## High School Topics Biology I Curriculum

**Course Description:** Biology is an introductory high school science course that covers the principles governing all life. It includes topics in cells and cell reproduction, genetics, natural selection, ecology, and environmental issues. It provides the basis for study in the more advanced life science courses. This course is a prerequisite for all other biological sciences.

### Scope and Sequence:

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Unit</th>
<th>Instructional Topics</th>
</tr>
</thead>
</table>
| 5-6 days  | Introduction to Science       | Topic 1: Scientific Investigations  
|           | Processes                     | Topic 2: Data Collection  
|           |                               | Topic 3: Graphing                                                                  |
| 6-7 days  | Organization and Homeostasis  | Topic 1: Characteristics of Life  
|           |                               | Topic 2: Levels of Organization  
|           |                               | Topic 3: Homeostasis                                                              |
| 7-8 days  | Energy                        | Topic 1: Macromolecules  
|           |                               | Topic 2: Photosynthesis  
|           |                               | Topic 3: Aerobic and Anaerobic Respiration                                        |
| 8-9 days  | DNA and Protein Synthesis     | Topic 1: Prokaryotic and Eukaryotic Cells  
|           |                               | Topic 2: Structure of DNA and RNA  
|           |                               | Topic 3: DNA Replication  
|           |                               | Topic 4: Protein Synthesis  
|           |                               | Topic 5: Mutations                                                               |
| 9-10 days | Reproduction and Heredity    | Topic 1: Cell Cycle  
|           |                               | Topic 2: Chromosomes  
|           |                               | Topic 3: Mitosis and Meiosis  
|           |                               | Topic 4: Punnett Squares                                                          |
| 9-10 days | Ecology | Topic 1: Ecological Levels  
|          |        | Topic 2: Population Growth  
|          |        | Topic 3: Interactions of Organisms  
|          |        | Topic 4: Nutrient Cycles  
| 9-10 days | Evolution | Topic 1: Geological Evolution  
|          |        | Topic 2: The Process of Natural Selection  
|          |        | Topic 3: Evidence for Evolution  
|          |        | Topic 4: Speciation and Extinction  
| 9-10 days | Earth and Human Activity | Topic 1: Environmental Impacts  
|          |        | Topic 2: Human Activities  
|          |        | Topic 3: Solutions  

*This document contains the entire High School Biology curriculum that is taught in a regular education setting. Items that are highlighted in yellow have been designated as priority information that should be taught in the High School Topics Biology class.*
Unit 1: Introduction to Science Processes

Subject: Biology  
Grade: 9-12  
Name of Unit: Introduction to Science Processes  
Length of Unit: 5-6 days  
Overview of Unit: This unit is an introduction to scientific practices such as lab safety, lab equipment and procedures, as well as analyzing and displaying data in science. Students will become familiar with qualitative and quantitative measurements used in lab experiments and how to approach a problem thinking logically and scientifically.

Supporting Standards for unit:
- **9-12-ETS-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.  
- **9-12-ETS-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.  
- **9-12-ETS3-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.  
- **9-12-ETS-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.  
- **ISTE-EMPOWERED LEARNER 1**: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.  
- **ISTE - KNOWLEDGE COLLECTOR.3**: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.  
- **ISTE - COMPUTATIONAL THINKER.5**: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.  
- **ISTE - CREATIVE COMMUNICATOR.6**: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

Essential Questions:
1. How is experimental design used as a means to conduct scientific investigations?  
2. How are quantitative and qualitative measurements observed and analyzed in scientific experiments?  
3. Why is it useful to display data and experimental evidence in charts or graphs?
Enduring Understanding/Big Ideas:

1. Experiments are used to test hypotheses in scientific investigations. Designing reliable and valid experiments are necessary to collect, analyze, and communicate data and results that focus on scientific concepts.

2. Quantitative and qualitative measurements can be collected using scientific tools and organized into data tables.

3. Charts and graphs are a way to visually represent data. These representations can provide an analysis and summary of scientific results.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific method</td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td></td>
</tr>
<tr>
<td>Hypothesis</td>
<td></td>
</tr>
<tr>
<td>Experiments</td>
<td></td>
</tr>
<tr>
<td>Theory</td>
<td></td>
</tr>
<tr>
<td>Constants</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td></td>
</tr>
<tr>
<td>Experimental group</td>
<td></td>
</tr>
<tr>
<td>Line graph</td>
<td></td>
</tr>
<tr>
<td>Bar graph</td>
<td></td>
</tr>
<tr>
<td>Independent variable</td>
<td></td>
</tr>
<tr>
<td>Dependent variable</td>
<td></td>
</tr>
</tbody>
</table>

Resources for Vocabulary Development: Textbook, Online resources
**Engaging Experience 1**

**Title:** Design an Experiment from an Advertisement (AVID Activity)

**Suggested Length of Time:** 60 minutes (modify to 1 block)

**Standards Addressed**

*Priority:* N/A

*Supporting:*

- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

- ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

**Detailed Description/Instructions:** Provide students an advertisement from a newspaper or magazine that makes a claim. Students will then design an experiment and create a poster of their experimental design for peer review.

**Bloom’s Levels:** Apply

**Webb’s DOK:** 3
Topic 2: Data Collection

Engaging Experience 1
Title: Generating and Constructing a Data Table Activity
Suggested Length of Time: 20 minutes (modify to 1 block)
Detailed Description/Instructions: Students will collect data and create a data table to organize it.
Bloom’s Levels: Apply
Webb’s DOK: 2
Topic 3: Graphing

Engaging Experience 1
Title: Graphing Exercises

Suggested Length of Time: 45 minutes (modify to 60 minutes)
Detailed Description/Instructions: Students will construct a line and bar graph using provided data sets and answer analysis questions based on their graphs.
Bloom’s Levels: Analyze
Webb’s DOK: 2
Engaging Scenario: Students design and conduct an experiment about the effect of exercise on heart rate. They will then communicate their results to the class by creating a science poster summarizing their experiment and results.
# Summary of Engaging Learning Experiences for Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Investigations</td>
<td>Design an Experiment from an Advertisement (AVID Activity) <img src="image.png" alt="Image" /></td>
<td>Provide students an advertisement from a newspaper or magazine that makes a claim. Students will then design an experiment and create a poster of their experimental design for peer review.</td>
<td>60 min (modify to 1 block)</td>
</tr>
<tr>
<td>Data Collection</td>
<td>Generating and Constructing a Data Table Activity</td>
<td>Students will collect data and create a data table to organize it.</td>
<td>20 min (modify to 1 block)</td>
</tr>
<tr>
<td>Graphing</td>
<td>Graphing Exercises</td>
<td>Students will construct a line and bar graph using provided data sets and answer analysis questions based on their graphs.</td>
<td>45 min (modify to 60 minutes)</td>
</tr>
</tbody>
</table>
Unit 2: Organization and Homeostasis

**Subject:** Biology  
**Grade:** 9  
**Name of Unit:** Organization and Homeostasis  
**Length of Unit:** 6-7 days  
**Overview of Unit:** Students will learn the characteristics of organisms and how they display organization. They will also investigate feedback mechanisms cells use to maintain homeostasis.

**Priority Standards for unit:**
- 9-12.LS1.A.3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels.]
- 9-12.LS1.A.2 Develop and use a model to illustrate the hierarchical organization of interacting System that provide specific functions within multicellular Organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to stimuli.]

**Supporting Standards for unit:**
- ISTE-EMPOWERED LEARNER 1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
- ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td>
<td>Plan</td>
<td>apply</td>
<td>3</td>
</tr>
</tbody>
</table>
an investigation to provide evidence that feedback mechanisms maintain homeostasis.

a model to illustrate the hierarchical organization of interacting System that provide specific functions within multicellular Organisms.

Essential Questions:
1. How can one distinguish between living a non-living thing?
2. How do living organisms display organization?
3. How do cells maintain homeostasis?

