Washington Township School District

The mission of the Washington Township Public Schools *is to provide a safe, positive, and progressive educational environment that provides opportunity for all students to attain the knowledge and skills specified in the NJ Learning Standards at all grade levels, so as to ensure their full participation in an ever-changing world as responsible, self-directed and civic-minded citizens.*

Course Title:	**Advanced Placement Biology**
Grade Level(s):	**11 & 12**

Duration:	*Full Year:*	**X**	*Semester:*		*Marking Period:*	
Course Description:	**This course is intended for students who have an interest in continuing post-graduation study of biology. This course is structured around the four big ideas, enduring understandings, and science practices developed by college board and serves students by developing an appreciation for the study of life, while helping students identify and understand unifying principles within a diversified biological world. Also, this course is designed to give a deep appreciation to the connections within the various branches of biology as well as how the other sciences are necessarily intertwined. This course is highly recommended for students who intend to pursue a career in Medicine, Genetic Engineering, Marine Biology, Ecology, and related fields. Major topics of study will include: Molecules and Cells (Chemistry of Life, Cells, Cellular Energetics), Heredity and Evolution (Heredity, Molecular Genetics, Evolutionary Biology), Organisms and Populations (Diversity of Organisms, Structure and Function of Plants and Animals, Ecology). Students are given the opportunity to engage in student-directed laboratory. Additional labs will be conducted to deepen student conceptual understanding and to reinforce the application of science practices within a hands-on, discovery based environment. All levels of inquiry will be used and all seven science practice skills will be used by students on a regular basis in formal labs as well as activities outside of the lab experience. Investigations. Therefore, a well-organized lab notebook is essential.**					
Grading Procedures:	**TESTS 45%, LABS 35%, QUIZZES 20%**					
Primary Resources:	**COLLEGE BOARD CURRICULUM FRAMEWORK FOR Advanced Placement Biology** **NEXT GENERATION SCIENCE STANDARDS NGSS** **NEW JERSEY STUDENT LEARNING STANDARDS NJSLS** **Process Oriented Guided Inquiry Learning (POGIL)** **Reece, J. B., Urry, L. A., Cain, M. L. 1., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.**					

Washington Township Principles for Effective Teaching and Learning

- Implementing a standards-based curriculum
- Facilitating a learner-centered environment
- Using academic target language and providing comprehensible instruction
- Adapting and using age-appropriate authentic materials
- Providing performance-based assessment experiences
- Infusing 21st century skills for College and Career Readiness in a global society

Designed by:	Angela Cardamone, MS

Under the Direction of:	Dr. Patricia Hughes

Written: _____

Revised: _____

BOE Approval: _____

Unit Title: Ecology

Unit Description: This unit relates the interaction of individual organisms, species, and communities with each other as well as with the three abiotic aspects of the Earth (hydrosphere, lithosphere, and atmosphere). Students will explore how populations are regulated by abiotic and biotic factors, how energy flows through an ecosystem while elements cycle, community and ecosystem structure and dynamics, and the human influence on ecosystem balance.

Unit Duration: 3.5 weeks

Desired Results

Standard(s): NGSS: HS-LS2-1-8, HS-LS4-5, HS-LS4-6

College Board: "Enduring Understanding" 2A, 2D, 2E, 4A, 4B, 4C

Indicators: NGSS: HS-LS2.A "Interdependent Relationships in Ecosystems" LS2.B "Cycles of Matter and Energy Transfer in Ecosystems" LS2.C "Ecosystem Dynamics, Functioning and Resilience" LS2.D"Social Interactions and Group Behavior" HS-LS4.B "Natural Selection" LS4.C "Adaptation" LS4.D "Biodiversity and Humans"

College Board: "Essential Knowledge" 2A.3, 2D.1, 2D.3, 2E.3, 4A.4, 4A.5, 4A.6, 4B.3, 4C.2, 4C.3, 4C.4

AP BIG IDEA 2 – Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

AP BIG IDEA 4- Biological systems interact, and these systems and their interactions possess complex properties.

Understandings:
Students will understand that…

- *Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments (EU2A).*
- *Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment (EU2D).*
- *Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination (EU2E).*
- *Interactions within biological systems lead to complex properties (EU4A).*
- *Competition and cooperation are important aspects of biological systems (EU4B).*
- *Naturally occurring diversity among and between components within biological systems affects interactions with the environment (EU4C).*

Essential Questions:
1.How do organisms use free energy to maintain organization, growth, and reproduction?
2. How do changes in free energy available to organisms result in changes in population size and disruptions to an ecosystem?
3. How are biological systems from cells to organisms to populations, communities, and ecosystems affected by complex biotic and abiotic interactions involving exchange of matter and free energy?
4. In what ways do communities interact within their environments that result in the movement of matter and energy?
5. In what ways do interactions between and within populations influence patterns of species distribution and amount of local and global ecosystem changes over time?
6. How does the diversity of a species within an ecosystem influence the stability of the ecosystem?

Assessment Evidence

Performance Tasks:

1. Explain, justify, and predict how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, growth, and reproduction.
2. Refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells, organisms, populations, communities, and ecosystems.

Other Evidence:

Quiz – Chapter 53 "Populations", Chapter 54 "Communities", Chapter 55 "Ecosystems"

Lab – "How temperature and light affect primary production" lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion

3. Design a plan for collecting data to show that all biological systems are affected by biotic and abiotic interactions. 4. Analyze data to identify patterns and relationships between biotic or abiotic factors and biological systems. 5. Connect concepts across domains to predict how environmental factors affect responses to information and change behavior. 6. Predict changes in communities. 7. Apply mathematical routines to quantities that describe communities composed of populations that interact. 8. Use data analysis to refine observations and measurements regarding the effect of populations interactions on patterns of distribution and abundance. 9. Predict consequences of human actions on ecosystems.	**Group and Independent studies-** • **Correct completion of Study Guides for corresponding Chapters (53,54,55).** • **Correct completion of Bozeman science video worksheets** • **Discussion board response.** • **Animated investigation on abiotic factor influence.** • **Back to the Bay case study.** • **Analysis of invasive species concept.** • **Investigation: How do temperature and light affect primary production?**

Benchmarks:

Unit test for Combined Ecology encompassing Chapters 53, 54, 55

Post lab analysis using previous Advanced Placement Biology free response question on primary productivity

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 53-55 For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. This Unit is an independent study to be completed over the summer. It is expected that students will need one week devoted to each chapter described.*

- Animated Investigation: How do Abiotic Factors Affect Distribution of Organisms? From: <www.campbellbiology.com>, Chapter 52. Students will use a simple model for observing ecological impact that occurs when single abiotic factors are changes. By changing abiotic factors, data can be collected and analyzed.

"Populations" – 1 week

- Carefully read Chapter 53 in Campbell Biology.
- Watch Bozeman Science ap biology system category video 50 on populations and complete the corresponding video worksheet. Also watch the exponential growth and logistic growth videos.
- Complete Using the Logistic Equation to Model Population Growth, p. 1198.
- Complete Back to the Bay case study from Waterman and Stanley.
- Complete the Population Chapter Study Guide.

"Communities" – 1 week

- Carefully read Chapter 54 in Campbell Biology.

- Watch Bozeman Science Advanced Placement Biology system category video 46 on communities and complete the corresponding video worksheet.
- Provide students with a copy of an article entitled “Invasive Plant Suppresses the Growth of Native Tree Seedlings by Disrupting Belowground Mutualisms”, by Kristina Stinson and others. Students will explore the research based study and analyze the data presented for related meaning.
- Complete the Community Chapter Study Guide.

“Ecosystems” – 1 week

- Carefully read Chapter 55 in Campbell Biology.
- Watch Bozeman Science Advanced Placment Biology system category video 47 on ecosystems, video 51 on how ecosystems change, and video 55 on biodiversity and complete the corresponding video worksheets.
- Physical laws that govern energy flow and chemical cycling in ecosystems.
  - Energy and other limiting factors to control primary production in Ecosystems Lab Investigation: How temperature and light affect primary production. From: www.campbellbiology.com, Chapter 55.
  - Pose the following question to students: In order to improve species richness, you decide to add phosphate to a pond. How might you determine how much phosphate to add in order to avoid eutrophication? Students will prepare a discussion board response to present their thinking to the class.
  - Complete the Ecosystem Chapter Study Guide.

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Waterman, M., & Stanley, E. (2008). *Biological Inquiry: A workbook of investigative cases for biology* (Eighth edition). San Francisco: Pearson.

Taylor, Martha. (2017) *Student Study Guide for Biology* 8th ed. Boston: Pearson.

Invasive Plant Suppresses the Growth of Native Tree Seedlings by Disrupting Belowground Mutualisms. PLOS Biology 12(2): e1001817. https://doi.org/10.1371/journal.pbio.1001817

Bozeman Science Ap Biology video series. (n.d.). Retrieved July 24, 2017, from www.bozemanscience.com

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): *EU2A: Growth, reproduction and maintenance of the organization of living systems require free energy and matter. EU2D/E: Growth, reproduction, and dynamic homeostasis of biological systems are influenced by changes in the environment and include temporal regulation and coordination.*	
4.0	**Students will be able to:** • **Formulate a hypothesis for how light affects primary production in an ecosystem** • **Design a plan for collecting data to show how systems are affected by biotic and abiotic interactions** • **Modify experimental design for lab extension** • **Predict the effects of a change in populations, communities, and ecosystems.**
3.0	**Students will be able to:** • **Justify scientific claims with evidence to show timing and coordination of physiological events involving regulation.** • **Analyze scientific data for describing effects of abiotic factors in ecosystems and primary production of species.** • **Compare and contrast growth curves and life tables.**
2.0	**Students will be able to:** • **Describe the carbon, nitrogen, and phosphorous cycles in an ecosystem.** • **Explain the energy movement through trophic levels.** • **Give examples of ecological succession.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *EU4A/B: Interactions within biological systems lead to complex properties which include competition and cooperation aspects. EU4C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.*	
4.0	**Students will be able to:** • **Propose or Design restoration methods for struggling ecosystems** • **Use data analysis to refine observations regarding the effect of population interactions on species distribution and abundance**
3.0	**Students will be able to:** • **Determine the consequences of human actions on ecosystems.** • **Differentiate between helpful and harmful interactions within ecosystems.** • **Explain ecological distribution and abundance and how it can change over time.**
2.0	**Students will be able to:** • **List interactions among populations, communities, and ecosystems.** • **Collect data to answer a particular ecological question.** • **Model an ecological food chain.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.

