# Pascack Valley Regional High School District

**Pascack Hills High School, Montvale, New Jersey**
**Pascack Valley High School, Hillsdale, New Jersey**

**Course Name: Honors Biology**

Born On: August, 2015
Revised On: August, 2020
Revised On: August, 2022
Current Version: August 2023
Board Approved: 8/28/2023

# New Jersey Curricular Mandates for Science Instruction

**Disabled & LGBT:**
18A:35-4.35 - History of disabled and LGBT persons included in middle and high school curriculum. A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards.

**Diversity, Equity, and Inclusion (DEI)**:
C.18A:35-4.36a - Curriculum to include instruction on diversity and inclusion. 1. a. Beginning in the 2021-2022 school year, each school district shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards. b. The instruction shall: (1) highlight and promote diversity, including economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance; (2) examine the impact that unconscious bias and economic disparities have at both an individual level and on society as a whole; and (3) encourage safe, welcoming, and inclusive environments for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs. c. The Commissioner of Education shall provide school districts with sample learning activities and resources designed to promote diversity and inclusion.

**Amistad Law**:
N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

**Climate Change**:
2020 NJSLS-Science: Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. Global climate change has already resulted in a wide range of impacts across New Jersey and in many sectors of its economy. The addition of academic standards that focus on climate change is important so that all students will have a basic understanding of the climate system, including the natural and human-caused factors that affect it. The underpinnings of climate change span across physical, life, as well as Earth and space sciences. The goal is for students to understand climate science as a way to inform decisions that improve quality of life for themselves, their community, and globally and to know how engineering solutions can allow us to mitigate impacts, adapt practices, and build resilient systems.

**Dissection Law**
N.J.S.A. 18A:35-4.25 and N.J.S.A. 18A:35-4.24 authorizes parents or guardians to assert the right of their children to refuse to dissect, vivisect, incubate, capture or otherwise harm or destroy animals or any parts thereof as part of a course of instruction.

**Honors Biology**

**Unit 1: Characteristic of Life / Scientific Investigation**

**Time Allotted: 2 weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
**HS-LS1-3** Plan and conduct investigations to provide evidence that feedback mechanisms maintain homeostasis.
**HS-LS3-1** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parent to offspring.
**HSL4-2** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for species to increase in number, (2) the heritable genetic variation of individuals in species due to mutations and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
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| **Developing and Using Models**<br>• Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system<br><br>**Planning and Carrying Out Investigations**<br>• Plan and investigate individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.<br><br>**Asking Questions and Defining Problems**<br>• Ask questions that arise from examining models or a theory to clarify relationships.<br><br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>*Connections to Nature of Science*<br><br>Scientific Investigations Use a Variety of Methods<br>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. | **LS1.A: Structure and Function**<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.<br>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)*<br><br>**LS3.A: Inheritance of Traits**<br>• Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. | **Systems and System Models**<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.<br><br>**Stability and Change**<br>• Feedback (negative or positive) can stabilize or destabilize a system.<br><br>**Cause and Effect**<br>• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. |

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
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| • *What does it mean to be living?*<br>• *How do you write a scientific explanation?*<br>• *How do scientists investigate a question?*<br>• *What are the most effective ways to represent data?*<br>• *What is your claim, evidence and reasoning (CER) and why is it important to share it with others?* | **Students will be able to:**<br>• Identify the major components of a controlled study such as hypothesis, control, variables etc.<br>• Design & conduct controlled scientific experiments.<br>• Distinguish between an experimental study and an observational study<br>• Identify various ways data is analyzed<br>• Develop analytical thinking and argumentative writing skills using the "Claim, Evidence, & Reasoning" scientific writing strategy<br>• Compare and contrast discrete and continuous data<br>• Explore concepts related to the biological definition of life and Identify characteristics of living organisms.<br>• Formulate associations between specific properties of life and the data that provides evidence for each property. | **Laboratory Investigations/Activities:**<br>*Use science process skills to construct claims based upon evidence:*<br>• *"Carbohydrate Consumption, Athletic Performance and Health"* - Students design an experiment and construct a scientific explanation that determines if athletic performance can be improved by consuming carbohydrates during sporting and exercise events.<br>• *"Are Nanobacteria alive?"* Case Study- Students review the characteristics of life evidence from biologists on both sides of the controversy questioning whether nanobacteria are living biological organisms and construct a scientific explanation defending their position on the matter.<br>*Application of scientific and technical skills:*<br>• *"Data Analysis and Graphing"* - students practice graphing in Excel using real life scientific data provided by the teacher.<br>*Scientist Spotlights:*<br>• **Dr. Geerat Vermeij** – how a blind paleontologist studies fossil evidence through touch.<br>• **"To Sea with A Blind Scientist"** by Dr. Geerat Vermeij<br>• **Temple Grandin** – Animal Behaviorist with Autism | • Create a graph using scientific data<br>• Construct a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it<br>• Assessment of skills such as asking questions, defining problems, and/or constructing explanations when completing the case study.<br>• Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test<br>• Assessment of written and verbal mastery of unit-specific vocabulary.<br>• Assessment of modeling skills by drawing and labeling diagrams, making analogies, building a 3D structure, and/or making observational sketches.<br>• Biology Benchmark #1 |