Enduring Understanding/Big Ideas:
1. All living organisms are composed of cells, use energy, respond to stimuli, reproduce, grow and develop, maintain homeostasis, and as populations, evolve over time.
2. Living organisms are organized into different levels, which are studied by biologists. These levels in multicellular organisms include the following: atoms, molecules, cells, tissues, organs, organ systems, and organism.
3. Homeostasis is regulated through negative and positive feedback mechanisms. 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. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>biology</td>
<td></td>
</tr>
<tr>
<td>growth</td>
<td></td>
</tr>
<tr>
<td>development</td>
<td></td>
</tr>
<tr>
<td>reproduction</td>
<td></td>
</tr>
<tr>
<td>species</td>
<td></td>
</tr>
<tr>
<td>stimulus</td>
<td></td>
</tr>
<tr>
<td>Response</td>
<td></td>
</tr>
<tr>
<td>cell</td>
<td></td>
</tr>
<tr>
<td>tissue</td>
<td>organ</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>organ system</td>
<td>organism</td>
</tr>
<tr>
<td>homeostasis</td>
<td>plasma membrane</td>
</tr>
<tr>
<td>passive transport</td>
<td>active transport</td>
</tr>
<tr>
<td>diffusion</td>
<td>osmosis</td>
</tr>
<tr>
<td>facilitated diffusion</td>
<td></td>
</tr>
</tbody>
</table>
Topic 1: Characteristics of Life

Engaging Experience 1
Title: Characteristics of Life Activity
Suggested Length of Time: 20 minutes (modify to 60 minutes)

Standards Addressed

Priority:
- 9-12.LS1.A.2 Develop and use a model to illustrate the hierarchical organization of interacting System that provide specific functions within multicellular Organisms.

Detailed Description/Instructions: “Glue Monster Activity”

In this activity, students make observations about an “organism” in a petri dish and discuss what makes it alive. The organisms are drops of Deco Cement glue in water that are projected onto a screen with a light source so as to not reveal that the materials are non-living.

Bloom’s Levels: Analyze

Webb’s DOK: 2
Topic 2: Levels of Organization

Engaging Experience 1
Title: Levels of Organization Flow Chart
Suggested Length of Time: 20-30 minutes (modify to 60 minutes)

Standards Addressed

Priority:

- 9-12.LS1.A.2 Develop and use a model to illustrate the hierarchical organization of interacting System that provide specific functions within multicellular Organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to stimuli.]

Detailed Description/Instructions: Students will create a flowchart that will include drawings of each level of organization ranging from smallest to most complex.

Bloom’s Levels: Understand

Webb’s DOK: 2
Engaging Experience 1

Title: Osmosis Lab (dialysis tube, potato, gummy bears, etc…)

Suggested Length of Time: 60 - 90 minutes

Standards Addressed

Priority:

- 9-12.LS1.A.3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels.]

Supporting:

- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: Students will complete an experiment to test conditions which affect the rate of osmosis across a membrane.

Bloom’s Levels: Apply

Webb’s DOK: 2
**Engaging Scenario:** Assign students a human body system (e.g. nervous, digestive, integumentary, circulatory, respiratory, immune, muscular, excretory) to research and determine how that system functions in order to maintain homeostasis. Students will present their results in digital format.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of Life</td>
<td>Characteristics of Life Activity</td>
<td>A suggested activity would be the “Glue Monster Activity”. In this activity, students make observations about an “organism” in a petri dish and discuss what makes it alive. The organisms are drops of Deco Cement glue in water that are projected onto a screen with a light source so as to not reveal that the materials are non-living.</td>
<td>20 min (modify to 60 minutes)</td>
</tr>
<tr>
<td>Levels of Organization</td>
<td>Levels of Organization Flow Chart</td>
<td>Students will create a flowchart that will include drawings of each level of organization ranging from smallest to most complex.</td>
<td>20-30 min (modify to 60 minutes)</td>
</tr>
<tr>
<td>Homeostasis</td>
<td>Osmosis Lab</td>
<td>Students will complete an experiment to test conditions which affect the rate of osmosis across a membrane.</td>
<td>60-90 min</td>
</tr>
</tbody>
</table>

**Unit 3: Energy**

*Subject*: Biology

Board Approved: February 8, 2018
Grade: 9
Name of Unit: Energy
Length of Unit: 7-8 days
Overview of Unit: This unit explores how all living things are composed of 4 macromolecules: carbohydrates, lipids, proteins, and nucleic acids. It also explains how all organisms obtain energy through photosynthesis and cellular respiration.

Priority Standards for unit:

- 9-12.LS1.C.3 Construct and revise an explanation based on evidence that organic macromolecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules. [Clarification Statement: Large carbon-based molecules included are proteins, carbohydrates, nucleic acids, and lipids.]
- 9-12.LS1.C.1 Use a model to demonstrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing Organisms. Examples of models could include diagrams, chemical equations, and conceptual models.]
- 9-12.LS1.C.2 Use a model to demonstrate that cellular respiration is a chemical process whereby the bonds of molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.]

Supporting Standards for unit:

- ISTE - EMPOWERED LEARNER 1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
- ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>an explanation based on evidence that organic macromolecules are</td>
<td>Construct</td>
<td>evaluate</td>
<td>3</td>
</tr>
</tbody>
</table>
primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules.

an explanation based on evidence that organic macromolecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules.

| a model to demonstrate how photosynthesis transforms light energy into stored chemical energy. | Revise | create | 2 |
| a model to demonstrate that cellular respiration is a chemical process whereby the bonds of molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. | use | understand | 3 |

**Essential Questions:**
1. How does photosynthesis produce energy?
2. How do the different types of macromolecules compare in structure and function?
3. How does the process of cellular respiration release energy to be used by cells?
4. How is anaerobic respiration different from aerobic respiration?

**Enduring Understanding/Big Ideas:**
1. The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.
2. The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.
3. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.
4. Anaerobic respiration releases energy stored in carbohydrate compounds for use in the cell without the use of oxygen.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Macromolecule</td>
</tr>
<tr>
<td>Metabolism</td>
<td>Polymer</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>Carbohydrate</td>
</tr>
<tr>
<td>Cellular respiration</td>
<td>Lipid</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Phospholipid</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Protein</td>
</tr>
<tr>
<td>Light energy</td>
<td>Amino acid</td>
</tr>
<tr>
<td>Chemical energy</td>
<td>Nucleic acid</td>
</tr>
<tr>
<td></td>
<td>Nucleotide</td>
</tr>
<tr>
<td></td>
<td>Glucose</td>
</tr>
</tbody>
</table>

Topic 1: Macromolecules

Engaging Experience 1
Title: Macromolecules Activity
Suggested Length of Time: 60 minutes (modify to 1 Block)
Standards Addressed

Priority:

- 9-12.LS1.C.3 Construct and revise an explanation based on evidence that organic macromolecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules. [Clarification Statement: Large carbon-based molecules included are proteins, carbohydrates, nucleic acids, and lipids.]

Detailed Description/Instructions: Students will identify and compare the different elements and monomers that compose carbohydrates, lipids, proteins, and nucleic acids. Activity can include drawing, sorting, classifying and creating a concept map.

Bloom’s Levels: Understand
Webb’s DOK: 2
Topic 2: Photosynthesis

Engaging Experience 1
Title: Photosynthesis Lab
Suggested Length of Time: 60 minutes (modify to 90 minutes)
Standards Addressed

Priority:

- 9-12.LS1.C.1 Use a model to demonstrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing Organisms. Examples of models could include diagrams, chemical equations, and conceptual models.]

Supporting:

- ISTE - EMPOWERED LEARNER 1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

Detailed Description/Instructions: Students will observe the process of photosynthesis through a lab and will create a model to demonstrate how photosynthesis converts light energy into chemical energy. A suggested activity would be a photosynthesis virtual lab where students work through simulations to research the process of photosynthesis and factors that affect the process.

Bloom’s Levels: Analyze
Webb’s DOK: 3
Topic 3: Aerobic and Anaerobic Respiration

Engaging Experience 1
Title: Cellular Respiration Concept Map/Graphic Organizer
Suggested Length of Time: 20-30 minutes (modify to 60 minutes)
Standards Addressed
Priority:
- 9-12.LS1.C.2 Use a model to demonstrate that cellular respiration is a chemical process whereby the bonds of molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.]