	• Use project-based science learning to connect science with observable phenomena. • Provide opportunities for the advanced learner to act as a peer tutor during class time that involves student choice of activities. • Facilitate access to extensive enrichment activities using online learning management system • Provide challenge problems for advanced learners to solve
Struggling Learners	• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Facilitate access to extensive review and remediation activities through the learning management system and/or online text content (for example, use of Khan Academy, Bozeman Science, Dynamic Study Modules and Tutorial problems available via MyLab&Mastering) • Utilize peer tutors during class to work with struggling learners
English Language Learners	• Coordinate with ELL advisors to modify activities where appropriate • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Utilize support offered by the following link http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: Common Core State Standards Connections: ELA/Literacy

- RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-6), (HS - LS2 - 7), (HS - LS2 - 8)
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS - LS2 - 1),(HS - LS2 - 2), (HS-LS2-6),(HS-LS2-8)
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS - LS2 - 6),(HS - LS2 - 7),(HS - LS2 - 8)
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6),(HS-LS2-7),(HS-LS2-8)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS - LS2 - 1),(HS LS2 - 2) WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS - LS4 - 6)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HSLS2-7),(HS-LS4-6)

Mathematic

- MP.2 Reason abstractly and quantitatively. (HS-LS2-1),(HS-LS2-2),(HS-LS2-6), (HS - LS2 - 7)
- MP.4 Model with mathematics. (HS - LS2 - 1),(HS - LS2 - 2)
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-1),(HS-LS2-2), (HS - LS2 - 7)
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS - LS2 - 1),(HS - LS2 - 2), (HS - LS2 - 7)
- HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-1),(HS-LS2-2), (HS - LS2 - 7)
- HSS-ID.A.1 Represent data with plots on the real number line. (HS - LS2 - 6)
- HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS - LS2 – 6)
- HSS-IC.B.6 Evaluate reports based on data. (HS - LS2 - 6)

Integration of 21st Century Skills

Indicators: The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

<u>Science & Engineering Practices</u>:
Asking questions and defining problems
Using Mathematics and Computational Thinking
Analyzing and Interpreting Data
Engaging in Argument from Evidence

<u>Cross-Cutting Connections:</u>
Cause and Effect, Scale proportion and quantity, Stability and Change

<u>Connections to Nature of Science:</u>
Scientific Knowledge is Open to Revision in Light of New Evidence

Unit Title: Biochemistry

Unit Description: This unit develops the physicochemical basis of how all life on Earth (and likely elsewhere) operates. All life is a collection of chemical reactions which it attempts to control. Life has evolved by being able to change both the internal and external environments, the methods used to control these, and pass on this ability to future progeny.

Unit Duration: 5 weeks

Desired Results

Standard(s): NGSS: HS-LS1-1, HS-LS1-2, HS-LS1-3, HS-LS1-6, HS-LS1-7

College Board: "Enduring Understanding" 1D, 2A, 4A, 4B,

Indicators: NGSS: HS-LS1.A "Structure and Function" LS1.C "Organization for Matter and Energy Flow in Organisms"

College Board: "Essential Knowledge" 1.D.1, 1.D.2, 2A.2, 4A.1, 4A.2, 4B.1

AP BIG IDEA 1 – The process of evolution drives the diversity and unity of life

AP BIG IDEA 2 – Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

AP BIG IDEA 4- Biological systems interact, and these systems and their interactions possess complex properties.

Understandings:
Students will understand that…

- *The origin of living systems is explained by natural processes (EU1.D)*
- *Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments (EU2A).*
- *Interactions within biological systems lead to complex properties (EU4A).*
- *Competition and cooperation are important aspects of biological systems (EU4B).*

Essential Questions:

1. What kind of data is needed to answer scientific questions about how organisms respond to changes in their external environment?
2. What types of molecules do organisms use for building blocks and excrete as wastes?
3. How do structures of biologically important molecules (carbohydrates, lipids, proteins, and nucleic acids) account for their functions?
4. How do molecules and atoms from the environment build new molecules?
5. What interactions between molecules affect their structure and function?

Assessment Evidence

Performance Tasks:

1. Use representations and models to communicate scientific phenomena and solve scientific problems.
2. Justify a scientific claim that free energy is required for living systems to maintain organization, to grow or to reproduce, but multiple strategies exist in different living systems.
3. Construct explanations based on scientific evidence as to how interactions of subcellular structures provide essential functions.
4. Describe a scientific hypothesis about the origin of life on earth.
5. Use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule.
6. Analyze data to identify how molecular interactions affect structure and function.

Other Evidence:

Quiz – functional groups and carbohydrates, free energy

Lab – "Coacervates" , "Enzyme function" (lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion)

Group and Independent studies-

- **Correct completion of study guides for corresponding chapters.**
- **POGIL Biochemistry basics, protein structures, free energy**
- **Wiley – introduction to metabolism , fatty acid metabolism, protein folding**
- **Practicing Biology – testing yourself Chapter 5**
- **Picture Perfect case study**

Benchmarks:

Chapters 4/5 test

Chapter 8 test

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 4,5, & 8 For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. Discussions are done through power point presentations that are created by the instructor.*

"Functional groups and Macromolecules"3 weeks

Lesson 1

- Discuss isomers and functional groups with a focus on changing characteristics of a parent compound.
- Functional group class activity
- Complete POGIL biochemistry basics

Lesson 2

- Discuss Dehydration synthesis and hydrolysis reactions
- Discuss the four classes of macromolecules and classes of carbohydrates
- Discuss glycogenesis and glycogenolysis with negative feedback
- Lab - Coacervates

Lesson 3

- Discuss different linkages in carbohydrates and colon health.
- Discuss the properties of fats, structural variations and fat digestion.
- Complete Wiley – fatty acid metabolism

Lesson 4

- Discuss emulsification, micelles, and properties of steroids.
- Inquiry portion of coacervated lab – design and complete
- Begin Picture Perfect case study

Lesson 5

- Discuss protein building blocks and secondary structure. Focus on bonding interactions and varying parent groups
- Complete POGIL protein structures
- Prepare lab notebook
- Case study

Lesson 6

- Discuss tertiary and quaternary protein structures.
- Discuss proteins as buffers
- Finish POGIL
- Practicing Biology testing yourself class activity
- Case study

" Metabolism and Enzyme Function" 2 weeks

Lesson 1

- Introduce metabolism and discuss Gibbs free energy, enthalpy, entropy, and the difference between spontaneous and nonspontaneous reactions.
- Free energy example problems in class
- Case study

Lesson 2

- Discuss atp and energy coupling
- Complete POGIL – free energy

Lesson 3

- Discuss energy of activation, enzyme structure, specificity, and temperature influence on activity
- Prelab – where, what and why of catalase

Lesson 4

- Discuss prelab questions
- Design lab with preapproved variables

Lesson 5

- Discuss trypsin, chymotrypsin, and pepsin

Lesson 6

- Discuss activation methods, cooperativity, and inhibition. Use Sarin gas as an example.

Lesson 7

- Discuss caspases enzymes, bone remodeling and regulation through feedback inhibition
- Prepare lab notebook

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Taylor, Martha. (2017) *Student Study Guide for Biology* 11th ed. Boston: Pearson.

Wiley biochemistry interactive animations (n.d.). Retrieved July 25, 2017, from http://www.wiley.com/college/boyer/0470003790/animations/animations.htm

Giffen, Cynthia and Heitz, Jean. *Practicing Biology*, 6rd Edition, 2017, Pearson Benjamin Cummings.

Trout, L. (Eds.). (2012). *POGIL Activities for ap biology.* Batavia: Flinn Scientific, Inc.

***AP Biology Investigative Labs: An Inquiry-Based Approach.* New York: The College Board, 2012**

***Carolina Investigations for AP Biology*.North Carolina: Carolina Biological Supply, 2012**

Masterman, David and Holman, Scott. *Biology with Computers Using LoggerPro™. 2nd ed.*

Waterman, M., & Stanley, E. (2008). *Biological Inquiry: A workbook of investigative cases for biology* (Eighth edition). San Francisco: Pearson.

