 1)
24. Describe genetic equilibrium and state what types of factors may affect it (DOK 1)
25. Identify the types of isolation that can lead to the formation of new species (DOK 1)
26. Summarize the processes that influenced survival or extinction of a species (DOK 2)

27. Identify some of the hypotheses about early Earth and the origin of life (DOK 1)
28. Explain the endosymbiotic theory for the evolution of eukaryotes from prokaryotes (DOK 1)
29. Explain how a species is defined using Ernst Mayr's Biological Species Concept and what the barriers are to interspecies reproduction. (DOK2)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Review the definitions and misconceptions of a Scientific Law and Scientific Theory.
    a. Connect these definitions to the Law of Evolution: that populations change over time, and the Theory of Evolution: the evidences to explain that and how species change over time.
    b. Read from Module 1 in the *Inspire Biology* textbook, Lesson 2, pages 11-14, to learn about the characteristics of scientific inquiry.
3. Learn about how Darwin and Wallace used evidences from their naturalist voyages, and information regarding geology and population growth to develop their Theory of Natural Selection. Review the evidences for evolution with real examples.
    a. Read from Module 14 in the *Inspire Biology* textbook, Lesson 1, pages 368-373, to learn about Darwin' Theory of Natural Selection.
    b. Watch HHMI Biointeractive "Making of a Theory".
    c. Play the Peppered Moth interactive to visualize how natural adaptations, such as camouflage can change the allele frequency of a population.
    d. Watch selected portions of "Your Inner Fish/Reptile/Monkey" to see examples of evolutionary evidences in the human body.
    e. Watch National Geographic's "The Science of Dogs" to observe mechanisms of artificial selection.
    f. Demonstrate how BLAST can be used to analyze DNA and protein sequences for species similarity.
4. Define evolution as a change in allele frequency in a population.
    a. Read from Module 14 in the *Inspire Biology* textbook, Lesson 3, pages 381-384, to learn about Hardy Weinberg, selection and speciation.
    b. Demonstrate how the Hardy Weinberg Equation can mathematically demonstrate changes in population allele frequencies.
    c. Use PTC paper to calculate allele frequencies in the classroom and describe scenarios that would cause evolution of the class population.
    d. Use the Jon Darwkow website to evaluate graphs of allele frequencies to determine if or when populations evolved for a trait.
    e. Watch TED-Ed "The Five Fingers of Evolution" to see how small populations (genetic drift), sexual selection, mutations, natural selection and gene flow contribute to population evolution.
5. Review the Biological Species Concept and barriers to successful reproduction
    a. Read from Module 14 in the *Inspire Biology* textbook, Lesson 3, pages 385-388, to learn about speciation.
    b. Review examples of pre-and post-zygotic reproductive barriers.

   c. Watch "Real Science: The hybridization of species".
6. Create and interpret Phylogenetic Trees to depict common ancestry of species.
   a. Read from Module 16 in the *Inspire Biology* textbook, Lesson 2, pages 436-439, to learn about phylogenetic organization.
   b. Play the NOVA Evolution Lab to interpret evolutionary relationships and derived traits based on a variety of evidences of evolution such as behaviors, homologous structures, fossil evidence, biogeography, and molecules biology (DNA).

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit
Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Evolution Common Assessment (Consists of both Multiple Choice and Free Response Questions)

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Unit 8: Ecology
Time Range in Days: Approximately 15 days

Standards: PA Keystone Biology Assessment Anchors and Enhanced Standards
3.1.B.A2, 3.1.B.A4, 3.1.B.A5, 3.1.B.A7, 3.1.B.A8, 3.2.B.B.6, 3.2.C.A1, 4.1.5.C, 4.1.10.1, 4.1.10.B, 4.1.10.C, 4.1.10 E, 4.1.12.A, 4.1.12.C, 4.2.10.A, 4.2.10.B, 4.2.10.C,4.1.12.A, 4.2.12.B, 4.3.10B, 4.3.12.A, 4.5.10B, 4.5.12.B

Anchors:
BIO.B.4.1 Describe ecological levels of organization in the biosphere.
BIO.B.4.2 Describe interactions and relationships in an ecosystem.