Detailed Description/Instructions: Students will create a concept map/graphic organizer where they will compare and contrast aerobic and anaerobic respiration.
Bloom’s Levels: Understand
Webb’s DOK: 4
Engaging Scenario

Students will have to explain and demonstrate their understanding of the relationship between photosynthesis and cellular respiration. A suggested activity will be using the online Carbon Transfer through Snails and Elodea lab to develop a hypothesis about cellular respiration and its relationship to photosynthesis and test it.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macromolecules</td>
<td>Macromolecules Activity</td>
<td>Students will identify and compare the different elements and monomers that compose carbohydrates, lipids, proteins, and nucleic acids. Activity can include drawing, sorting, classifying and creating a concept map.</td>
<td>60 minutes (modify to 1 Block)</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>Photosynthesis Lab</td>
<td>Students will observe the process of photosynthesis through a lab and will create a model to demonstrate how photosynthesis converts light energy into chemical energy. A suggested activity would be a photosynthesis virtual lab where students work through simulations to research the process of photosynthesis and factors that affect the process.</td>
<td>60 minutes (modify to 1 Block)</td>
</tr>
<tr>
<td>Aerobic and Anaerobic Respiration</td>
<td>Cellular Respiration Concept Map/Graphic Organizer</td>
<td>Students will create a concept map/graphic organizer where they will compare and contrast aerobic and anaerobic respiration.</td>
<td>20-30 minutes (modify to 60 minutes)</td>
</tr>
</tbody>
</table>
Unit 4: DNA and Protein Synthesis

Subject: Biology  
Grade: 9  
Name of Unit: DNA and Protein Synthesis  
Length of Unit: 8-9 days  
Overview of Unit: In this unit, students will learn about the structure and function of DNA and how DNA codes for RNA, which guides protein synthesis. Students will also investigate how gene mutations affect proteins.

Priority Standards for unit:

- 9-12.LS1.A.1 Construct a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through System of specialized cells. [Clarification Statement: Genes are the regions in DNA that code for proteins. Basic transcription and translation explain the roles of DNA and RNA in coding the instructions for making polypeptides.]
- 9-12.LS3.B.2 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. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.]
- 9-12.LS3.B.3 Make and defend a claim that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) mutations occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.]

Supporting Standards for unit:

- ISTE-EMPOWERED LEARNER 1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
- ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
- TT.AB.D.8: Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through the system of specialized cells.</td>
<td>Construct</td>
<td>apply</td>
<td>2</td>
</tr>
<tr>
<td>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.</td>
<td>Develop</td>
<td>apply</td>
<td>2</td>
</tr>
<tr>
<td>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.</td>
<td>Use</td>
<td>Understand</td>
<td>2</td>
</tr>
<tr>
<td>a claim that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) mutations occurring during replication, and/or (3) mutations caused by environmental factors.</td>
<td>Make</td>
<td>create</td>
<td>4</td>
</tr>
<tr>
<td>a claim that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) mutations occurring during replication, and/or (3) mutations caused by environmental factors.</td>
<td>Defend</td>
<td>evaluate</td>
<td>3</td>
</tr>
</tbody>
</table>
**Essential Questions:**
1. Why is the role of genetic information in cells important?
2. How do genetic mutations occur in DNA?

**Enduring Understanding/Big Ideas:**
1. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
2. DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prokaryotes</td>
<td></td>
</tr>
<tr>
<td>Eukaryotes</td>
<td></td>
</tr>
<tr>
<td>DNA</td>
<td></td>
</tr>
<tr>
<td>Double helix</td>
<td></td>
</tr>
<tr>
<td>DNA replication</td>
<td></td>
</tr>
<tr>
<td>RNA (mRNA, tRNA, rRNA)</td>
<td></td>
</tr>
<tr>
<td>Transcription</td>
<td></td>
</tr>
<tr>
<td>Translation</td>
<td></td>
</tr>
<tr>
<td>Codon</td>
<td></td>
</tr>
<tr>
<td>Anticodon</td>
<td></td>
</tr>
<tr>
<td>Mutagen</td>
<td></td>
</tr>
<tr>
<td>Mutation</td>
<td></td>
</tr>
</tbody>
</table>
Engaging Experience 1

Title: Prokaryotic and Eukaryotic Cell Comparison

Suggested Length of Time: 30-45 minutes

Standards Addressed

**Priority:**

- 9-12.LS1.A.1 Construct a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through System of specialized cells. [Clarification Statement: Genes are the regions in DNA that code for proteins. Basic transcription and translation explain the roles of DNA and RNA in coding the instructions for making polypeptides.]

**Detailed Description/Instructions:** Students can write a diamante poem (AVID strategies) or any other graphic organizer to compare and contrast prokaryotic and eukaryotic cells. Students will then share their work with their classmates (gallery walk is a suggested method of presentation).

**Bloom’s Levels:** analyze

**Webb’s DOK:** 3
Engaging Experience 1
Title: Venn Diagram of DNA and RNA Molecular Structure
Suggested Length of Time: 30 minutes

Standards Addressed

Priority:
- 9-12.LS1.A.1 Construct a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through System of specialized cells. [Clarification Statement: Genes are the regions in DNA that code for proteins. Basic transcription and translation explain the roles of DNA and RNA in coding the instructions for making polypeptides.]

Detailed Description/Instructions: Students will construct a Venn diagram that compares the structure of DNA and RNA molecules.
Bloom’s Levels: apply
Webb’s DOK: 2
Engaging Experience 1
Title: Models of DNA Replication
Suggested Length of Time: 30-45 minutes (modify to 1 Block)

Standards Addressed
- **Priority:**
  - 9-12.LS1.A.1 Construct a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through System of specialized cells. [Clarification Statement: Genes are the regions in DNA that code for proteins. Basic transcription and translation explain the roles of DNA and RNA in coding the instructions for making polypeptides.]

Detailed Description/Instructions: Using models, students will replicate a given DNA sequence to show the semiconservative process of DNA replication.

Bloom’s Levels: apply
Webb’s DOK: 2
Topic 4: Protein Synthesis

Engaging Experience 1
Title: Models of Protein Synthesis
Suggested Length of Time: 90 minutes
Standards Addressed

Priority:
- 9-12.LS1.A.1 Construct a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through System of specialized cells. [Clarification Statement: Genes are the regions in DNA that code for proteins. Basic transcription and translation explain the roles of DNA and RNA in coding the instructions for making polypeptides.]

Detailed Description/Instructions: Students will create a model of the process of protein synthesis, including transcription and translation, to illustrate the roles of DNA and RNA molecules in protein synthesis.

Bloom’s Levels: apply
Webb’s DOK: 2
Engaging Experience 1
Title: Mutations Activity
Suggested Length of Time: 45 minutes
Standards Addressed

Priority:

- 9-12.LS3.B.2 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. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.]
- 9-12.LS3.B.3 Make and defend a claim that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) mutations occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.]

Supporting:

- ISTE-EMPOWERED LEARNER 1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

Detailed Description/Instructions: Students need to use a model to describe how gene mutations affect proteins. A suggested activity is How Do Cells Make Proteins? online activity through the Concord Consortium to determine how changes in DNA result in modified proteins.