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): *EU1D: The origin of living systems is explained by natural processes.*	
4.0	**Students will be able to:** • **Formulate a hypothesis for the amount of acid and its effect on coacervate formation** • **Design a plan for collecting data to show how coacervated formation is affected by environmental factors such as light, temperature, pH, protein, and carbohydrates** • **Modify experimental design for lab extension**
3.0	**Students will be able to:** • **Develop rules for identifying macromolecules** • **Differentiate among the three types of isomers (structural, geometric, and enantiomers).** • **Distinguish between the carbohydrate classes.** • **Compare and contrast monomers and polymers.**
2.0	**Students will be able to:** • **Recognize and name macromolecules** • **Name and describe the major chemical groups found in organic molecules.** • **List the four main classes of macromolecules**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *EU2A: Growth, reproduction and maintenance of the organization of living systems require free energy and matter.*	
4.0	**Students will be able to:** • **Formulate a hypothesis for the effect of substrate concentration on enzyme function.** • **Design a plan for collecting data to show how enzyme function is affected by environmental factors such as temperature, pH, concentration, cofactors, and inhibitors** • **Modify experimental design for lab extension** • **Predict the buffering capacity of specific enzymes in biological systems.**
3.0	**Students will be able to:** • **Explain how ATP functions as the primary energy transfer molecule in living cells.** • **Describe the function of enzymes in biological systems.** • **Explain how enzyme structure determines specificity**
2.0	**Students will be able to:** • **Illustrate the dehydration and hydrolysis reactions** • **Describe the induced fit model of enzyme function.** • **Determine the substrate and active site for enzyme function.** • **Name substrates and enzymes by using simple rules.** • **List four conditions under which proteins may be denatured.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *EU4A/B: Interactions within biological systems lead to complex properties which include competition and cooperation aspects.*	
4.0	**Students will be able to:** • **Predict the behavior of molecules by structural characteristics.** • **Analyze the effects of environmental factors on macromolecule characteristics.** • **Construct explanations based on scientific evidence as to how interactions of subcellular structures provide essential functions.**

3.0	**Students will be able to:** • **Use representations or models to analyze the effects of disruptions to dynamic homeostasis in biological systems.** • **Explain the chemical digestion of various macromolecules.** • **Describe emulsification and the need to emulsify fats during digestion.**
2.0	**Students will be able to:** • **List and describe the four major components of an amino acid.** • **Differentiate between steroids and phospholipids** • **Explain what determines protein structure and why it is important**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students

Advanced Learners	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide opportunities for the advanced learner to act as a peer tutor during class time that involves student choice of activities. • Facilitate access to extensive enrichment activities using online learning management system • Provide challenge problems for advanced learners to solve
Struggling Learners	• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Facilitate access to extensive review and remediation activities through the learning management system and/or online text content (for example, use of Khan Academy, Bozeman Science, Dynamic Study Modules and Tutorial problems available via MyLab&Mastering) Utilize peer tutors during class to work with struggling learners
English Language Learners	• Coordinate with ELL advisors to modify activities where appropriate • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Utilize support offered by the following link http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product

	Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: ELA/Literacy –

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1) WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1) (HS-LS1-6)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS - LS1 - 3)
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1) SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS - LS1 - 2)(HS - LS1 - 7)
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6)

Integration of 21st Century Skills

Indicators: : The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:
Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions , Using Mathematics and Computational Thinking
Cross-Cutting Connections:
System and System models, Structure and Function, Stability and Change, Energy and Matter

Connections to Nature of Science:
Scientific investigation use a variety of methods, Scientific Knowledge is Open to Revision in Light of New Evidence

Unit Title: The Cell and Cell processes: Energy, Communication, and Interaction Part 1

Unit Description: The cell is the biological unit of life (except when considering viruses, virions, etc.). Cell architecture is consistent throughout the domains which allows for controlled chemical reactions both internally and externally. The cell's anabolic reactions are, and must be, coupled to the cell's catabolic reactions. The two major coupled reactions involve cellular respiration and the harvesting of energy in reactions such as photosynthesis.

Unit Duration: 7 weeks

Desired Results

Standard(s): NGSS: HS-LS1-3, HS-LS1-5, HS-LS1-7, HS-LS2-3, HS-LS2-5, HS-LS4-1

College Board: "Enduring Understanding" 1B, 1D, 2A, 2B, 2C, 4A,

Indicators: NGSS: HS-LS1.A "Structure and Function" LS1.C "Organization for Matter and Energy Flow in Organisms" LS2.B:" Cycles of Matter and Energy Transfer in Ecosystems" LS4.A "Evidence of Common Ancestry and Diversity"

College Board: "Essential Knowledge" 1.B.1, 1.B.2, 1.D.1, 1.D.2, 2.A.1, 2A.2, 2.B.1, 2.B.3, 2.C.1, 4A.2

AP BIG IDEA 1 – The process of evolution drives the diversity and unity of life

AP BIG IDEA 2 – Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

AP BIG IDEA 4- Biological systems interact, and these systems and their interactions possess complex properties.

Understandings:

Students will understand that…

- *Organisms are linked by lines of descent from common ancestry (EU1B).*
- *The origin of living systems is explained by natural processes (EU1D).*
- *Growth, reproduction and maintenance of the organization of living systems require free energy and matter (EU2A).*
- *Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments (EU2B).*
- *Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis (EU2C).*
- *Interactions within biological systems lead to complex properties (EU4A).*

Essential Questions:

1. How do shared conserved cellular processes support the idea that all organisms are linked by lines of descent from common ancestry?
2. How do cells create and maintain internal environments that are different from their external environments?
3. How do structure and function of subcellular components and their interactions provide essential cellular processes?
4. How do cells maintain dynamic homeostasis by the movement of molecules across membranes?
5. How do surface-area-to-volume ratios affect the ability of biological systems to obtain necessary resources or eliminate waste products?
6. How is growth and dynamic homeostasis maintained by the constant movement of molecules across membranes?
7. In what ways do all living systems require a constant input of free energy?
8. How do organisms capture and store free energy for use in biological processes?
9. How do interactions between molecules affect their structure and function?

Assessment Evidence

Performance Tasks:

1. Evaluate scientific hypotheses about the origin of life on earth.
2. Explain how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow, and to reproduce.
3. Construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store or use free energy.
4. Use calculated surface area-to-volume ratios to predict which cells might eliminate wastes or procure nutrients faster by diffusion.
5. Justify the selection of data regarding the types of molecules that an animal, plant or bacterium will take up as necessary building blocks and excrete as waste products.
6. Explain how internal membranes and organelles contribute to cell functions.
7. Use models to describe differences in prokaryotic and eukaryotic cells.
8. Justify the selection of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment.
9. Make a prediction about the interactions of subcellular organelles.
10. Explain how interactions of subcellular structures provide essential functions.
11. Identify how molecular interactions affect structure and function.

Other Evidence:

Quiz – microscopy, cells, and prokaryotes (Chapter 6 & 27), respiration (Chapter 9), Chapter 39 free response

Lab – "Cellular Respiration" , "Photosynthesis A- chromatography" , "Photosynthesis B – the light reactions", "Stomata's and transpiration" (lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion)

Group and Independent studies-

- **Correct completion of study guides for corresponding chapters.**
- **Practicing Biology – Chapter 27, Chapter 10**
- **POGIL – glycolysis, citric acid events, oxidative phosphorylation, light dependent and independent reactions, plant hormones**
- **Bean Brew case study**

Benchmarks:

Chapter 6 & 27 test

Chapter 9 test

Chapter 10 test

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 6, 27, 9, and 10.*

For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. Discussions are done through power point presentations that are created by the instructor.

"The Cell, Bacteria and Archaea" 2 weeks

Lesson 1
- Discuss microscopy, compare eukaryotes and prokaryotes, and introduce gram staining
- Independent reading

Lesson 2
- Discuss genetic exchange in bacteria, cell structure, movement, and salmonella

Lesson 3
- Discuss lymes disease, syphilis, and anthrax
- Independent reading

Lesson 4
- Discuss energy organelles, endosymbiosis, and mutualism
- Chapter 6 & 27 Study Guide and Practicing Biology review

" Cellular Respiration and Fermentation" 2.5 weeks

Lesson 1
- Discuss redox and energy coupling reactions

Lesson 2
- Discus glycolysis
- POGIL - glycolysis

Lesson 3
- Review POGIL – glycolysis
- Finish discussing glycolysis and begin transition events
- Begin Bean Brew case study

Lesson 4
- Discuss the citric acid cycle and their product fates
- POGIL – Citric Acid Cycle events
- Case study

Lesson 5
- Review POGIL – CAC
- Discuss the electron transport chain, ATP synthase structure and function by utilizing oxidation
- POGIL – oxidative phosphorylation
- Case study

Lesson 6
- Review POGIL – oxidative phosphorylation
- Discuss the NADH shuttle and fermentation
- Case study

Lesson 7
- Discuss lab – seeds and germination methods
- Respiration prelab questions

Lesson 8
- Complete lab – respiration
- Chapter 9 Study Guide

Lesson 9
- Discuss interconnections between synthesis and breakdown
- Prepare lab Notebook

Lesson 10
- Finish interconnections
- Prepare lab notebook

" Photosynthesis, Resource Acquisition in Vascular Plants, and Plant Responses to Internal and External Signals" 3 weeks

Lesson 1
- Introduce photosynthesis and discuss the architecture of a chloroplast and its relation to function
- Discuss the electromagnetic spectrum

Lesson 2
- Continue discussing the electromagnetic spectrum, various chemical reactions in photosynthesis
- POGIL – the light reactions

Lesson 3
- Discuss the comparison of chemiosmosis of mitochondria and chloroplasts
- Discuss the Calvin Cycle
- Prelab Photosynthesis A - chromatography

Lesson 4
- Discuss prelab questions
- Complete lab – Photosynthesis A – chromatography
- Review POGIL – the light reactions

Lesson 5
- Discuss Photorespiration and C4 photosynthesis
- POGIL – Light independent reactions

Lesson 6
- Discuss Photosynthesis Lab part B – the light reactions
- Finish discussing CAM photosynthesis and tropisms

Lesson 7
- Complete lab – Photosynthesis part B – the light reactions
- Prepare lab notebook

Lesson 8
- Complete Practicing Biology review
- Prepare lab notebook

Lesson 9
- Discuss stomata and transpiration lab
- Prelab questions

Lesson 10
- Complete stomata impression and density portion of the lab
- Discuss plant hormones
- POGIL – plant hormones

Lesson 11
- Complete transpiration portion of the lab
- Complete Study Guide Chapter 10

Lesson 12
- Leaf trace method for data collection
- Lab notebook prep

Lesson 13
- Phototropism essay
- Lab notebook prep

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Taylor, Martha. (2017) *Student Study Guide for Biology* 11th ed. Boston: Pearson.