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| | | Spectrum Disorder | |
| **Resources/Materials** | - Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. | | |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br><br>***Connections to NJSLS – Mathematics:***<br>**MP.2** - Reason abstractly and quantitatively.<br>**MP.4**- Model with mathematics. | | |

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| | **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.<br>**HSN.Q.A.2**- Define appropriate quantities for the purpose of descriptive modeling.<br>**HSN.Q.A.3-** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

| Modifications | | | |
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| **Multi-Lingual Learners** | **Special Education** | **At-Risk** | **Gifted and Talented** |
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Give the characteristics prior to the lab and have them reinforce what they represent.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Don't give the students the characteristics prior to the lab and through inquiry allow students to develop the characteristics based on the clues<br>● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements. |

**Honors Biology**

**Unit 2: The Chemical Basis of Life**

**Time Allotted: 4 weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HSLS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

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

**HSLS1-6** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

**HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
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| **Constructing Explanations and Designing Solutions**<br>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.<br>• Design a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.<br>**Planning and Carrying Out Investigations**<br>• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>*Connections to Nature of Science*<br>**Scientific Investigations**<br>• Use a Variety of Methods Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. | **LS1.A: Structure and Function**<br>• Systems of specialized cells within organisms help them perform the essential functions of life.<br>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.<br>**LS1.C: Organization for Matter and Energy Flow in Organisms**<br>• The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.<br>• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.<br>**ETS1.C: Optimizing the Design Solution**<br>• Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed | **Structure and Function**<br>• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.<br>**Stability and Change**<br>• Feedback (negative or positive) can stabilize or destabilize a system.<br>**Energy and Matter**<br>• Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. |

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
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| ● *How is matter organized?*<br>● *What are the various ways that atoms arrange themselves to create new substances?*<br>● *What is the chemical basis of life?*<br>● *What are the unique characteristics of water?*<br>● *How do the characteristics of water aid living things?*<br>● *How does the structure of the different molecules (carbohydrates, lipids, proteins) affect their function?*<br>● *How are enzymes essential for survival in living things?* | **Students will be able to:**<br>● Define polarity and determine why the chemical composition of water allows it to have many biologically significant properties<br>● Calculate the standard deviation and standard error of the mean<br>● Describe how the properties of water are important to all living things.<br>● Identify the structure, function, synthesis and degradation of the four major macromolecules in detail<br>● Defend a position using evidence from biological molecules: carbohydrates, lipids, proteins, and nucleic acids.<br>● Describe the role of enzymes in catalyzing reactions.<br>● Interpret reaction rate graphs for catalyzed and uncatalyzed reactions<br>● Distinguish between competitive and noncompetitive inhibition in enzymes. | **Laboratory Investigations/Activities:**<br>*Investigation where students will analyze data and construct claims based upon evidence and apply scientific and technical skills:*<br>● *"Properties of Water Lab with Statistics"* Students use mathematical computations and statistical analysis to investigate the properties of water as they relate to life.<br>● *"Who took Jake's iphone?"* Students learn how to test for different types of organic molecules using chemical indicators and design an investigation to determine who stole a student's iphone using evidence from biological molecules found in food items.<br>● *"Enzyme Lab"* Students test enzyme function and enzyme specificity and draw conclusions to determine presence of lactase and sucrase deficiency from experimental data.<br>● *"Oh What a Difference a Carbon Can Make" Enzyme Inhibition Case Study-* Students analyze and graph experimental data, and draw conclusions obtained from an enzymatic kinetic experiment<br>*Activities that create models of biological* | ● Create a graph with error bars from scientific data collected in a properties of water experiment<br>● Carry out an investigation to determine how soap affects hydrogen bonds between water molecules and write a CER to support the claim with evidence and reasoning.<br>● Design and carry out an investigation to examine characteristics of enzymes.<br>● Analyze and interpret data on a food label/ diet.<br>● Carry out an investigation to determine the presence of biological molecules in various substances.<br>● Write and present claims and findings about what properties make water such an important molecule for living things<br>● Assessment of skills such as asking questions, defining problems, and/or constructing explanations when completing the enzyme inhibition case study.<br>● Assessment of research, argumentation, and/or presentation skills by |