Bloom’s Levels: Understand
Webb’s DOK: 2
Engaging Scenario

Students will need to create a model/poster/video that explains the relationship between DNA, RNA, and proteins and explain how mutations can affect proteins. A suggested activity would be having students use their previously built models to create their own tutorial video in which they explain how cells produce proteins through transcription and translation and describe how DNA mutations can alter proteins and their functions.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prokaryotic and Eukaryotic Cells</td>
<td>Prokaryotic and Eukaryotic Cell Comparison</td>
<td>Students can write a diamante poem (AVID strategies) or any other graphic organizer to compare and contrast prokaryotic and eukaryotic cells. Students will then share their work with their classmates (gallery walk is a suggested method of presentation).</td>
<td>30-45 minutes</td>
</tr>
<tr>
<td>Structure of DNA and RNA</td>
<td>Venn Diagram of DNA and RNA Molecular Structure</td>
<td>Students will construct a Venn diagram that compares the structure of DNA and RNA molecules.</td>
<td>30 minutes</td>
</tr>
<tr>
<td>DNA Replication</td>
<td>Models of DNA Replication</td>
<td>Using models, students will replicate a given DNA sequence to show the semiconservative process of DNA replication.</td>
<td>30-45 minutes (modify to 1 Block)</td>
</tr>
<tr>
<td>Protein Synthesis</td>
<td>Models of Protein Synthesis</td>
<td>Students will create a model of the process of protein synthesis, including transcription and translation, to illustrate the roles of DNA and RNA molecules in protein synthesis.</td>
<td>90 minutes</td>
</tr>
<tr>
<td>Mutations</td>
<td>Mutations Activity</td>
<td>Students need to use a model to describe how gene mutations affect proteins. A suggested activity is How Do Cells Make Proteins? online activity through the Concord Consortium to determine how changes in DNA result in modified proteins.</td>
<td>45 minutes</td>
</tr>
</tbody>
</table>
Subject: Biology
Grade: 9
Name of Unit: Reproduction and Heredity
Length of Unit: 9-10 days
Overview of Unit: This unit relates how the mitotic and meiotic division of cells contributes to the growth and reproduction of organisms and heredity. Students will gain an understanding of how genetic information in the form of DNA and chromosomes are inherited from one generation to the next and how mathematical concepts can be used to predict patterns of inheritance.

Priority Standards for unit:

- 9-12.LS1.B.1 Develop and use models to communicate the role of mitosis, cellular division, and differentiation in producing and maintaining complex Organisms. [Clarification Statement: Major events of the cell cycle include cell growth, DNA replication, preparation for division, separation of chromosomes, and separation of cell contents.]
- 9-12.LS3.A.1 Develop and use models to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.
- 9-12.LS3.B.1 Compare and contrast asexual and sexual reproduction with regard to genetic information and variation in offspring.
- 9-12.LS3.B.4 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics (Punnett Squares) to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.]

Supporting Standards for unit:

- 9-12-ETS-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- 9-12-ETS-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- 9-12-ETS3-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- ISTE-EMPOWERED LEARNER.1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
- TT.AB.D.7: Students will develop language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups.
- TT.AB.D.8: Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way.
- TT.AB.D.9: Students will respond to diversity by building empathy, respect, understanding and connection.
- TT.AB.J.11: Students will recognize stereotypes and relate to people as individuals rather than representatives of groups.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb’s DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>models to communicate the role of mitosis, cellular division, and differentiation in producing and maintaining complex Organisms.</td>
<td>Develop</td>
<td>apply</td>
<td>2</td>
</tr>
<tr>
<td>models to communicate the role of mitosis, cellular division, and differentiation in producing and maintaining complex Organisms.</td>
<td>Use</td>
<td>understand</td>
<td>2</td>
</tr>
<tr>
<td>models to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.</td>
<td>Use</td>
<td>understand</td>
<td>2</td>
</tr>
<tr>
<td>models to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.</td>
<td>Develop</td>
<td>apply</td>
<td>2</td>
</tr>
</tbody>
</table>
asexual and sexual reproduction with regard to genetic information and variation in offspring

| concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. |
|------------------|------------------|
|                  | Compare and contrast | understand | 2 |
|                  | Apply             | understand | 3 |

**Essential Questions:**

1. How is DNA organized in chromosomes?
2. How do organisms grow and develop through the process of mitosis and meiosis?
3. How does sexual reproduction promote genetic variation?
4. How are Punnett squares used to understand heredity?

**Enduring Understanding/Big Ideas:** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA.

1. In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.
2. In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.
3. Punnett squares are a statistical tool used to predict the outcomes of genetic crosses involving traits of an organism.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell cycle</td>
<td></td>
</tr>
<tr>
<td>Interphase (G1, S, G2)</td>
<td></td>
</tr>
<tr>
<td>Mitosis</td>
<td></td>
</tr>
<tr>
<td>Cytokinesis</td>
<td></td>
</tr>
<tr>
<td>Meiosis</td>
<td></td>
</tr>
<tr>
<td>Daughter cells</td>
<td></td>
</tr>
<tr>
<td>Cell division</td>
<td></td>
</tr>
<tr>
<td>Haploid</td>
<td></td>
</tr>
<tr>
<td>Diploid</td>
<td></td>
</tr>
<tr>
<td>Chromatin</td>
<td></td>
</tr>
<tr>
<td>Chromatid</td>
<td></td>
</tr>
<tr>
<td>Chromosomes</td>
<td>recessive</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>homozygous</td>
<td>genotype</td>
</tr>
<tr>
<td>heterozygous</td>
<td>carrier</td>
</tr>
<tr>
<td>autosome</td>
<td>sex-linked trait</td>
</tr>
</tbody>
</table>

**Topic 1: Cell Cycle**
Engaging Experience 1
Title: The Cell Cycle Activity
Suggested Length of Time: 45-60 minutes (modify to 1 Block)
Standards Addressed

Priority:
- 9-12.LS1.B.1 Develop and use models to communicate the role of mitosis, cellular division, and differentiation in producing and maintaining complex Organisms. [Clarification Statement: Major events of the cell cycle include cell growth, DNA replication, preparation for division, separation of chromosomes, and separation of cell contents.]

Supporting:
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: The Cell Cycle POGIL activity requires students to refer to models and data tables to observe patterns and determine what occurs in the cell cycle and how mutations occur that can affect cell division.

Bloom’s Levels: apply
Webb’s DOK: 2

Topic 2: Chromosomes

Engaging Experience 1
Title: Karyotype Activity

Board Approved: February 8, 2018
Suggested Length of Time: 30 minutes (modify to 1 Block)

Standards Addressed

Priority:

- 9-12.LS3.A.1 Develop and use models to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.

Supporting:

- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: Students will construct and analyze a karyotype. Suggested activities include Make a Karyotype from Learn.Genetics and Karyotyping Activity from The Biology Project, University of Arizona. In these online activities, students arrange chromosomes using size, banding pattern, and centromere position. Then students will analyze their karyotypes and determine the sex and genetic disorders of individuals.

Bloom’s Levels: analyze
Webb’s DOK: 2

Topic 3: Mitosis and Meiosis

Engaging Experience 1
Title: Mitosis and Meiosis Comparison
Suggested Length of Time: 30-45 minutes (modify to 1 Block)
Standards Addressed
Priority:
- 9-12.LS3.B.1 Compare and contrast asexual and sexual reproduction with regard to genetic information and variation in offspring.

Detailed Description/Instructions: Students will compare/contrast mitosis and meiosis. Suggested tools include using a graphic organizer or diamante poem.

Bloom’s Levels: analyze

Webb’s DOK: 3

---

Topic 4: Punnett Squares

Engaging Experience 1
Title: Using Punnett Squares
Suggested Length of Time: 45-60 minutes (modify to 2 Class blocks)

Standards Addressed
Priority:

- 9-12.LS3.B.4 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics (Punnett Squares) to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.]

Supporting:

- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: Students will explore how punnett squares are used to predict the outcomes of monohybrid genetic crosses and analyze the expected genotypes and phenotypes that result from each cross. A suggested activity is the Punnett Squares Virtual Lab by McGraw Hill.