Giffen, Cynthia and Heitz, Jean. *Practicing Biology*, 6rd Edition, 2017, Pearson Benjamin Cummings.

Trout, L. (Eds.). (2012). *POGIL Activities for ap biology.* Batavia: Flinn Scientific, Inc.

***AP Biology Investigative Labs: An Inquiry-Based Approach.* New York: The College Board, 2012**

Masterman, David and Holman, Scott. *Biology with Computers Using LoggerPro.* 2nd ed.

Waterman, M., & Stanley, E. (2008). *Biological Inquiry: A workbook of investigative cases for biology* (Eighth edition). San Francisco: Pearson.

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): *Organisms are linked by lines of descent from common ancestry (EU1B).* *The origin of living systems is explained by natural processes (EU1D).*	
4.0	**Students will be able to:** • **Describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and how these features support the concept of common ancestry for all organisms.** • **Evaluate evidence in conjunction with a phylogenic tree to determine evolutionary history** • **Evaluate scientific hypotheses about the origin of life on earth.**
3.0	**Students will be able to:** • **Describe the structural and functional adaptations for prokaryotic success.** • **Compare and contrast the three domains.** • **Explain prokaryotic impacts on humans.** • **Explain the endosymbiotic theory as it pertains to eukaryotic evolution and energy organelles.**
2.0	**Students will be able to:** • **Differentiate between gram positive and gram negative bacteria.** • **List examples of gram positive and gram negative bacteria that cause human infection.** • **Compare and contrast the structures and functions of energy organelles**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Growth, reproduction and maintenance of the organization of living systems require free energy and matter (EU2A).* *Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments (EU2B).*	
4.0	**Students will be able to:** • **Formulate a hypothesis for the rate of respiration in germinating seeds, and for the rate of photosynthesis in chloroplasts exposed to light.** • **Design a plan for collecting data to show how various germinating seeds and animals respire when exposed to temperature differences.** • **Modify experimental design for lab extension**
3.0	**Students will be able to:** • **Predict how changes in free energy availability affect organisms.** • **Construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store or use free energy.**
2.0	**Students will be able to:** • **Name the three stages of cellular respiration and state the region of the eukaryotic cell where each stage takes place.** • **Distinguish between substrate level phosphorylation and oxidative phosphorylation.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis (EU2C).* *Interactions within biological systems lead to complex properties (EU4A).*	
4.0	**Students will be able to:**

	• **Examine plant responses to environmental factors.** • **Design an experiment to explore the effect of environmental factors on the rate of transpiration in different angiosperm plants.** • **Evaluate data that show the effects of changes in concentrations of key molecules on negative feedback mechanisms.** • **Construct explanations based on scientific evidence as to how interactions of subcellular structures provide essential functions.**
3.0	**Students will be able to:** • **Explain how the exergonic slide of electrons down the electron transport chain is coupled to the endergonic production of ATP by chemiosmosis in both respiration and photosynthesis.** • **Calculate the efficiency of respiration in generating ATP.** • **Trace the electron flow through photosystem 1 and 2.** • **Compare and contrast cyclic and noncyclic electron flow.** • **Compare and contrast C3, C4, and CAM photosynthesis**
2.0	**Students will be able to:** • **Explain how a respiratory electron transport chain creates a proton gradient.** • **Explain why ATP synthase is considered a molecular rotary motor.** • **Explain what happens when chlorophyll or accessory pigments absorb photons.** • **List the components of a photosystem and explain their functions.** • **Summarize the carbon-fixing reactions of the Calvin cycle.** • **Determine tissue systems in a plant body.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide opportunities for the advanced learner to act as a peer tutor during class time that involves student choice of activities. • Facilitate access to extensive enrichment activities using online learning management system • Provide challenge problems for advanced learners to solve
Struggling Learners	• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Facilitate access to extensive review and remediation activities through the learning management system and/or online text content (for example, use of Khan Academy, Bozeman Science, Dynamic Study Modules and Tutorial problems available via MyLab&Mastering) Utilize peer tutors during class to work with struggling learners
English Language Learners	• Coordinate with ELL advisors to modify activities where appropriate • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Utilize support offered by the following link http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that

	student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: ELA/Literacy –

- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS - LS1 – 3)
- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS - LS1 - 5),(HS - LS1 - 7)
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS - LS4 - 1), (HS-LS4-2), (HS - LS4 - 3), (HS-LS4-4)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS - LS4 - 1), (HS-LS42) ,(HS - LS4 - 3), (HS-LS4-4) WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS - LS4 - 1), (HS-LS4-2), (HS - LS4 - 3), (HS-LS4-4),(HS-LS4-5)
- SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS - LS4 - 1), (HS - LS4 - 2)

Mathematics –

- MP.2 Reason abstractly and quantitatively. (HS - LS4 - 1), (HS-LS4-2),(HS-LS4-3), (HS - LS4 – 4).

Integration of 21st Century Skills

Indicators: The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:
Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions , Using Mathematics and Computational Thinking, Obtaining, Evaluating, and Communicating Information
Cross-Cutting Connections:
Patterns, Cause and Effect, System and System models, Structure and Function, Stability and Change, Energy and Matter

Connections to Nature of Science:
Scientific investigation use a variety of methods, Scientific Knowledge is Open to Revision in Light of New Evidence Scientific Knowledge Assumes an Order and Consistency in Natural Systems, Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Unit Title: The Cell and Cell Processes: Energy, Communication, and Interaction Part 2

Unit Description: This unit focuses on membrane structure and function in conjunction with transport and cell signaling. Enzyme responses and nuclear responses along with transduction pathways as part of communication, energy production and basic interaction is observed. Mammalian systems that include: respiration, digestion, immunity, urinary, sensory, nervous, and muscular structure and function are studied on both the cellular and organismal level. Feedback control loops are included.

Unit Duration: 8 weeks

Desired Results

Standard(s): NGSS: HS-LS1-2, HS-LS1-3,

College Board: "Enduring Understanding" 2B, 2C, 2D, 3D, 3E

Indicators: NGSS: HS-LS1.A "Structure and Function"

College Board: "Essential Knowledge" 2.B.1, 2.B.2, 2.C.1, 2.C.2, 2.D.2, 2.D.3, 2.D.4, 2.E.2, 3.D.1, 3.D.2, 3.D.3, 3.D.4, 3.E.2

AP BIG IDEA 2 – Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

AP BIG IDEA 3 – Living systems store, retrieve, transmit and respond to information essential to life processes.

Understandings:

Students will understand that…

- *Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments (EU2B).*
- *Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis (EU2C).*
- *Growth, and dynamic homeostasis of a biological system are influenced by changes in the system's environment (EU2D).*
- *Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination (EU2E).*
- *Cells communicate by generating, transmitting and receiving chemical signals (EU3D).*
- *Transmission of information results in changes within and between biological systems (EU3E).*

Essential Questions:

1. How are external signals converted into cellular responses?
2. How is growth and dynamic homeostasis maintained by the constant movement of molecules across membranes?
3. How do cells communicate, transmit, and receive chemical signals, and how does signal transmission within and between cells mediate gene expression and cell function?
4. In what ways are timing and coordination of specific events necessary for the normal development of an organism, and how are these events regulated?
5. In what ways are timing and coordination of behavior regulated by various mechanisms, and how are they important in natural selection?
6. How do organisms use feedback mechanisms to regulate growth and reproduction, and maintain dynamic homeostasis?
7. What types of chemical defenses do plants and animals have against infections that affect their homeostasis?
8. In what ways do the nervous systems of animals detect external and internal signals, transmit and integrate information, and produce responses?

Assessment Evidence

Performance Tasks:

1. Construct models that connect the movement of molecules across membranes with membrane structure and function.
2. Use models to analyze situations to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes.
3. Justify a claim made about the effects on a biological system at the molecular, physiological or organismal level when given a scenario in which one or more components within a negative regulatory system is altered.
4. Evaluate data that show the effects of changes in concentrations of key molecules on negative feedback.
5. Connect differences in the environment with the evolution of homeostatic mechanisms.
6. Create representations to describe immune responses
7. Justify claims with scientific evidence to show that timing and coordination of several events are necessary for normal development in an organism which are regulated by multiple mechanisms.
8. Connect concepts that describe mechanisms that regulate the timing and coordination of physiological events.
9. Describe a model that expresses the key elements of signal transduction pathways by which a signal is converted to a cellular response.

Other Evidence:

Quiz – 7.1, anatomy and urinary pathway, immunity

Lab – "Diffusion and Osmosis" , "Urinalysis", "ELISA" (lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion)

Group and Independent studies-

- **Correct completion of Study Guides for corresponding Chapters (7,11,36, 44, 43)**
- **POGIL – cell communication and signal transduction,**
- **Google doc group presentation – membrane transport mechanisms, structural urinary differences per species**
- **Conflict immunity game**
- **Pathways with Friends:** http://learn.genetics.utah.edu
- **Shh: Silencing the hedgehog pathway case study**

10. Construct an explanation based on scientific theories and models, about how nervous systems detect external and internal signals, transmit and integrate information, and produce responses.	