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| | | *concepts:*<br>● *"Biochemistry POGIL"* Students use models of biological molecules to demonstrate the structure and function of these essential biological molecules needed for life and how the bonds in the molecules are continually broken and reformed during chemical reactions.<br><br>*Scientist Spotlight:*<br>• **Dr. Carolyn Bertozzi** – 2022 Nobel Prize in Chemistry. Developed the science needed to utilize "click chemistry" in living organisms.<br>• **Dr. Ruth Smith Lloyd** – First African American Woman in the US to earn her doctorate degree in Anatomy. Studied endocrinology/sex-hormones. | completing a project, including supporting documentation.<br>● Graph enzyme data<br>● Interpret rate of reaction graphs<br>● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test<br>● Assessment of written and verbal mastery of unit-specific vocabulary.<br>● Assessment of modeling skills by drawing and labeling diagrams, making analogies, building a 3D structure, and/or making observational sketches. |
| **Resources/Materials** | - Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). | | |

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| | **RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br><br>***Connections to NJSLS – Mathematics:***<br>**MP.2:** Reason abstractly and quantitatively.<br>**MP.4:** Model with mathematics. |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |

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| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

| **Modifications** | | | |
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| **Multi-Lingual Learners** | **Special Education** | **At-Risk** | **Gifted and Talented** |
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate steps aloud before lab/project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds for the design process.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve study techniques. | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements.<br>● Engage in a more complex project or laboratory protocol. |

**Honors Biology**

**Unit 3: Cells and Cell Transport**

**Time Allotted: 3 weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HS-LS1-1:** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
**HS-LS-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
**HS-LS-3**: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
**HS-ETS-1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
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| **Constructing Explanations and Designing Solutions**<br>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.<br>• Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.<br>**Developing and Using Models Modeling**<br>• Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.<br>**Planning and Carrying Out Investigations**<br>• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>*Connections to Nature of Science*<br>**Scientific Investigations**<br>• Use a Variety of Methods Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. | **LS1.A: Structure and Function**<br>• Systems of specialized cells within organisms help them perform the essential functions of life.<br>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*<br>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br>**ETS1.B: Developing Possible Solutions**<br>• When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. | **Structure and Function**<br>• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.<br>**Stability and Change**<br>• Feedback (negative or positive) can stabilize or destabilize a system.<br>**Systems and System Models**<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales<br>.<br>- - - - - - - - - - - - - - - - - - - - - - - - -<br>*Connections to Engineering, Technology, and Applications of Science*<br>• New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. |