Bloom’s Levels: analyze
Webb’s DOK: 3

Engaging Scenario

Students will use knowledge of cell division, chromosomes, and Punnett squares to investigate patterns of inheritance of specific traits. A suggested activity is the Geniverse Lab from the Concord Consortium in which students investigate genes, alleles, traits, meiosis and patterns of genetic inheritance in a fanciful and amusing game world while...
also exploring authentic genetics. Using a dragon genome based on accurate, real world
genetics, students make intentional breeding decisions with phenotypically and genotypically
different dragons.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
</table>

Summary of Engaging Learning Experiences for Topics
<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Cycle POGIL activity</td>
<td>Requires students to refer to models and data tables to observe patterns and determine what occurs in the cell cycle and how mutations occur that can affect cell division.</td>
<td>45-60 min (modify to 1 Block)</td>
</tr>
<tr>
<td>Chromosomes Karyotype activity</td>
<td>Students will construct and analyze a karyotype. Suggested activities include Make a Karyotype from Learn.Genetics and Karyotyping Activity from The Biology Project, University of Arizona. In these online activities, students arrange chromosomes using size, banding pattern, and centromere position. Then students will analyze their karyotypes and determine the sex and genetic disorders of individuals.</td>
<td>30 min   (modify to 1 Block)</td>
</tr>
<tr>
<td>Mitosis and Meiosis comparison</td>
<td>Students will compare/contrast mitosis and meiosis. Suggested tools include using a graphic organizer or diamante poem.</td>
<td>30-45 min (modify to 1 Block)</td>
</tr>
<tr>
<td>Punnett Squares</td>
<td>Students will explore how punnett squares are used to predict the outcomes of monohybrid genetic crosses and analyze the expected genotypes and phenotypes that result from each cross. A suggested activity is the Punnett Squares Virtual Lab by McGraw Hill.</td>
<td>45-60 min (modify to 2 Class Blocks)</td>
</tr>
</tbody>
</table>

Unit 6: Ecology

Subject: Biology  
Grade: 9  
Name of Unit: Ecology  
Length of Unit: 9-10 days  
Overview of Unit: This unit explores the abiotic and biotic factors that affect different levels of organization within ecosystems. Students will analyze energy flow, nutrient cycling, population...
growth, and interactions among organisms to develop an understanding of how Earth’s systems support life on Earth.

Priority Standards for unit:

- **9-12.LS2.A.1** Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations. [Clarification Statement: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Genetic diversity includes within a population and species within an ecosystem. Examples of mathematical comparisons could include graph, charts, histograms, and population changes gathered from simulations or historical data sets.]

- **9-12.LS2.B.1** Construct and revise an explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and anaerobic respiration are responsible for the cycling of matter and flow of energy through Ecosystems and that environmental conditions restrict which reactions can occur. [Clarification Statement: Examples of environmental conditions can include the availability of sunlight or oxygen.]

- **9-12.LS2.B.2** Communicate the pattern of the cycling of matter and the flow of energy among trophic levels in an ecosystem. [Clarification Statement: Emphasis is on using a model of stored energy in biomass to describe the transfer of energy from one trophic level to another. Emphasis is on atoms and molecules as they move through an ecosystem.]

- **9-12.LS2.B.3** Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: The primary forms of carbon include carbon dioxide, hydrocarbons, waste, and biomass. Examples of models could include simulations and mathematical and conceptual models.]

- **9-12.LS2.C.1** Evaluate the claims, evidence, and reasoning that the interactions in Ecosystems maintain relatively consistent populations of species while conditions remain stable, but changing conditions may result in new ecosystem dynamics. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

- **9-12.LS4.C.2** 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. [Clarification statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, and application of
fertilizers, droughts, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.

- 9-12.ESS2.E.1 Construct an argument based on evidence about the simultaneous coevolution of Earth's System and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth’s other System, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples of coevolution include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for new life.]

Supporting Standards for unit:
- 9-12-ETS-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- 9-12-ETS3-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- 9-12-ETS-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
- ISTE-EMPOWERED LEARNER.1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE-DIGITAL CITIZEN.2: Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb’s DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations.</td>
<td>Explain</td>
<td>analyze</td>
<td>3</td>
</tr>
<tr>
<td>An explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and anaerobic respiration are responsible for the cycling of matter and flow of energy through Ecosystems and that environmental conditions restrict which reactions can occur.</td>
<td>Construct</td>
<td>evaluate</td>
<td>3</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>An explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and anaerobic respiration are responsible for the cycling of matter and flow of energy through Ecosystems and that environmental conditions restrict which reactions can occur.</td>
<td>Revise</td>
<td>create</td>
<td>2</td>
</tr>
<tr>
<td>The pattern of the cycling of matter and the flow of energy among trophic levels in an ecosystem.</td>
<td>Communicate</td>
<td>understand</td>
<td>2</td>
</tr>
<tr>
<td>A model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.</td>
<td>Use</td>
<td>understand</td>
<td>2</td>
</tr>
<tr>
<td>The claims, evidence, and reasoning that the interactions in Ecosystems maintain relatively consistent populations of species while conditions remain stable, but changing conditions may result in new ecosystem dynamics.</td>
<td>Evaluate</td>
<td>evaluate</td>
<td>3</td>
</tr>
<tr>
<td>The evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the</td>
<td>Evaluate</td>
<td>evaluate</td>
<td>3</td>
</tr>
</tbody>
</table>
emergence of new species over time, and (3) the extinction of other species.

an argument based on evidence about the simultaneous co-evolution of Earth's System and life on Earth.

Construct create 4

a model to demonstrate how photosynthesis transforms light energy into stored chemical energy.

Use understand 2

a model to demonstrate that cellular respiration is a chemical process whereby the bonds of molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Use understand 2

**Essential Questions:**

1. How is carrying capacity affected by the biotic and abiotic factors of an ecosystem?
2. How do food webs illustrate the flow of energy in ecosystems?
3. How do nutrients cycle through Earth?

**Enduring Understanding/Big Ideas:**

1. Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

2. Food webs and food chains indicate the feeding relationships among organisms in an ecosystem. These feeding relationships represent the transfer of energy from one trophic level to the next.

3. Carbon, nitrogen, phosphorus, and water are examples of nutrients that cycle through Earth’s biosphere, atmosphere, hydrosphere, cryosphere, and geosphere.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>biotic</td>
<td></td>
</tr>
<tr>
<td>abiotic</td>
<td></td>
</tr>
<tr>
<td>limiting factor</td>
<td></td>
</tr>
<tr>
<td>carrying capacity</td>
<td></td>
</tr>
<tr>
<td>food chain</td>
<td>food web</td>
</tr>
<tr>
<td>competition</td>
<td>symbiosis</td>
</tr>
<tr>
<td>parasitism</td>
<td>mutualism</td>
</tr>
<tr>
<td>commensalism</td>
<td>autotroph</td>
</tr>
<tr>
<td>heterotroph</td>
<td>producer</td>
</tr>
<tr>
<td>consumer</td>
<td>biomass</td>
</tr>
<tr>
<td>ecological pyramid</td>
<td>nutrient cycle</td>
</tr>
<tr>
<td>hydrosphere</td>
<td>biosphere</td>
</tr>
<tr>
<td>cyrosphere</td>
<td>geosphere</td>
</tr>
<tr>
<td>atmosphere</td>
<td>decomposition</td>
</tr>
<tr>
<td>combustion</td>
<td>climate</td>
</tr>
<tr>
<td>weather</td>
<td>species</td>
</tr>
<tr>
<td>population</td>
<td>community</td>
</tr>
<tr>
<td>ecosystem</td>
<td></td>
</tr>
</tbody>
</table>

**Topic 1: Ecological Levels**

**Engaging Experience 1**

**Title:** Levels of Organization Illustration Activity

**Suggested Length of Time:** 20 minutes (modify to 1 Block)

**Standards Addressed**
Priority:

- 9-12.LS2.A.1 Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations. [Clarification Statement: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Genetic diversity includes within a population and species within an ecosystem. Examples of mathematical comparisons could include graph, charts, histograms, and population changes gathered from simulations or historical data sets.]

Detailed Description/Instructions: Students will label, classify, and illustrate the levels of organization within an ecosystem.

Bloom’s Levels: Understand
Webb’s DOK: 2

Topic 2: Population Growth

Engaging Experience 1
Title: Population Biology Activity
Suggested Length of Time: 45-60 minutes (modify to 1 Block)
Standards Addressed
Priority

- 9-12.LS2.A.1 Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations. [Clarification Statement: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Genetic diversity includes within a population and species within an ecosystem. Examples of mathematical comparisons could include graph, charts, histograms, and population changes gathered from simulations or historical data sets.]