Benchmarks:

Power point presentation : Big picture of a mammalian system as it relates to cellular processes, autoimmune disease

Test Chapter 7/11

Midterm will include Chapter 44

All previous chapters will be assessed by the midterm

Test Chapter 43 – will be included in the final exam

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 7,11, 36, 44, 43, 45, 48, and parts of 41 and 50*

For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. Discussions are done through power point presentations that are created by the instructor.

"Membrane Structure and Function and Cell Communication" 3 weeks

Lesson 1
- Discuss the plasma membrane structure and function part 1 – lipid composition
- Independent Reading

Lesson 2
- Discuss Protein functions of the membrane – adhesion, signal transduction, lipid rafts, and transport
- Independent Reading

Lesson 3
- Lab part A – Diffusion and Osmosis – basic premise

Lesson 4
- Discuss google project part 1 – group transport mechanisms
- Discuss water potential

Lesson 5
- Plan lab part B – can sucrose diffuse?
- Google project part 1

Lesson 6
- Set up lab part B
- Student presentation prep on big picture function with cellular processes

Lesson 7
- Data collection for lab part B
- Plan lab part C – water potential of various plant cells

Lesson 8
- Set up lab part C
- Discuss guard cells regulation of transpiration as a big picture example

Lesson 9
- Data collection for lab part C
- Discuss HCl production and absorption of sugar big picture examples

Lesson 10
- Student presentation preparation

Lesson 11
- Finish transport mechanisms
- Discuss Chapter 11 introduction of cell communication up to pathways (G protein, Tyrosine Kinase, and Calcium channels
- POGIL – cell communication and signal transduction

Lesson 12
- Discuss G protein pathways, abscisic acid, and Cholera
- Lab notebook preparation
- Pathway with friends

Lesson 13
- Discuss parietal cell secretion and other pathways (Wnt signaling, Hedgehog, Smad)
- Presentation preparation
- Silencing the hedgehog case study

Lesson 14
- Discuss apoptosis
- Lab notebook preparation
- Silencing the hedgehog case study

Lesson 15
- Lab notebook preparation
- Presentation preparation
- Silencing the hedgehog case study
- Student Study Guides for Chapters 7, 11, 36

"The Urinary System" 2 weeks

Lesson 1
- Introduce the urinary system: modifications found in organisms. Fish Urinary system and student tasks on other organisms

Lesson 2
- Discuss nitrogenous waste
- Anatomy labeling
- Human urinary system – trace the path of blood flow and filtrate formation through the kidney
- Discuss lab

Lesson 3
- Lab – urinalysis
- Finish pathways and discuss filtration

Lesson 4
- Collect lab data
- Discuss reabsorption, and secretion
- Pair and share structural differences per species

Lesson 5
- Finish reabsorption and secretion
- Group share – structural differences per species

Lesson 6
- Discuss loop and duct
- Finish group share- structural differences per species

Lesson 7
- Lab notebook preparation
- Discuss hormonal influence – ADH AND RAAS system
- Student Study Guide Chapter 44

"The immune system" 3 weeks

Lesson 1
- Introduce the immune system: adaptive vs. innate immunity, cells, organs, barrier defenses, and inflammation
- Independent reading

Lesson 2
- Discuss innate immunity, toll-like receptors, interferon, complement, and NK cells.
- Independent reading

Lesson 3
- Discuss acquired immunity – humoral vs. cell mediated responses, lymphocytes (B cell)
- Independent reading

Lesson 4
- Continue acquired immunity – receptors, antigens, antibody response, clonal selection, primary and secondary response
- Game – conflict immunity

Lesson 5
- Discuss types of antibodies, passive immunization, and monoclonal uses
- Discuss T cell receptors, MHC, humoral and cell mediated responses with T cell influence
- Continue playing conflict immunity
- Lab - ELISA

Lesson 6
- Finish T cell mediated responses
- Independent reading
- Prepare lab notebook

Lesson 7
- Discuss immune rejection, antigenic variation, and latency
- Begin autoimmune disease presentation preparation

Lesson 8
- Finish latency
- Autoimmune disease project preparation

Lesson 9-11
- Autoimmune disease project preparation
- Study Guide for Chapter 43

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Taylor, Martha. (2017) *Student Study Guide for Biology* 11th ed. Boston: Pearson.

Trout, L. (Eds.). (2012). *POGIL Activities for ap biology.* Batavia: Flinn Scientific, Inc.

***AP Biology Investigative Labs: An Inquiry-Based Approach.* New York: The College Board, 2012**

Waterman, M., & Stanley, E. (2008). *Biological Inquiry: A workbook of investigative cases for biology* (Eighth edition). San Francisco: Pearson.

***Carolina Investigations for AP Biology*.North Carolina: Carolina Biological Supply, 2012.**

Learn Genetics Pathway with Friends (n.d.). Retrieved August 3, 2017, from http://learn.genetics.utah.edu

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): *Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments (EU2B).* *Growth, and dynamic homeostasis of a biological system are influenced by changes in the system's environment (EU2D).*	
4.0	**Students will be able to:** • **Create a representation that describes how organisms exchange information in response to internal changes and external cues, which can result in changes in behavior.** • **Use representations or models to analyze quantitatively and qualitatively the effects of disruptions to homeostasis in biological systems.** • **Use models or representations to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure.**
3.0	**Students will be able to:** • **Describe the fluidity components of a cell membrane and how it is maintained through environmental changes** • **Describe the six functions of membrane proteins.** • **Explain the role of membrane carbohydrates in cell-cell recognition.** • **Manipulate the water potential formula to explain the behavior of cells when placed in different solutions.**
2.0	**Students will be able to:** • **Distinguish between peripheral and integral membrane proteins** • **List six major functions of membrane proteins.** • **Describe and state the transport processes and provide examples for where they are used by life.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis (EU2C).* *Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination (EU2E).*	
4.0	**Students will be able to:** • **Justify claims with scientific evidence to show that timing and coordination of several events are necessary for normal development and regulation of an organism** • **Describe the role of programmed cell death in development and differentiation, the reuse of molecules, and maintenance of homeostasis** • **Connect concepts that describe mechanisms that regulate the timing and coordination of physiological events.** • **Justify claims made about the effects on a biological system at the molecular, physiological or organismal level when given a scenario in which one or more components within a negative regulatory system is altered.**
3.0	**Students will be able to:** • **Observe how apoptosis integrates multiple cell-signaling pathways** • **Describe various regulation models in different organisms.** • **Explain how the endocrine system affects urine output.** • **Analyze synthetic urine samples.**
2.0	**Students will be able to:** • **Give examples of barrier defenses** • **Describe passive and active immunity** • **Define antigen and antibody.** • **Name the cells of the immune system and describe their functions.**

1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Cells communicate by generating, transmitting and receiving chemical signals (EU3D). Transmission of information results in changes within and between biological systems (EU3E).*	
4.0	**Students will be able to:** • **Describe a model that expresses the key elements of signal transduction pathways by which a signal is converted to a cellular response.** • **Construct an explanation of how certain drugs affect signal reception and signal transduction pathways** • **Create a visual representation of how a nervous system receives, integrates, and transmits information to produce a response**
3.0	**Students will be able to:** • **Explain the processes of three different receptors and corresponding responses.** • **Describe the activation of lymphocytes.** • **Differentiate between innate and adaptive immunity.** • **Explain how a secondary infection is overcome by the immune system.** • **Explain the exposure and progress of allergies.**
2.0	**Students will be able to:** • **State the three processes of signal transduction** • **List the secondary messengers and explain the amplification through transduction.** • **Define apoptosis and distinguish between the needs for this processes**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students

Advanced Learners	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide opportunities for the advanced learner to act as a peer tutor during class time that involves student choice of activities. • Facilitate access to extensive enrichment activities using online learning management system • Provide challenge problems for advanced learners to solve
Struggling Learners	• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Facilitate access to extensive review and remediation activities through the learning management system and/or online text content (for example, use of Khan Academy, Bozeman Science, Dynamic Study Modules and Tutorial problems available via MyLab&Mastering) Utilize peer tutors during class to work with struggling learners
English Language Learners	• Coordinate with ELL advisors to modify activities where appropriate • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Utilize support offered by the following link http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf

Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: ELA/Literacy

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS - LS1 - 3)
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1)
- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-2)

Integration of 21st Century Skills

Indicators: The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:

Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions

Cross-Cutting Connections:

System and System models, Structure and Function, Stability and Change

Connections to Nature of Science:

Scientific investigation use a variety of methods

Unit Title: Molecular Genetics

Unit Description: This is the molecular extension classical heredity where life programs and controls the chemical reactions that are necessary for life. DNA, RNA, the central dogma of information flow, protein synthesis, virus life cycles, gene expression and regulation, and biotechnology methods will be studied.

Unit Duration: 6 weeks

Desired Results

Standard(s): NGSS: HS-LS1-1, HS-LS1-6, HS-LS3-1, HS-LS3-2, HS-LS4-1

College Board: "Enduring Understanding" 2E, 3A, 3B, 3C

Indicators: NGSS: HS-LS1.A "Structure and Function" , HS-LS1.C "Organization for Matter and Energy Flow in Organisms". HS-LS3.A "Inheritance of Traits", HS-LS3.B "Variation of Traits", HS-LS-4.A "Evidence of Common Ancestry and Diversity"

College Board: "Essential Knowledge" 2.E.1, 3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.B.1, 3.B.2, 3.C.1, 3.C.2, 3.C.3

AP BIG IDEA 2 – Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

AP BIG IDEA 3 – Living systems store, retrieve, transmit and respond to information essential to life processes.