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
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| ● *What are the functions of the main organelles of the cell and how do they work together to support the life of a cell/organism?*<br>● *How does structure relate to function in living systems from the organismal to the cellular level?*<br>● *What are stem cells and what roles do they play in the body?*<br>● *What is the structure of the cell membrane and how does it help aid in its function?*<br>● *How does the cell membrane control what enters and leaves the cell?*<br>● *How is homeostasis maintained in different environments?* | **Students will be able to:**<br>● Explain how organelles work together to accomplish cellular functions and how organs and organ systems work together to accomplish functions needed by the organism<br>● Explain the concept of selectively permeable as it applies to the cell membrane, distinguish between active and passive transport<br>● Students will investigate and demonstrate an understanding of the processes by which materials are brought into and taken out of a cell.<br>● Define homeostasis and illustrate how transport is used to maintain an internal environment<br>● Identify the consequences of excessive cell growth.<br>● Construct a model which explains the events that occur during the major periods of the cell cycle.<br>● Display an understanding of how cell division is involved in the growth and repair of an organism. | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will analyze data and construct claims based upon evidence*<br>● *"Dialysis Tubing Lab"* - Students will investigate the processes of diffusion, osmosis and movement of molecules across a semipermeable membrane.<br>● *"Introduction to Cells"* analysis and discussion activity where students learn about the characteristics shared by all cells, the differences between prokaryotic and eukaryotic cells, and the differences between animal and plant cells. Students also use mathematical computations to determine which size cell will be most efficient for survival.<br>● *"Structure and Function of Cells, Organs and Organ Systems"* students construct and evaluate an argument to support the claim that structure is related to function in cells, organs and organ system<br>● *"Agony and Ecstasy: A Case Study on Cell Membrane Structure and Function"* - students will analyze data that investigates the human body's physiological response to | ● Create graphs of data from scientific evidence.<br>● Construct a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it.<br>● Carry out an investigation to determine the effect of various solutions on a cell.<br>● Lab analysis- collect observational data to determine cell environment- hypertonic, hypotonic, isotonic.<br>● Calculate surface area to volume ratios and analyze which cell size would be most efficient at diffusing materials.<br>● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test<br>● Assessment of written and verbal mastery of unit-specific vocabulary.<br>● Assessment of modeling skills by drawing and labeling diagrams, making analogies, building a 3D structure, and/or making observational sketches.<br>● Assessment of skills such as asking questions, defining |

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| | | the drug ecstasy as it relates to cell membrane structure, diffusion and electrolyte imbalance.<br><br>*Scientist Spotlight*:<br>• **Dr. Ben Barres** – Neuroscience Pioneer & Gender Champion.<br>- **Stanford Medicine article**– Ben Barres & his work on glial cells<br><br>*Diversity, Equity, and Inclusion*:<br>• The importance of Increasing the Diversity of Cells Used in Medical Research | problems, and/or constructing explanations when completing the case study.<br>• Assessment of research, argumentation, and/or presentation skills by completing a project, including supporting documentation. |
| **Resources/Materials** | - Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. | | |

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| | **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br>**SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.<br><br>***Connections to NJSLS – Mathematics:***<br>**MP.4:** Model with mathematics.<br>**MP.2**: Reason abstractly and quantitatively<br>**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.<br>**HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling.<br>**HSS-ID.A.1:** Represent data with plots on the real number line.<br>**HSS-IC.B.6:** Evaluate reports based on data |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions. |

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| | Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). |

| **Modifications** | | | |
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| **Multi-Lingual Learners** | **Special Education** | **At-Risk** | **Gifted and Talented** |
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds for the design process.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements.<br>● Engage in a more complex laboratory activity or project. |

**Honors Biology**

**Unit 4: Cell Energy**

**Time Allotted: 4-5 weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
**HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
**HS-LS1-6:** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
**HS-LS1-7**: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
**HS-LS2-3**: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
**HS-LS2-5**: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
**HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
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| **Developing and Using Models Modeling**<br>• Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.<br>• Use a model based on evidence to illustrate the relationships between systems or between components of a system.<br>• Develop a model to describe unobservable mechanisms.<br>• Develop a model to describe phenomena.<br><br>**Constructing Explanations and Designing Solutions**<br>• Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and | **LS1.A: Structure and Function**<br>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.<br><br>**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems**<br>• Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.<br>• Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.<br><br>**LS1.C: Organization for Matter and Energy Flow in Organisms**<br>• The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.<br>• The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.<br>• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. | **Systems and System Models**<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales<br><br>**Energy and Matter**<br>• Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.<br>• Matter is conserved because atoms are conserved in physical and chemical processes.<br>• The transfer of energy can be tracked as energy flows through a natural system |

laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

**Asking Questions and Defining Problems**

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

**PS3.D: Energy in Chemical Processes and Everyday Life**

- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (*secondary*)
- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *(secondary)*

**ETS1.A: Defining and Delimiting Engineering Problems**

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

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*Connections to Nature of Science*