- 9-12.LS2.C.1 Evaluate the claims, evidence, and reasoning that the interactions in Ecosystems maintain relatively consistent populations of species while conditions remain stable, but changing conditions may result in new ecosystem dynamics. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

Supporting:

- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: In the Population Biology Virtual Lab from McGraw Hill, students will demonstrate how competition for natural resources in the environment can affect population growth. Students will explain and analyze how availability of resources, such as food, can be limiting for populations.

Bloom’s Levels: Analyze
Webb’s DOK: 3

Topic 3: Interactions of Organisms

Engaging Experience 1
Title: Food Web Activity
Suggested Length of Time: 60-90 minutes
Standards Addressed
• 9-12.LS2.A.1 Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations. [Clarification Statement: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Genetic diversity includes within a population and species within an ecosystem. Examples of mathematical comparisons could include graph, charts, histograms, and population changes gathered from simulations or historical data sets.]

• 9-12.LS2.B.2 Communicate the pattern of the cycling of matter and the flow of energy among trophic levels in an ecosystem. [Clarification Statement: Emphasis is on using a model of stored energy in biomass to describe the transfer of energy from one trophic level to another. Emphasis is on atoms and molecules as they move through an ecosystem.]

Supporting:

• ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: Given data on feeding relationships, students construct and analyze a food web for energy flow among trophic levels and population changes related to biotic and abiotic factors in the ecosystem.

Bloom’s Levels: analyze
Webb’s DOK: 3

Topic 4: Nutrient Cycles

Engaging Experience 1
Title: Carbon Dioxide and the Carbon Cycle
Suggested Length of Time: 30-45 minutes
Standards Addressed
Priority:
● 9-12.LS2.B.3 Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: The primary forms of carbon include carbon dioxide, hydrocarbons, waste, and biomass. Examples of models could include simulations and mathematical and conceptual models.]

Supporting:

● ISTE-DIGITAL CITIZEN.2: Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.

Detailed Description/Instructions: In the interactive Carbon Dioxide and the Carbon Cycle by PBS Learning Media, students will explore how human activities alter the carbon cycle and cause atmospheric carbon dioxide to increase. Students will learn about the reservoirs and flows of the carbon cycle and how human activities increase the amount of carbon dioxide in the air and ocean. Then, students will have an online discussion about how higher carbon dioxide levels cause global warming.

Bloom’s Levels: evaluate
Webb’s DOK: 3

Engaging Scenario

**Engaging Scenario** Students will analyze a population to determine how abiotic and biotic factors affect its growth and survival. A suggested activity is the African Lions: Modeling Populations (Concord Consortium) online activity in which students learn to distinguish between exponential and logistic growth of populations, identify carrying capacity, differentiate density-dependent and density-independent limiting factors, apply population
models to data sets and determine carrying capacity from population data. Students also make predictions on graphs and interpret graphical data to analyze factors that influence population growth.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
</table>

Summary of Engaging Learning Experiences for Topics

Board Approved: February 8, 2018
<table>
<thead>
<tr>
<th>Ecological Levels</th>
<th>Levels of Organization Illustration Activity</th>
<th>Students will label, classify, and illustrate the levels of organization within an ecosystem.</th>
<th>20 minutes (modify to 1 Block)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Growth</td>
<td>Population Biology Activity</td>
<td>In the Population Biology Virtual Lab from McGraw Hill, students will demonstrate how competition for natural resources in the environment can affect population growth. Students will explain and analyze how availability of resources, such as food, can be limiting for populations.</td>
<td>45-60 minutes (modify to 1 Block)</td>
</tr>
<tr>
<td>Interactions of Organisms</td>
<td>Food Web Activity</td>
<td>Given data on feeding relationships, students construct and analyze a food web for energy flow among trophic levels and population changes related to biotic and abiotic factors in the ecosystem.</td>
<td>60-90 minutes</td>
</tr>
<tr>
<td>Nutrient Cycles</td>
<td>Carbon Dioxide and the Carbon Cycle</td>
<td>In the interactive Carbon Dioxide and the Carbon Cycle by PBS Learning Media, students will explore how human activities alter the carbon cycle and cause atmospheric carbon dioxide to increase. Students will learn about the reservoirs and flows of the carbon cycle and how human activities increase the amount of carbon dioxide in the air and ocean. Then, students will have an online discussion about how higher carbon dioxide levels cause global warming.</td>
<td>30-45 minutes</td>
</tr>
</tbody>
</table>

**Unit 7: Evolution**

**Subject:** Biology  
**Grade:** 9  
**Name of Unit:** Evolution  
**Length of Unit:** 9-10 days  
**Overview of Unit:** This unit provides an overview of biological evolution through natural selection. Students will explore the interdependence of Earth’s geological evolution and
biological evolution, develop an understanding of the process of natural selection, analyze evidence that supports biological evolution, and examine how speciation and extinction are related to environmental changes.

Priority Standards for unit:

- **9-12.LS4.A.1** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. (Clarification statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development. Communicate could mean written report, oral discussion, etc.)

- **9-12.LS4.A.2** Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. (Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different Organisms by comparing the macroscopic appearance of diagrams or pictures.)

- **9-12.LS4.B.1** 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. (Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of Organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graph and proportional reasoning.)

- **9-12.LS4.B.2** 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. (Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.)

- **9-12.LS4.C.1** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. (Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in Ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other Organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.)

- **9-12.LS4.C.2** 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. [Clarification statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, and application of fertilizers, droughts, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

- 9-12.ESS2.E.1 Construct an argument based on evidence about the simultaneous co-evolution of Earth's System and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth’s other System, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples of co-evolution include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for new life.]

Supporting Standards for unit:
- 9-12-ETS3-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- 9-12-ETS-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
- ISTE-EMPOWERED LEARNER.1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</td>
<td>Communicate</td>
<td>understand</td>
<td>2</td>
</tr>
<tr>
<td>displays of pictorial data to compare patterns of similarities in the embryological development across</td>
<td>Analyze</td>
<td>analyze</td>
<td>2</td>
</tr>
</tbody>
</table>
multiple species to identify relationships not evident in the fully formed anatomy.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Construct</th>
<th>create</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Construct</td>
<td>create</td>
<td>2</td>
</tr>
<tr>
<td>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.</td>
<td>Apply</td>
<td>analyze</td>
<td>2</td>
</tr>
<tr>
<td>an explanation based on evidence for how natural selection leads to adaptation of populations.</td>
<td>Construct</td>
<td>create</td>
<td>2</td>
</tr>
<tr>
<td>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.</td>
<td>Evaluate</td>
<td>evaluate</td>
<td>3</td>
</tr>
<tr>
<td>an argument based on evidence about the simultaneous co-evolution of Earth's System and life on Earth.</td>
<td>Construct</td>
<td>create</td>
<td>4</td>
</tr>
</tbody>
</table>

**Essential Questions:**

1. How does the process of evolution through natural selection occur in populations?
2. How do molecular and structural comparisons among organisms provide evidence for evolution?
3. How are adaptations related to the genetic makeup of a population?
4. How do changes in the environment lead to speciation and extinction?

**Enduring Understanding/Big Ideas:**

1. **Evolution** is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

2. Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.

3. Adaptations can be the traits that positively affect survival and are more likely to be reproduced, and thus are more common in the population. Adaptation also means that the distribution of traits in a population can change when conditions change.

4. Changes in the physical environment, whether naturally occurring or human induced, have contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.

**Unit Vocabulary:**

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>fossil</td>
<td>natural selection</td>
</tr>
<tr>
<td></td>
<td>adaptation</td>
</tr>
<tr>
<td></td>
<td>fitness</td>
</tr>
<tr>
<td></td>
<td>mutation</td>
</tr>
<tr>
<td></td>
<td>gene flow</td>
</tr>
<tr>
<td></td>
<td>genetic drift</td>
</tr>
<tr>
<td></td>
<td>population bottleneck</td>
</tr>
<tr>
<td></td>
<td>founder effect</td>
</tr>
<tr>
<td></td>
<td>speciation</td>
</tr>
<tr>
<td></td>
<td>geographic isolation</td>
</tr>
<tr>
<td></td>
<td>behavioral isolation</td>
</tr>
<tr>
<td></td>
<td>reproductive isolation</td>
</tr>
<tr>
<td></td>
<td>Extinction</td>
</tr>
<tr>
<td></td>
<td>homologous structure</td>
</tr>
<tr>
<td></td>
<td>analogous structure</td>
</tr>
<tr>
<td></td>
<td>vestigial structure</td>
</tr>
</tbody>
</table>
Engaging Experience 1
Title: Investigating Earth’s Geological Evolution
Suggested Length of Time: 30-45 minutes
Standards Addressed

Priority:
- 9-12.ESS2.E.1 Construct an argument based on evidence about the simultaneous co-evolution of Earth's System and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere...
and Earth’s other System, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples of co-evolution include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for new life.]