Understandings:

Students will understand that…

- *Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination (EU2E).*
- *Heritable information provides for continuity of life (EU3A).*
- *Expression of genetic information involves cellular and molecular mechanisms (EU3B).*
- *The processing of genetic information is imperfect and is a source of genetic variation (EU3C).*

Essential Questions:

1. How is DNA, and in some cases RNA, the primary source of heritable information?
2. How does gene regulation result in differential gene expression, leading to cell specialization?
3. In what ways do a variety of intercellular and intracellular signal transmissions mediate gene expression?
4. How does viral replication result in genetic variation, and how can viral infection introduce genetic variation into the hosts?
5. How do interactions between external stimuli and regulated gene expression result in specialization of cells, tissues, and organs?

Assessment Evidence

Performance Tasks:

1. Analyze data to support the claim that responses to information and communication of information affect natural selection.
2. Construct explanations that use structures and mechanisms of DNA and RNA to support the claim that DNA and, in some cases, RNA are the primary sources of heritable information.
3. Justify the selection of data from historical investigations that support the claim that DNA is a source of heritable information.
4. Describe the connection between the regulation of gene expression and observed differences between different kinds of organisms.
5. Explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function.

Other Evidence:

Quiz – DNA history, Replication and telomeres, Protein Synthesis, Operon

Lab – "Transformation" , "Transcription and Gene Expression", "Gel Electrophoresis", [lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion]

Group and Independent studies-

- **Correct completion of Study Guides for corresponding Chapters (16, 17, 18, 20)**
- **POGIL – Chapter 18 review**
- **Virtual Microarray**
- **The Donors Dilemma case study**
- **Corn Under Construction case study**

6. Explain the connection between genetic variations in organisms and phenotypic variations in populations. 7. Use representations and models to describe how viral replication introduces genetic variation in the viral population and host organisms.	

Benchmarks:

Power point presentation on various viruses (Chapter 19) – life cycle, symptoms, treatment

Test – Chapters 16 & 17

Test – Chapters 18 & 20

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 16, 17, 18, 19, and 20.*

For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. Discussions are done through power point presentations that are created by the instructor.

"The Molecular Basis of Inheritance, from Gene to Protein" 2.5 weeks

Lesson 1

- Discuss history of DNA, the discoveries, and scientists involved with the structure of DNA. Describe the structure of DNA.
- Independent Reading

Lesson 2

- Discuss replication and repair mechanisms
- Independent Reading
- The Donors Dilemma case study

Lesson 3

- Discuss telomeres, aging, and cancer relationship
- Independent Reading
- The Donors Dilemma case study

Lesson 4

- Discuss the central dogma of biology: gene to protein. The basic principles of transcription and translation and begin transcription
- Independent Reading

Lesson 5

- Discuss processing of Mrna, splicing, and distinguish among Mrna, Trna, and rRna.
- Describe structures and functions and explain codon anticodon relationship.
- Independent Reading
- Corn Under Construction case study

Lesson 6

- Lab – discuss and set up
- Corn Under Construction case study

Lesson 7

- Data collection for lab
- Discuss Translation – all phases

Lesson 8

- Finish translation and discuss polysomes
- Practice quiz for protein synthesis

Lesson 9

- Discuss protein folding and post translational modifications
- Independent Reading

Lesson 10

- Discuss mutations
- Complete Study Guide for Chapters 16 & 17
- Prepare lab notebook

"Regulation of Gene Expression, Viruses, and DNA tools with Biotechnology" 3.5 weeks

Lesson 1
- Discuss bacterial gene expression – lac and tryp operon
- POGIL – review Chapter 18

Lesson 2
- Practice pipetting for gel electrophoresis lab
- Finish POGIL review

Lesson 3
- Discuss eukaryotic gene expression – DNA packing, epigenetics, and cloning
- Independent Reading

Lesson 4
- Discuss eukaryotic gene expression – transcription and translation
- Complete Epigenetic Worksheet and 18.3 – Practicing Biology

Lesson 5
- Discuss RNAi and protein degradation
- Discuss the introduction to Chapter 20 – biotechnology, Dna cloning using plasmids, restriction enzymes
- Virtual microarray

Lesson 6
- Discuss libraries, Cdna, and probes
- Hillis genes reading

Lesson 7
- Discuss how restriction enzymes and gel electrophoresis are used to isolate DNA fragments.
- Online DNA sequencing – sanger activity and capillary electrophoresis reading

Lesson 8
- Discuss RFLP and PCR
- Review Sanger and capillary electrophoresis
- Prelab - Transformation

Lesson 9
- Lab – Transformation set up

Lesson 10
- Data analysis for Transformation Lab
- Discuss STR use un CODIS
- Decide on virus presentation

Lesson 11
- Gel Electrophoresis Lab
- Virus preparation

Lesson 12
- Gel electrophoresis data analysis
- Virus preparation

Lesson 13
- Lab notebook preparation for transformation and gel electrophoresis labs
- Virus preparation

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Hillis, D. M., Sadava, D., Heller, C. H., & Price, M. V. (2012). *Principles of life* (First edition.). Sunderland: Sinauer.

Taylor, Martha. (2017) *Student Study Guide for Biology* 11th ed. Boston: Pearson.

Trout, L. (Eds.). (2012). *POGIL Activities for ap biology.* Batavia: Flinn Scientific, Inc.

AP Biology Investigative Labs: An Inquiry-Based Approach. **New York: The College Board, 2012**

Waterman, M., & Stanley, E. (2008). *Biological Inquiry: A workbook of investigative cases for biology* (Eighth edition). San Francisco: Pearson.

***Carolina Investigations for AP Biology*.North Carolina: Carolina Biological Supply, 2012.**

Giffen, Cynthia and Heitz, Jean. *Practicing Biology*, 6rd Edition, 2017, Pearson Benjamin Cummings.

The Sanger method of sequencing (n.d.). Retrieved August 7, 2017, from http://dnalc.org

The DNA microarray (n.d.). Retrieved August 7, 2017, from http://learngenetics.edu

Unit Learning Goal and Scale
(Level 2.0 reflects a minimal level of proficiency)

Standard(s): *Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination (EU2E).*
Heritable information provides for continuity of life (EU3A).

4.0	**Students will be able to:** • **Connect concepts in and across domains to predict how environmental factors affect responses to information and change behavior.** • **Create a visual representation to illustrate how changes in a DNA sequence can result in a change in the polypeptide produced.** • **Give experimental evidence to implicate proteins as a link between genotype and phenotype.**
3.0	**Students will be able to:** • **Describe representations that illustrate how genetic information is copied for transmission between generations.** • **Describe representations that illustrate how genetic information is translated into polypeptides.** • **Explain the significance of telomeres in aging and telomerase in healthy and cancerous cells.**
2.0	**Students will be able to:** • **Explain how DNA differs from RNA.** • **Trace the flow of information from gene to protein.** • **Differentiate between prokaryotic and eukaryotic transcription and translation.** • **List, describe, and give examples of point mutations.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Expression of genetic information involves cellular and molecular mechanisms (EU3B).*
The processing of genetic information is imperfect and is a source of genetic variation (EU3C).

4.0	**Students will be able to:** • **Formulate a hypothesis for the efficacy of transformation of E.coli with glow plasmid resistant to ampicillin** • **Design a plan for collecting data to show how E.coli can be transformed to be resistant to ampicillin** • **Modify experimental design for lab extension** • **Justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies.**
3.0	**Students will be able to:** • **Predict how change in specific DNA or RNA sequence can result in change in gene expression.** • **Describe connections between the regulation of gene expression and observed differences between individuals in a population.** • **Construct an explanation of how viruses introduce genetic variation in host organisms.**
2.0	**Students will be able to:** • **List and describe four complementary approaches used to map the human genome.** • **List advantages for using bacteria and yeast in the production of gene products.** • **Describe how genes of interest can be identified with the use of a probe.** • **List and describe two major sources of genes for cloning.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students

Advanced Learners	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide opportunities for the advanced learner to act as a peer tutor during class time that involves student choice of activities. • Facilitate access to extensive enrichment activities using online learning management system • Provide challenge problems for advanced learners to solve
Struggling Learners	• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Facilitate access to extensive review and remediation activities through the learning management system and/or online text content (for example, use of Khan Academy, Bozeman Science, Dynamic Study Modules and Tutorial problems available via MyLab&Mastering) • Utilize peer tutors during class to work with struggling learners
English Language Learners	• Coordinate with ELL advisors to modify activities where appropriate • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Utilize support offered by the following link http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Lerners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: ELA/Literacy –

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1) WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1) RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-6),(HS-LS2-3)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6),(HS-LS23)
- WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6),(HS-LS2-3)
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS - LS3 - 1),(HS - LS3 - 2)
- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS - LS3 - 1)
- WHST.9-12.1 Write arguments focused on discipline - specific content. (HS-LS3-2)
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS - LS4 - 1), (HS-LS4-2),
  (HS - LS4 - 3), (HS-LS4-4)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS - LS4 - 1), (HS-LS4-2) ,(HS - LS4 - 3), (HS-LS4-4)

Mathematics –

- MP.2 Reason abstractly and quantitatively. (HS-LS3-2),(HS-LS3-3) MP.2 Reason abstractly and quantitatively. (HS - LS4 - 1), (HS-LS4-2),(HS-LS4-3), (HS - LS4 - 4),(HS - LS4 - 5)

Integration of 21st Century Skills

Indicators: The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:
Constructing Explanations and Designing Solutions, Asking Questions and Defining Problems, Engaging in Argument from Evidence, Obtaining, Evaluating, and Communicating Information
Cross-Cutting Connections:
Energy and Matter, Cause and Effect, Patterns, Structure and Function
Connections to Nature of Science:
Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Unit Title: Reproduction and Heredity

Unit Description:

This unit focuses on concepts of the passage of structural, physiological and behavior traits from one generation to the next. Specific concepts include: mechanisms by which mitosis produces genetically identical daughter cells, mechanisms by which the eukaryotic cell cycle is regulated by a molecular control system, mechanisms by which genes are passed from parents to offspring by the inheritance of chromosomes, mechanisms by which meiosis reduces the number of chromosomes (diploid to haploid), the evolutionary significance of genetic variation that results from sexual life cycles, concepts of Mendelian genetics (laws of probability, inheritance patterns), statistical testing using Chi Square analysis, and concepts of gene linkage, mapping and causes of genetic disorders.