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
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| • *How do organisms use energy?*<br>• *How do organisms break down sugar without oxygen?*<br>• *What role do pigments play in gathering energy during photosynthesis?*<br>• *What are the major steps involved in turning light energy into stored chemical energy (glucose)?*<br>• *How are photosynthesis and cellular respiration related?* | **Students will be able to:**<br>• Compare the reactants of photosynthesis and cellular respiration to their products.<br>• Relate the role of light and chlorophyll in photosynthesis to the production of ATP.<br>• Describe how glucose is converted into ATP.<br>• Create and interpret models of cell energy processes<br>• Analyze and interpret data | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will analyze data and construct claims based upon evidence :*<br>Cellular Respiration:<br>• *"How do Organisms Use Energy"* students construct explanations as to how organisms use energy by examining the role of ATP synthesis and cellular respiration.<br>• *"Exercise and Cellular Respiration"* | • Apply scientific ideas, principles, and/or evidence to provide an explanation of ATP synthesis and the process of cellular respiration<br>• Measure and compare the types and quantities of pigments found in different types of plant leaves.<br>• Determine factors that |

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| ● *How does photosynthesis support both the organism that is performing it and other life forms on Earth?* | pertaining to cell energy processes.<br>● Design experiments that demonstrate how plants and animals undergo processes that create and utilize cellular energy.<br>● Design experiments to determine the factors that influence photosynthesis.<br>● Measure and compare the types and quantities of pigments found in plant leaves. | analyze the effect of exercise on the rate of cellular respiration and explain how aerobic cellular respiration, anaerobic fermentation, and creatine phosphate contribute to ATP production in muscle cells during different types of athletic activity.<br><br>● *"The Mystery of the Seven Deaths: A Case Study in Cellular Respiration"* Students examine the various components of cellular respiration and the role they play in ATP production in order to determine and understand the cause of death of 7 people in Chicago in 1982. This case is based loosely on the real-life 1982 Chicago Tylenol murders in which seven people died from cyanide poisoning.<br><br>Bio-Engineering Design Challenge:<br>● *"Alcoholic Fermentation in Yeast"* identify the optimum sucrose concentration and temperature to maximize rapid $CO_2$ production as students step through the basic engineering steps of specifying the design criteria, applying the scientific background, and developing and testing the proposed design solutions<br><br>Photosynthesis:<br>● *"Factors Affecting Photosynthesis"*: analyze data that examines the factors that influence the rate of photosynthesis<br><br>● Plant Pigment Chromatography Lab: | affect the rate of photosynthesis. defend their claim with a CER<br>● Collect and analyze data from laboratory investigations of photosynthesis and/or cellular respiration<br>● Use a mathematical model to describe the cycling of matter and flow of energy among organisms in an ecosystem.<br>● Carry out an investigation to determine the effect of sucrose concentration and temperature on rate of cellular respiration.<br>● Carry out an investigation to determine the effect of exercise on the rate of cellular respiration.<br>● Assessment of skills such as asking questions, defining problems, and/or constructing explanations when completing the case study.<br>● Analyze and interpret data to determine where a plant's mass comes from.<br>● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test |

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| | | separate and identify pigments found in plants using paper chromatography<br><br>● *"Where do Plants Get their Mass"* Students interpret data to understand how photosynthesis makes an essential contribution to increases in plant biomass, and cellular respiration can result in decreases in plant biomass.<br><br>● *"Photosynthesis STEM AP Case Lab"*: ExploreLearning Gizmo - Students explore factors that affect photosynthesis and investigate why coral reefs are bleaching in an aquatic ecosystem<br><br>*Climate change*:<br>● **Photosynthesis & Emission-Free Energy**<br>● **Engineering Photosynthesis as a solution to Climate Change** | ● Assessment of written and verbal mastery of unit-specific vocabulary.<br>● Assessment of modeling skills by drawing and labeling diagrams, making analogies, building a 3D structure, and/or making observational sketches. |
| **Resources/Materials** | - **Explore Learning**<br>- Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). | | |

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| | **RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br><br>***Connections to NJSLS – Mathematics:***<br>**MP.4:** Model with mathematics<br>**HSF-IF.C.7:** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.4.12.IML.7**: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change<br>**9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights.<br>**9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors. |

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| | **Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).<br>**8.2.12.NT.1**: Explain how different groups can contribute to the overall design of a product. |

**Modifications**

| Multi-Lingual Learners | Special Education | At-Risk | Gifted and Talented |
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| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds for the projects and laboratory investigations..<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements. |

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| | instructions<br>• Work or take a test in a different setting, such as a quiet room with few distractions<br>• Sit where they learn best (for example, near the teacher)<br>• Use an alarm to help with time management<br>• Work with a partner | | • Engage in a more complex project, laboratory experiment or design challenge. |

**Honors Biology**

**Unit 5: DNA and Cell Cycle**

**Time Allotted: 6 weeks**

**New Jersey Student Learning Standards (NJSLS)**

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

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

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

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

**HSLS1-6** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

**HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
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| **Constructing Explanations and Designing Solutions**<br>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and | **LS1.A: Structure and Function**<br>• Systems of specialized cells within organisms help them perform the essential functions of life.<br>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. | **Structure and Function**<br>• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. |

the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

**Developing and Using Models**

- Use a model based on evidence to illustrate the relationships between systems or between components of a system.