Supporting:

- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: A suggested activity for investigating Earth’s geological evolution is the Winogradsky column experiment found at HHMI Biointeractive. This experiment requires students to create zones of microbial activity in a glass column and collect data on microbial activity as it relates to soil formation.

Bloom’s Levels: analyze
Webb’s DOK: 3

---

Topic 2: The Process of Natural Selection

Engaging Experience 1
Title: Natural Selection Lab
Suggested Length of Time: 45-60 minutes (modify to 1 Block)

Standards Addressed
Priority:

- 9-12.LS4.B.1 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. (Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of Organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graph and proportional reasoning.)

● 9-12.LS4.C.2 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. [Clarification statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, and application of fertilizers, droughts, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

● 9-12.LS4.B.2 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. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.]

● 9-12.LS4.C.1 Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in Ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other Organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

Supporting:

● ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: Students will explore how natural selection causes populations to change. Students will carry out a lab to determine how selective pressures affect the survival of individuals in a population and lead to natural selection of specific traits.

Bloom’s Levels: analyze

Webb’s DOK: 3
Topic 3: Evidence for Evolution

Engaging Experience 1
Title: Analyzing Evidence for Evolution Activity
Suggested Length of Time: 45-60 minutes (modify to 1 Block)
Standards Addressed

- 9-12.LS4.A.1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
  (Clarification statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical
9-12.LS4.A.2 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different Organisms by comparing the macroscopic appearance of diagrams or pictures.]

Supporting:

- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: The Biology POGIL Evidence for Evolution activity requires students to refer to models and data tables to observe patterns and determine how DNA and comparative anatomy are used to show relatedness.

Bloom’s Levels: apply

Webb’s DOK: 2
of change of the environment affect distribution or disappearance of traits in species.]

Supporting:

- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Detailed Description/Instructions: Students will discover the environmental factors that caused the five big mass extinctions in Earth’s History and which species they impacted through the “Mass Extinctions Activity” from HHMI BioInteractive.

Bloom’s Levels: apply

Webb’s DOK: 2
**Engaging Scenario** Students will design and conduct experiments about natural selection in populations. Variables that can be manipulated include mutations, environmental conditions, and selective pressures. A suggested tool for students to use in their experiments is the PhET Natural Selection online simulation.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geological Evolution</td>
<td>Investigating Earth’s Geological Evolution</td>
<td>A suggested activity for investigating Earth’s geological evolution is the Winogradsky column experiment found at HHMI BioInteractive. This experiment requires students to create zones of microbial activity in a glass column and collect data on microbial activity as it relates to soil formation.</td>
<td>30-45 minutes</td>
</tr>
<tr>
<td>The Process of Natural Selection</td>
<td>Natural Selection Lab</td>
<td>Students will explore how natural selection causes populations to change. Students will carry out a lab to determine how selective pressures affect the survival of individuals in a population and lead to natural selection of specific traits.</td>
<td>45-60 minutes (modify to 1 Block)</td>
</tr>
<tr>
<td>Evidence for Evolution</td>
<td>Analyzing Evidence for Evolution Activity</td>
<td>The Biology POGIL Evidence for Evolution activity requires students to refer to models and data tables to observe patterns and determine how DNA and comparative anatomy are used to show relatedness.</td>
<td>45-60 minutes (modify to 1 Block)</td>
</tr>
<tr>
<td>Speciation and Extinction</td>
<td>Speciation and Extinction Activity</td>
<td>Students will discover the environmental factors that caused the five big mass extinctions in Earth’s History and which species they impacted through the “Mass Extinctions Activity” from HHMI BioInteractive.</td>
<td>60 minutes (modify to 1 Block)</td>
</tr>
</tbody>
</table>
Unit 8: Earth and Human Activity

Subject: Biology
Grade: 9
Name of Unit: Earth and Human Activity
Length of Unit: 9-10 days
Overview of Unit: This unit investigates the impact of human activity on Earth’s systems. Students will explore Earth’s natural resources and how human activity has impacted these natural resources and altered Earth’s systems. Additionally, students will investigate and develop solutions to address these changes to Earth’s systems in order to preserve and maintain natural resources.

Priority Standards for unit:

- 9-12.LS2.C.2 Design, evaluate, and/or refine solutions that positively impact the environment and biodiversity. [Clarification Statement: Examples of solutions may include captive breeding programs, habitat restoration, pollution mitigation, energy conservation, agriculture and mining programs, and ecotourism.]

- 9-12.LS4.C.3 Create or revise a model to test a solution to mitigate adverse impacts of human activity on biodiversity. [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of Organisms for multiple species.]

- 9-12.ESS3.A.1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water, regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather. Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

- 9-12.ESS3.C.1 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.]

- 9-12.ESS3.C.2 Evaluate or refine a technological solution that reduces impacts of human activities on natural system in order to restore stability and or biodiversity of the
ecosystem as well as prevent their recurrences. [Clarification Statement: Examples of human activities could include forest fires, acid rain, flooding, urban development, pollution, deforestation, and introduction of an invasive species.]

- 9-12.ESS3.D.2 Predict how human activity affects the relationships between Earth System in both positive and negative ways. [Clarification Statement: Examples of Earth System to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere.]

**Supporting Standards for unit:**

- 9-12-ETS-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- 9-12-ETS-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- 9-12-ETS3-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- 9-12-ETS-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
- ISTE-EMPOWERED LEARNER.1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - INNOVATIVE DESIGNER.4: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
- ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
- TT.AB.J.13: Students will analyze the harmful impact of bias and injustice on the world, historically and today.
- TT.AB.J.14: Students will recognize that power and privilege influence relationships on interpersonal, intergroup and institutional levels and consider how they have been affected by those dynamics.
<table>
<thead>
<tr>
<th>Unwrapped Concepts (Students need to know)</th>
<th>Unwrapped Skills (Students need to be able to do)</th>
<th>Bloom’s Taxonomy Levels</th>
<th>Webb's DOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>solutions that positively impact the environment and biodiversity.</td>
<td>Design</td>
<td>create</td>
<td>4</td>
</tr>
<tr>
<td>solutions that positively impact the environment and biodiversity.</td>
<td>Evaluate</td>
<td>evaluate</td>
<td>4</td>
</tr>
<tr>
<td>solutions that positively impact the environment and biodiversity.</td>
<td>Refine</td>
<td>create</td>
<td>4</td>
</tr>
<tr>
<td>a model to test a solution to mitigate adverse impacts of human activity on biodiversity.</td>
<td>Create</td>
<td>create</td>
<td>3</td>
</tr>
<tr>
<td>a model to test a solution to mitigate adverse impacts of human activity on biodiversity.</td>
<td>Revise</td>
<td>create</td>
<td>4</td>
</tr>
<tr>
<td>an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</td>
<td>Construct</td>
<td>evaluate</td>
<td>3</td>
</tr>
<tr>
<td>a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</td>
<td>Create</td>
<td>create</td>
<td>3</td>
</tr>
<tr>
<td>a technological solution that reduces impacts of human activities on natural System in order to restore stability and or biodiversity of the ecosystem as well as prevent their recurrences.</td>
<td>Evaluate</td>
<td>evaluate</td>
<td>3</td>
</tr>
<tr>
<td>a technological solution that reduces impacts of human activities on natural System in order to restore stability and or biodiversity of the ecosystem as well as prevent their recurrences.</td>
<td>Refine</td>
<td>evaluate</td>
<td>4</td>
</tr>
<tr>
<td>how human activity affects the relationships between Earth System in both positive and negative ways.</td>
<td>Predict</td>
<td>create</td>
<td>2</td>
</tr>
</tbody>
</table>
Essential Questions:
1. How do ecosystems respond to biological or physical disturbances?
2. How do human activities disrupt an ecosystem?
3. How is biodiversity important for sustaining all life on Earth?