Unit Duration: 7 weeks

Desired Results

Standard(s): NGSS: HS-LS3-1, HS-LS3-2, HS-LS3-3

College Board: "Enduring Understanding" 3A, 3B, 3C

Indicators: NGSS: HS-LS3.A "Inheritance of Traits", HS-LS3.B "Variation of Traits"

College Board: "Essential Knowledge"3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.B.2, 3.C.1, 3.C.2,

AP BIG IDEA 3 – Living systems store, retrieve, transmit and respond to information essential to life processes.

Understandings:

Students will understand that…

- *Heritable information provides for continuity of life (EU3A).*
- *Expression of genetic information involves cellular and molecular mechanisms (EU3B).*
- *The processing of genetic information is imperfect and is a source of genetic variation (EU3C).*
- *Interactions between and within populations influence patterns of species distribution and abundance (EU4B4).*

Essential Questions:

1. How is heritable information passed to the next generation in eukaryotes, and how do changes in genotype result in changes in phenotype of an organism?
2. In what ways does the chromosomal basis of inheritance provide an understanding of the patterns of transmission of genes from parent to offspring, and how are inheritance patterns of many traits explained other than through simple Mendelian genetics?
3. What multiple processes increase genetic variation in biological systems, and how do environmental factors influence the expression of the genotype in an organism?

Assessment Evidence

Performance Tasks:

1. Describe the events that occur in the cell cycle
2. Use visual representations to show how DNA in chromosomes is transmitted to the next generation via mitosis or meiosis followed by fertilization
3. Pose questions about ethical, social or medical issues surrounding human genetic disorders.
4. Apply mathematical routines to determine Mendelian patterns of inheritance provided by data sets.
5. Explain deviations from Mendel's model of the inheritance of traits.

Other Evidence:

Quiz – 12-2, Genetics part 1, Genetics part 2

Lab – "Mitosis Onion Root Tip" , "Sordaria Fimicola-Tetrad Analysis", "Pill Bug Animal Behavior"," Fruit Fly genetic investigation" [lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion]

Group and Independent studies-

- **Correct completion of Study Guides for corresponding Chapters (12,13,14,15)**

6. Construct an explanation of the multiple processes that increase variation within a population.	• **POGIL – cell cycle regulation, the statistics of inheritance** • **Practicing Biology 13-2 – how do mitosis and meiosis differ** • **Instructor created genetics practice problems**

Benchmarks:

Test Chapter 12 & 13

Test Chapter 14 & 15

Fruit fly lab write up using research methods

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 12, 13, 14, and 15.*

For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. Discussions are done through power point presentations that are created by the instructor.

"The Cell cycle, Meiosis and Sexual life Cycles" 3 weeks

Lesson 1
- Introduce asexual and sexual reproduction
- Independent mitosis study
- Independent Reading

Lesson 2
- Discuss the cell cycle control factors affecting cell division
- Independent Reading
- POGIL – cell cycle regulation

Lesson 3
- Discuss factors affecting cell division and cancer and its causes
- Independent Reading

Lesson 4
- Discuss cancer from a genetic perspective
- Hillis genes reading 2

Lesson 5
- Discuss Chi Square statistical analysis with example problems
- Lab – onion root tip
- Data collection
- Data analysis

Lesson 6
- Discuss the human life cycle and indicate where in the human body where mitosis and meiosis takes place
- Begin discussing meiosis 1 ups to crossing over and chromosome mapping

Lesson 7
- Discuss independent assortment and mutations at metaphase and nondisjunction
- Lab notebook preparation

Lesson 8
- Discuss examples of nondisjunction
- Lab notebook preparation
- Hillis genes reading 3

Lesson 9
- Discuss gametogenesis and fertilization
- Prelab sordaria
- Practicing Biology 13-2 – how do mitosis and meiosis differ

Lesson 10
- Lab sordaria

"Mendelian and other genetics and the chromosomal basis of inheritance" 4 weeks

Lesson 1
- Discuss Mendel's Law of Dominance, monohybrid and dihybrid cross
- POGIL – the statistics of inheritance

Lesson 2
- Discuss test cross and probability
- Practice problems

Lesson 3
- Discuss incomplete dominance and codominance, and how the phenotypic expression of the heterozygote is affected
- Practice problems

Lesson 4
- Discuss inheritance of the ABO blood system and explain why the alleles can be codominant.
- Discuss Pleiotropic traits
- Independent reading

Lesson 5
- Discuss epistasis and how it affects phenotypic ratios for dihybrid crosses
- Discuss polygenic inheritance, quantitative terms and examples

Lesson 6
- Discuss multifactorial traits and examples
- Practice problems

Lesson 7
- Discuss sex-linked inheritance, SRY gene and its influence

Lesson 8
- Discuss dominant and recessive sex-linked examples
- Practice problems
- Independent reading

Lesson 9
- Discuss x-inactivation, sex influenced traits, and genomic imprinting
- Practice problems

Lesson 10
- Discuss pedigree and recessive disorders
- Review linked and non-linked traits, ratios, and crossover frequency
- Pill bug prelab

Lesson 11
- Pill bug design

Lesson 12
- Lab – pill bug animal behavior set up and data collection

Lesson 13
- Lab notebook preparation for pill bug lab
- Set up fruit fly crosses

Students will collect fruit fly data and construct a professional researched based lab write up for the conclusion of genetics and ap biology

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Hillis, D. M., Sadava, D., Heller, C. H., & Price, M. V. (2012). *Principles of life* (First edition.). Sunderland: Sinauer.

Taylor, Martha. (2017) *Student Study Guide for Biology* 11th ed. Boston: Pearson.

Trout, L. (Eds.). (2012). *POGIL Activities for ap biology.* Batavia: Flinn Scientific, Inc.

AP Biology Investigative Labs: An Inquiry-Based Approach. **New York: The College Board, 2012**

Carolina Investigations for AP Biology**.North Carolina: Carolina Biological Supply, 2012.**

AP Biology Lab Manual**. New York: The College Board, 2001.**

Giffen, Cynthia and Heitz, Jean. *Practicing Biology*, 6rd Edition, 2017, Pearson Benjamin Cummings.

The mitosis onion root tip lab (n.d.). Retrieved August 7, 2017, from https://bio.rutgers.edu/~gb101/lab2_mitosis/index2.html

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): *Heritable information provides for continuity of life (EU3A).*	
4.0	**Students will be able to:** • **Make predictions about natural phenomena occurring during the cell cycle.** • **Represent the connection between meiosis and increased genetic diversity necessary for evolution.** • **Evaluate evidence provided by data sets to support the claim that heritable information is passed from one generation to another through mitosis, or meiosis followed by fertilization.**
3.0	**Students will be able to:** • **Explain how the inheritance patterns of many traits cannot be accounted for by Mendelian genetics.** • **Describe representations of an appropriate example of inheritance patterns that cannot be explained by Mendel's model of the inheritance of traits.** • **Use the rule of multiplication and addition to calculate the probability of inherited traits.** • **Use a Punnett square to predict probable inherited results in both genotype and phenotype.**
2.0	**Students will be able to:** • **State in your own words Mendel's Law of Independent Assortment.** • **State the phenotypic and genotypic ratios of F2 generations.** • **Give examples of incomplete and codominance.** • **Describe the inheritance of ABO blood groups.** • **Define pleiotropy and polygenic inheritance.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Expression of genetic information involves cellular and molecular mechanisms (EU3B).* *The processing of genetic information is imperfect and is a source of genetic variation (EU3C).* *Interactions between and within populations influence patterns of species distribution and abundance (EU4B4).*	
4.0	**Students will be able to:** • **Design a plan for collecting data to show that all biological systems are affected by complex biotic and abiotic interactions.** • **Apply mathematical routines to quantities that describe interactions among living systems and their environment that result in the movement of matter and energy.** • **Construct an explanation of the multiple processes that increase variation within a population**
3.0	**Students will be able to:** • **Describe how gene regulation influences cell products and function.** • **Predict how a change in genotype, when expressed as a phenotype, provides a variation that can be subject to natural selection.** • **Explain how sex is genetically determined in humans and the significance of the SRY gene and potential dysfunction of this gene in male development.**
2.0	**Students will be able to:** • **Explain how linked genes are inherited differently from non-linked genes** • **Describe the variations associated with sex-lined inheritance** • **Explain the chromosome basis of the principles of segregation and independent assortment as it pertains to variation.** • **Distinguish among the life cycle patterns of animals, fungi, and plants.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide opportunities for the advanced learner to act as a peer tutor during class time that involves student choice of activities. • Facilitate access to extensive enrichment activities using online learning management system • Provide challenge problems for advanced learners to solve
Struggling Learners	• Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Facilitate access to extensive review and remediation activities through the learning management system and/or online text content (for example, use of Khan Academy, Bozeman Science, Dynamic Study Modules and Tutorial problems available via MyLab&Mastering) • Utilize peer tutors during class to work with struggling learners
English Language Learners	• Coordinate with ELL advisors to modify activities where appropriate • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Utilize support offered by the following link http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: ELA/Literacy –
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS - LS3 - 1),(HS - LS3 - 2)
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS - LS3 - 1)
WHST.9-12.1 Write arguments focused on discipline - specific content. (HS-LS3-2)
Mathematics –
MP.2 Reason abstractly and quantitatively. (HS-LS3-2),(HS-LS3-3)

Integration of 21st Century Skills

Indicators: The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:
Asking Questions and Defining Problems, Engaging in Argument from Evidence, Analyzing and Interpreting Data
Cross-Cutting Connections:
Scale, Proportion, and Quantity, Cause and Effect, Patterns, Systems and System Models
Connections to Nature of Science:
Science is a Human Endeavor

Unit Title: Evolution

Unit Description: This unit focuses on the study of the origins of life and how life has descended with modifications through successive generations. Specific topics include: how natural selection serves as a mechanism for evolution, evidence supporting evolution, the Hardy-Weinberg concept, how allele frequencies can be altered in a population, concepts of speciation, the origin of life, fossil records, and the history of life with phylogenic trees.