**Asking Questions and Defining Problems**

- Ask questions that arise from examining models or a theory to clarify relationships.
- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

**Engaging in Argument from Evidence**

- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

**LS1.B: Growth and Development of Organisms**

- In multicellular organisms' individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.

**LS3.A: Inheritance of Traits**

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

**LS3.B: Variation of Traits**

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.
- Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.

**LS1.C: Organization for Matter and Energy Flow in Organisms**

- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.

**ETS1.A: Defining and Delimiting Engineering Problems**

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

**Systems and System Models**

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

**Cause and Effect**

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Energy and Matter**

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

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*Connections to Engineering, Technology, and Applications of Science*

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
|---|---|---|---|
| • *Is DNA your destiny?*<br>• *How is genetic information stored in DNA?*<br>• *How is genetic information passed through generations?*<br>• *How does DNA contribute to the traits that make you who you are?*<br>• *Do mutations affect the overall survival of a species?*<br>• *How can we manipulate protein synthesis to advance quality of human life?*<br>• *How do cells control the cell cycle and what happens when those controls break down?*<br>• *How can we reduce our chances of getting cancer?*<br>• *What happens when a mistake occurs in meiosis?* | Students will be able to:<br>• Analyze and interpret cell cycle data.<br>• Develop and use a model of cell cycle to illustrate function and malfunction.<br>• Create a mathematical model to demonstrate the importance of cell size.<br>• Explain how cancer is caused by uncontrolled cell division.<br>• Model DNA structure, replication, transcription, & translation<br>• Model the flow of information from DNA to protein<br>• Model mutations and construct explanations supported by evidence as to how they can be beneficial, harmful, or neutral.<br>• Model how genetic information flows from generation to generation via meiosis and fertilization and that each parent contributes an equal amount of genetic information.<br>• Students determine why individuals of the same species vary in how they look, | Laboratory Investigations/Activities:<br><br>I.Cell Cycle:<br>*Activities that create models of biological concepts:*<br>• *"Investigation: Mitosis and Cancer"*: Students count cells in specific mitotic states to create a mitotic index that will be used as a measure of cell proliferation and a strong predictor of human and canine cancers to determine mast cell cancer in dogs.<br>• *"Karyotype Webquest"* -observe karyotypes to examine chromosomes and determine specific genetic abnormalities.<br><br>*Inquiry investigation where students will analyze data and construct claims*<br>• *"Meowsis" STEM Case Gizmo ExploreLearning:* Students explore how gametes are formed during meiosis and then must determine why a male cat that displays calico fur colors.<br>• **A Look at Cancer Alley, Louisiana** – students analyze real-world data to learn more about Cancer Alley and take concrete actions to address environmental injustice.<br><br>II. DNA & Protein Synthesis<br>*Application of scientific and technical skills*<br>• *"Genetic Mutations"*- examine mistakes that occur when DNA is replicated. | • Develop and use a model of cell cycle to illustrate function and malfunction.<br>• Analyze and interpret cell cycle data.<br>• Create a mathematical model to demonstrate the importance of cell size.<br>• Construct explanations pertaining to different forms of cancer and assess treatments.<br>• Obtain, evaluate, and communicate information pertaining to cancer.<br>• Model DNA structure, replication, transcription, & translation<br>• Model the flow of information from DNA to protein<br>• Construct an amino acid sequence using the codon chart<br>• Model mutations and construct explanations supported by evidence as to how they can be beneficial, harmful, or neutral.<br>• Obtain and evaluate information and use it to |