Enduring Understanding/Big Ideas:
1. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
2. Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.
3. Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Unit Vocabulary:

<table>
<thead>
<tr>
<th>Academic Cross-Curricular Words</th>
<th>Content/Domain Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>acid rain</td>
<td></td>
</tr>
<tr>
<td>mass wasting</td>
<td></td>
</tr>
<tr>
<td>deforestation</td>
<td></td>
</tr>
<tr>
<td>invasive species</td>
<td></td>
</tr>
<tr>
<td>pollution</td>
<td></td>
</tr>
<tr>
<td>urban planning</td>
<td></td>
</tr>
<tr>
<td>endangered/threatened species</td>
<td></td>
</tr>
<tr>
<td>fossil fuels</td>
<td></td>
</tr>
<tr>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td>agricultural efficiency</td>
<td></td>
</tr>
<tr>
<td>captive breeding programs</td>
<td></td>
</tr>
<tr>
<td>habitat restoration</td>
<td></td>
</tr>
<tr>
<td>pollution mitigation</td>
<td></td>
</tr>
<tr>
<td>ecotourism</td>
<td></td>
</tr>
<tr>
<td>energy conservation</td>
<td></td>
</tr>
<tr>
<td>climate change</td>
<td></td>
</tr>
<tr>
<td>biodiversity</td>
<td></td>
</tr>
<tr>
<td>natural resources</td>
<td></td>
</tr>
<tr>
<td>anthropogenic</td>
<td></td>
</tr>
</tbody>
</table>
Engaging Experience 1

Title: How Does the Environment Impact Human Activity Project

Suggested Length of Time: 90 minutes (modify to 2 Class Blocks)

Standards Addressed

**Priority:**
- 9-12.ESS3.A.1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to freshwater, regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather. Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

**Supporting:**
- ISTE-EMPOWERED LEARNER.1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

Detailed Description/Instructions: Students will research the before and after effects of a natural disaster or ecological event, such as Hurricane Katrina, Mount St. Helens or the Dust Bowl, and how they have altered human activity. Students will aggregate their information into a presentation that can be shared with peers. A suggested activity is a gallery walk activity in which students share individually created posters of specific natural resources they researched.

Bloom’s Levels: understand

Webb’s DOK: 2
Topic 2: Human Activities

Engaging Experience 1
Title: Human Impact on the Environment
Suggested Length of Time: (modify to 1 Block)
Standards Addressed

Priority:
- 9-12.ESS3.D.2 Predict how human activity affects the relationships between Earth System in both positive and negative ways. [Clarification Statement: Examples of Earth System to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere.]

Supporting:
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

Detailed Description/Instructions: In “The Anthropocene: Human Impact on the Environment” from HHMI BioInteractive, students explore key human impacts on the environment and how they have affected Earth’s landscape, ocean, atmosphere, and biodiversity.

Bloom’s Levels: apply
Webb’s DOK: 2
Engaging Experience 1
Title: Cookie Mining Activity
Suggested Length of Time: 90 minutes

Standards Addressed

Priority:
- 9-12.LS2.C.2 Design, evaluate, and/or refine solutions that positively impact the environment and biodiversity. [Clarification Statement: Examples of solutions may include captive breeding programs, habitat restoration, pollution mitigation, energy conservation, agriculture and mining programs, and ecotourism.]
- 9-12.LS4.C.3 Create or revise a model to test a solution to mitigate adverse impacts of human activity on biodiversity. [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of Organisms for multiple species.]
- 9-12.ESS3.C.1 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.]
- 9-12.ESS3.C.2 Evaluate or refine a technological solution that reduces impacts of human activities on natural System in order to restore stability and or biodiversity of the ecosystem as well as prevent their recurrences. [Clarification Statement: Examples of human activities could include forest fires, acid rain, flooding, urban development, pollution, deforestation, and introduction of an invasive species.]

Supporting:
- ISTE-EMPOWERED LEARNER.1: Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
- ISTE - KNOWLEDGE COLLECTOR.3: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- ISTE - INNOVATIVE DESIGNER.4: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
- ISTE - COMPUTATIONAL THINKER.5: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
• ISTE - CREATIVE COMMUNICATOR.6: Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

Detailed Description/Instructions: Students will use a cookie mining activity to model use of natural resources and preserving the environment. They will calculate cost/benefits and evaluate the effectiveness of their mining operation.

Bloom’s Levels: create
Webb’s DOK: 4
Engaging Scenario

Students will choose an environmental issue (air pollution, water pollution, soil pollution, loss of habitat, excessive waste, loss of biodiversity, etc...) in a specific region, county, or city. Students will research the cause/source of the issue, discuss how it’s affecting that specific ecosystem, and present a solution for that issue. Students will then present their findings to the classroom.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Engaging Experience Title</th>
<th>Description</th>
<th>Suggested Length of Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Impacts</td>
<td>How Does the Environment Impact Human Activity Project</td>
<td>Students will research the before and after effects of a natural disaster or ecological event, such as Hurricane Katrina, Mount St. Helens or the Dust Bowl, and how they have altered human activity. Students will aggregate their information into a presentation that can be shared with peers. A suggested activity is a gallery walk activity in which students share individually created posters of specific natural resources they researched.</td>
<td>90 minutes (modify to 2 Class Blocks)</td>
</tr>
<tr>
<td>Human Activities</td>
<td>Human Impact on the Environment</td>
<td>In “The Anthropocene: Human Impact on the Environment” from hhmi BioInteractive, students explore key human impacts on the environment and how they have affected Earth’s landscape, ocean, atmosphere, and biodiversity.</td>
<td>60-90 minutes</td>
</tr>
<tr>
<td>Solutions</td>
<td>Cookie Mining Activity</td>
<td>Students will use a cookie mining activity to model use of natural resources and preserving the environment. They will calculate cost/benefits and evaluate the effectiveness of their mining operation.</td>
<td>90 minutes</td>
</tr>
</tbody>
</table>

Unit of Study Terminology
**Appendices**: All Appendices and supporting material can be found in this course’s shell course in the District’s Learning Management System.

**Assessment Leveling Guide**: A tool to use when writing assessments in order to maintain the appropriate level of rigor that matches the standard.

**Big Ideas/Enduring Understandings**: Foundational understandings teachers want students to be able to discover and state in their own words by the end of the unit of study. These are answers to the essential questions.

**Engaging Experience**: Each topic is broken into a list of engaging experiences for students. These experiences are aligned to priority and supporting standards, thus stating what students should be able to do. An example of an engaging experience is provided in the description, but a teacher has the autonomy to substitute one of their own that aligns to the level of rigor stated in the standards.

**Engaging Scenario**: This is a culminating activity in which students are given a role, situation, challenge, audience, and a product or performance is specified. Each unit contains an example of an engaging scenario, but a teacher has the ability to substitute with the same intent in mind.

**Essential Questions**: Engaging, open-ended questions that teachers can use to engage students in the learning.

**Priority Standards**: What every student should know and be able to do. These were chosen because of their necessity for success in the next course, the state assessment, and life.

**Supporting Standards**: Additional standards that support the learning within the unit.

**Topic**: These are the main teaching points for the unit. Units can have anywhere from one topic to many, depending on the depth of the unit.

**Unit of Study**: Series of learning experiences/related assessments based on designated priority standards and related supporting standards.

**Unit Vocabulary**: Words students will encounter within the unit that are essential to understanding. Academic Cross-Curricular words (also called Tier 2 words) are those that can be found in multiple content areas, not just this one. Content/Domain Specific vocabulary words are those found specifically within the content.

**Symbols**:
- This symbol depicts an experience that can be used to assess a student’s 21st Century Skills using the rubric provided by the district.
- This symbol depicts an experience that integrates professional skills, the development of professional communication, and/or the use of professional mentorships in authentic classroom learning activities.