Unit Duration: 2 weeks

Desired Results

Standard(s): NGSS: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5, HS-LS4-6

College Board: "Enduring Understanding" 1A, 1B, 1C, 1D, 3C

Indicators: NGSS: HS-LS4.A "Evidence of Common Ancestry and Diversity", HS-LS4.B "Natural Selection", HS-LS4.C "Adaptation"

College Board: "Essential Knowledge"1.A.1, 1.A.2, 1.A.3, 1.A.4, 1.B.1, 1.B.2, 1.C.1, 1.C.2, 1.C.3, 1.D.1, 1.D.2, 3.C.2

AP BIG IDEA 1 – The process of evolution drives the diversity and unity of life.

AP BIG IDEA 3 – Living systems store, retrieve, transmit and respond to information essential to life processes.

Understandings:

Students will understand that…

- *Change in the genetic makeup of a population over time is evolution (EU1A).*
- *Organisms are linked by lines of descent from common ancestry (EU1B).*
- *Life continues to evolve within a changing environment (EU1C).*
- *The origin of living systems is explained by natural processes (EU1D).*
- *The processing of genetic information is imperfect and is a source of genetic variation (EU3C).*

Essential Questions:

1. How is natural selection a major mechanism of evolution, and in what ways does it act on phenotypic variations in a population?
2. In what ways do organisms share many conserved core processes and features, and how do phylogenetic trees and cladograms graphically represent or model evolutionary history?
3. What hypotheses exist with supporting scientific evidences, including mathematical models, about the natural origin of life on Earth?
4. What changes in genotype may affect phenotypes that are subject to natural selection?
5. How does evolution by natural selection drive the diversity and unity of life?
6. How can phylogenetic trees and cladograms be used to graphically model evolutionary history among species?

Assessment Evidence

Performance Tasks:

1. Evaluate evidence provided by data to qualitatively and quantitatively investigate the role of natural selection in evolution
2. Apply mathematical methods to data from a real or simulated population to predict what will happen to the population over time.
3. Make predictions about the effects of genetic drift, migration, and artificial selection on the genetic makeup of a population.
4. Connect scientific evidence from many scientific disciplines to support the modern concept of evolution.
5. Pose scientific questions that identify essential properties of shared, core life processes that provide insights into the history of life on earth.

Other Evidence:

Quiz – Hardy-Weinberg problems, evolution 2, evolution 3

Lab – "Natural Selection", "Mathematical Modeling: Hardy-Weinberg" "Comparing DNA sequences to understand evolutionary relationships with BLAST [lab abstract format for constructing a report which consists of : hypothesis, parameters, methods, experimental design, control and variable factors, results (including charts, graphs, statistical analysis), discussion]

Group and Independent studies-

- **Correct completion of Study Guides for corresponding Chapters (22,23,24,25)**

6. Create a phylogenetic tree or simple cladogram that correctly represents evolutionary history and speciation from a provided data set. 7. Justify the selection of data that address questions related to reproductive isolation and speciation. 8. Justify the selection of geological, physical, and chemical data that reveal early earth conditions. 9. Predict how a change in genotype, when expresses as a phenotype, provides a variation that can be subject to natural selection.	• **POGIL – selection and speciation, phylogenic trees, the Hardy-Weinberg equation, Mass extinctions.** • **Practicing Biology 23-2 and 23-2 test yourself** • **Unveiling the carboniferous case study** • **Completion of Bozeman science video worksheets**

Benchmarks:

Unit test - Evolution

Learning Plan

Learning Activities: *The concepts in this unit are presented in Campbell's Biology (2018) Chapters 22, 23, 24, & 25*

For each major topic/lesson, specific activities are listed. Sources of activities can be found at the end of this section. Discussions are done through power point presentations that are created by the instructor.

"The evolution of populations and decent with modification: Darwinian view" 1 week

Lesson 1

- Introduce evolution by genetic variation, gene pools, allele frequencies and the Hardy-Weinberg equation. Examine the agents of evolutionary change and what it means to be in equilibrium.
- POGIL – the Hardy-Weinberg equation and practice
- Bozeman science videos in big idea 1 with worksheets
- Independent Reading

Lesson 2

- Discuss earth changes, classification of species, Darwin's research and the origin of species, and observations of evolutionary change
- POGIL – selection and speciation
- Continue Bozeman

Lesson 3

- Lab – mathematical modeling – Hardy-Weinberg

Lesson 4

- Practicing Biology – 23.1 and 23.2 testing yourself
- Pre-lab Natural selection

Lesson 5

- Lab – Natural selection – set up brine shrimp in various salt solutions

"The origin of species and the history of life on earth" 1 week

Lesson 1

- Discuss reproductive isolation, allopatric and sympatric speciation, hybridization
- Collect data for natural selection lab

Lesson 2

- Discuss speciation to macroevolution, the fossil record and dating, plate tectonics, mass extinction, and adaptive radiation
- Collect data for natural selection lab
- POGIL – mass extinctions and phylogenic trees

Lesson 3

- Lab – BLAST- comparing DNA sequences

Lesson 4

- Prepare lab notebook for natural selection and BLAST
  Student Study Guides for Chapters 22,23,24,25

Lesson 5

- Prepare lab notebook
- Student study guides
- Unveiling the carboniferous case study

Lesson 6

- Unveiling the carboniferous case study

Resources:

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Jackson, R., & Campbell, N. A. (2018). *Campbell Biology* (Eleventh edition.). Boston: Pearson.

Waterman, M., & Stanley, E. (2008). *Biological Inquiry: A workbook of investigative cases for biology* (Eighth edition). San Francisco: Pearson.

Taylor, Martha. (2017) *Student Study Guide for Biology* 8th ed. Boston: Pearson.

Bozeman Science Ap Biology video series. (n.d.). Retrieved July 24, 2017, from www.bozemanscience.com

Giffen, Cynthia and Heitz, Jean. *Practicing Biology*, 6rd Edition, 2017, Pearson Benjamin Cummings.

Trout, L. (Eds.). (2012). *POGIL Activities for ap biology.* Batavia: Flinn Scientific, Inc.

***AP Biology Investigative Labs: An Inquiry-Based Approach.* New York: The College Board, 2012**

***Carolina Investigations for AP Biology*.North Carolina: Carolina Biological Supply, 2012.**

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): *Change in the genetic makeup of a population over time is evolution (EU1A).* *Organisms are linked by lines of descent from common ancestry (EU1B).* *The processing of genetic information is imperfect and is a source of genetic variation (EU3C).*	
4.0	**Students will be able to:** • **Convert data from a table of numbers that reflect a change in genetic makeup of a population over time and apply mathematical methods and conceptual understandings to investigate cause and effect of this change.** • **Design a plan to answer questions regarding how organisms have changed over time using information from morphology, biochemistry, and geology.**
3.0	**Students will be able to:** • **Describe a model that represents evolution within a population.** • **Evaluate data that illustrate evolution as an ongoing process.** • **Calculate the change in population frequencies due to genetic drift or selection.**
2.0	**Students will be able to:** • **State the formulas that describe the genotype distributions of a population in Hardy-Weinberg equilibrium and describe the meaning of each variable.** • **List the five conditions under which a population will remain in Hardy-Weinberg equilibrium.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): *Life continues to evolve within a changing environment (EU1C).* *The origin of living systems is explained by natural processes (EU1D).*	
4.0	**Students will be able to:** • **Create a phylogenic tree that correctly represents evolutionary history and speciation from a provided data set.** • **Analyze the graphical data that supports the concept that numbers of species have been increasing through time, but not at a constant rate and are affected by mass extinctions.**
3.0	**Students will be able to:** • **Justify mathematical models, diagrams, or simulations that represent processes of biological evolution.** • **Compare amino acid sequences of known proteins between species and calculate the sequence divergence to determine relatedness.**
2.0	**Students will be able to:** • **Provide examples of adaptive radiation as a result of mass extinction.** • **List and describe reproductive isolation methods.** • **Describe a hypothesis about the origin of life on earth.**
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
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Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
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RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS - LS4 - 1), (HS-LS42) ,(HS - LS4 - 3), (HS-LS4-4) WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
(HS - LS4 - 1), (HS-LS4-2), (HS - LS4 - 3), (HS-LS4-4),(HS-LS4-5)
SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS - LS4 - 1), (HS - LS4 - 2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (HS - LS4 - 1), (HS-LS4-2),(HS-LS4-3), (HS - LS4 - 4),(HS - LS4 - 5) MP.4 Model with mathematics. (HS - LS4 – 2)

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Cross-Cutting Connections: Cause and Effect, Patterns
Connections to Nature of Science:
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena, Scientific Knowledge Assumes an Order and Consistency in Natural Systems