Eligible Content:
BIO.B.4.1.1 Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).
BIO.B.4.1.2 Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.
BIO.B.4.2.1 Describe how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids).
BIO.B.4.2.2 Describe biotic interactions in an ecosystem (e.g., competition, predation, symbiosis).
BIO.B.4.2.3 Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle).
BIO.B.4.2.4 Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).
BIO.B.4.2.5 Describe the effects of limiting factors on population dynamics and potential species extinction.

2025 Standards:
3.1.6-8.I Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
3.1.6-8.J Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
3.1.6-8.K Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
3.1.6-8.L Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
3.1.6-8.U Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
3.1.9-12.H Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
3.1.9-12.I Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
3.1.9-12.K Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
3.1.9-12.L Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

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3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
3.1.9-12.N Can design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
3.1.9-12.V Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Objectives:

1. Define ecology and describe the methods used to study ecology (DOK 2)
2. Distinguish between the ecological levels of organization of living things (species→ population→community→ecosystem→biome→biosphere) (DOK 2)
3. Explain how biotic and abiotic factors influence an ecosystem (DOK 3)
4. Define primary producers/autotrophs (DOK 1)
5. Predict how the loss of primary producers will affect the ecosystem (DOK 2)
6. Define consumers/heterotrophs (primary, secondary, tertiary) and identify patterns in which they obtain energy and nutrients (DOK 1 and DOK 2)
7. Trace the flow of energy through living systems by using food chains, food webs, and energy pyramids (DOK 2)
8. Identify cycles as patterns in nature and differentiate between the water cycle, carbon cycle, nitrogen cycle, and phosphorus cycle (DOK 2 and DOK 3)
9. Connect the biogeochemical cycles to the elements found in biological molecules and predict the impact of disruptions of the cycles on living things (DOK 3,4)
10. Define niche. (DOK 1)
11. Describe the role competition plays in shaping communities. (DOK2)
12. Describe the role predation and herbivory play in shaping communities. (DOK2)
13. Identify the three types of symbiotic relationships in nature. (DOK1)
14. Describe how ecosystems recover from a disturbance. (DOK2)
15. Compare succession after a natural disturbance with succession after a human caused disturbance. (DOK3)
16. Describe and compare the characteristics of the major land biomes. (DOK3)
17. Discuss the factors that affect aquatic ecosystems. (DOK3)
18. Identify the major categories of freshwater ecosystems. (DOK1)
19. List the characteristics used to describe a population. (DOK1)
20. Identify factors that affect population growth and differentiate into density dependent and density independent factors. (DOK2,3)
21. Describe, calculate and graph exponential growth. (DOK1)
22. Describe logistic growth. (DOK1)
23. Analyze data to determine the type of population growth. (DOK4)
24. Identify factors that determine carrying capacity. (DOK1)
25. Identify the limiting factors that depend on population density. (DOK1)
26. Identify the limiting factors that do not depend on population density. (DOK1)
27. Discuss the trends of human population growth. (DOK2)
28. Describe human activities that can affect the biosphere. (DOK2)
29. Describe the relationship between resource use and sustainable development. (DOK2)
30. Define biodiversity and explain its value and factors affecting it. (DOK2)

31. Explain the concept of ecological footprint. (DOK1)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Describe the levels of ecological study and biotic and abiotic components of terrestrial and aquatic biomes.
    a. Read from Module 3 in the *Inspire Biology* textbook, Lesson 2 & 3, pages 50-72, to learn about the major characteristics of biomes.
    b. Research the major climate, defining features, threats, plants and animals of a biome.
    c. Use the iNaturalist website/Seek app to research the major flora and fauna of species within the students' biome.
3. Investigate the trophic relationships in an ecosystem.
    a. Read from Module 2 in the *Inspire Biology* textbook, Lesson 2, pages 35-38, to learn about food chains, foods webs and trophic efficiency.
    b. Create real examples of food chains and food webs in specific ecosystems.
    c. Analyze owl pellets for evidence of meal choice and sources of energy. Calculate biomass and energetic contributions of different species to graph and generate conclusions.
4. Review the ways by which species interact with each other.
    a. Read from Module 2 in the *Inspire Biology* textbook, Lesson 1, pages 24-24, to learn about symbiotic relationships.
    b. Research and present symbiotic relationships in a specific biome.
5. Study population growth curves and demography
    a. Read from Module 4 in the *Inspire Biology* textbook, Lesson 1&2, pages 77-93 to learn about population growth curves, limiting factors and demography.
    b. Use population formulas to calculate logistical and exponential growth in sample populations and graph results. Calculate rate of growth in populations based on graphical representations.
    c. Use the https://www.footprintcalculator.org/home/en to calculate a student's ecological footprint and predict impacts of global resource usage.
6. Review current threats to biodiversity.
    a. Read from Module 5 in the *Inspire Biology* textbook, Lessons 1-3, pages 98-113, to learn about biodiversity, threats and actions for remediation.
    b. Research a specific ecological threat, determine short-term and long-term impacts and provide actionable suggestions for bioremediation.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit

Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:
Ecology Common Assessment (Consists of both Multiple Choice and Free Response Questions)

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Unit 9: Life Origins, Diversity and Classification
Time Range in Days: Approximately 15 days

Standards: PA Keystone Biology Assessment Anchors and Enhanced Standards
4.7.10.C, 3.3.10.D

2025 Standards:
3.1.6-8.C Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells
3.1.6-8.D Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively.
3.1.6-8.H Gather and synthesize information about how sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
3.1.9-12.B Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
3.1.9-12.C Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Anchors:
BIO.A.1.1 Explain the characteristics common to all organisms.
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.B.3.2 Analyze the sources of evidence for biological evolution.
BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments

Eligible Content:
BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
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).
BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.
BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

Objectives:
1. Identify and evaluate some of the hypotheses about early Earth and the origin of life (DOK 1, 4)
2. Explain the endosymbiotic theory for the evolution of eukaryotes from prokaryotes (DOK 1)
3. Describe the goals of binomial nomenclature and systematics (DOK 1)
4. Identify the taxa in the classification system devised by Linnaeus (DOK 1)
5. Interpret a cladogram (DOK 2)
6. Analyze the use of DNA sequences in classification (DOK 4)
7. Name the six kingdoms of life as they are currently identified (DOK 1)
8. Explain what the tree of life represents (DOK 1)

9. Summarize some major characteristics of viruses (DOK 2)
10. Explain why viruses are not classified as living organisms (DOK 1)
11. Summarize some major characteristics of eubacteria and archaebacteria (DOK 2)
12. Explain the roles of bacteria in the living world (DOK 1)
13. Identify ways in which bacteria cause disease (DOK 2)
14. Identify ways in which viruses cause disease (DOK 2)
15. Summarize some major characteristics of protists (DOK 2)
16. Summarize some major characteristics of fungi (DOK 2)
17. Summarize some major characteristics of plants (DOK 2)
18. Summarize some major characteristics of animals (DOK 2)
19. Develop a logical argument that all organisms share common characteristics (DOK 3)
20. Students will identify the four major characteristics of the Animal Kingdom (DOK1)
21. Students will compare and contrast the animal phyla (DOK 2)
22. Students will learn about the animal organ systems and their major features and structures (DOK 2)
23. Students may dissect an earthworm, grasshopper, crayfish and frog to learn about anatomical features and physiological function (DOK4)

Core Activities and Corresponding Instructional Methods:

1. Students may investigate major themes of the unit that correspond to lessons and activities to *Encounter the Phenomenon,* complete *BioLab Activities,* review *Vocabulary terms*, and the *Go Further Data Analysis Lab* as provided in the Inspire textbook series.
2. Read from Modules 16-20 in the *Inspire Biology* textbook, to review major features of all kingdoms of life.
3. Read from Modules 22-27 in the *Inspire Biology* textbook, to review major features of animal anatomy and physiology.
    a. Review the major structures and functions of the cardiovascular system.
    b. Review the major structures and functions of the digestive system.
    c. Review the major structures and functions of the immune system.
    d. Review the major structures and functions of the musculoskeletal system.
4. Compare and contrast different eukaryotic phyla.
    a. Water videos from the Shape of Life to observe unique features of animal phyla.
    b. Use dissections of choice such as the flower, the earthworm, the sea star, the grasshopper, the crayfish, and the frog dissection to allow students the opportunity to investigate characteristics of organisms in various animal phyla.

Assessments:

Diagnostic:

Teacher prepared diagnostic test
Teacher questioning and observation

Formative:

Teacher observations, questioning techniques
Define Vocabulary words for this unit

Group activities
Homework – example problems from the textbook and workbook for each section
Quizzes/graded assignments

Summative:

Earthworm, Grasshopper and Frog Dissections and Lab Practical (Consists of both Multiple Choice, item identification and Free Response Questions)