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| | function, and behave.<br>● Students develop *conceptual models* of the role of DNA in the unity of life on Earth and *use statistical models* to explain the importance of variation within populations for the survival and evolution of species.<br>● Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions. | ● *"From Gene To Protein"*- students transcribe and translate gene sequences to determine specific characteristics<br>● *"How Genes Can Cause Disease"*: transcribe and translate gene sequences of a normal hemoglobin protein sequence and an individual with sickle cell anemia.<br><br>*Activities that create models of biological concepts:*<br>● *"Control of Gene Expression in Prokaryotes"* - use models to explain how prokaryotes control how genes are regulated<br><br>*Scientist Spotlights*:<br>● **Dr. Sara Rankin** – a neurodiverse scientist/professor of Leukocyte and stem cell biology.<br>- **Neurodiversity Celebration** – Dr. Sara Rankin.<br>● **Dr. Dave Bryant and Dr. Amy Tibbo** – LGBTQ+ cancer research scientists<br>● **Dr. Rosalind Franklin** – How her stolen data led to the discovery of the structure of DNA. | argue a point of view on a controversial biological, societal, and ethical issue.<br>● Biology Benchmark #2 |
| **Resources/Materials** | - **Explore Learning**<br>- Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |

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| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br>**SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.<br><br>***Connections to NJSLS - Mathematics***<br>**MP.2:** Reason abstractly and quantitatively. |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design |

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| | solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights.<br>**9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

| **Modifications** | | | |
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| **Multi-Lingual Learners** | **Special Education** | **At-Risk** | **Gifted and Talented** |
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before | ● Provide adequate scaffolds.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes |

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| project activity.<br>● Assign a native language partner. | instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | techniques. | additional research outside of lab requirements. |

**Honors Biology**

**Unit 6: Genetics**

**Time Allotted: 4-5 Weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HSLS1-1** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
**HSLS3-1** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
**HSLS3-2** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
**HSLS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
**HSLS4-3** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions**<br>● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and | **LS1.A: Structure and Function**<br>● Systems of specialized cells within organisms help them perform the essential functions of life.<br>● All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. | **Structure and Function**<br>● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. |

the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

**Asking Questions and Defining Problems**

- Ask questions that arise from examining models or a theory to clarify relationships.

**Analyzing and Interpreting Data**

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

**LS3.A: Inheritance of Traits**

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

**LS3.B: Variation of Traits**

- Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.

**LS4.B: Natural Selection**

- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.

**LS4.C: Adaptation**

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.
- Adaptation also means that the distribution of traits in a population can change when conditions change.

**Cause and Effect**

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Scale, Proportion, and Quantity**

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

**Patterns**

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

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*Connections to Nature of Science*

**Science is a Human Endeavor**

- Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3)
- Science and engineering are influenced by society and society is influenced by science and engineering.

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
|---|---|---|---|
| • *How to determine the probability of traits from parents to offspring?*<br>• *How can you recognize various patterns of inheritance?*<br>• *What is the relationship between genotypes and phenotypes?*<br>• *How does the environment play a role in phenotype?* | **Students will be able to:**<br>• Investigate and practice how to use punnett squares and probability to predict basic inheritance of one and two traits.<br>• Explain the laws of inheritance (segregation, | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will analyze data and construct claims based upon evidence :*<br>• "Real World Mendelian Genetics Practice Problems" -solve one and two trait punnett square word problems using mathematical and computational | • Analyze and compare evidence for different types of inheritance.<br>• Develop and interpret pedigree charts<br>• Predict the results of a monohybrid/dihybrid |

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| ● *How does the formation of gametes lead to genetic variation?*<br>● *What happens if someone is given the wrong blood in a blood transfusion?* | independent assortment, dominance).<br>● Identify non-Mendelian patterns of inheritance and how to predict offspring of various crosses.<br>● Identify and predict the unique Inheritance patterns of traits linked to sex chromosomes.<br>● Identify patterns of inheritance where the trait is controlled by more than one gene and how to predict offspring of various crosses.<br>● Investigate and predict the pattern of inheritance of a trait through generations by evaluating pedigrees<br>● Construct a human pedigree of a genetic trait<br>● Explore the immunobiology of the ABO blood type system and why blood transfusions can be harmful<br>● Distinguish between chemical markers on blood cells such as antigens and antibodies and their role in blood typing | thinking to determine genotype and phenotype of offspring.<br><br>• *"Incomplete and Codominance Real World Practice Problems"* -calculate probability and identify genotype and phenotype of the offspring using non-Mendelian patterns of inheritance such as incomplete dominance and codominance.<br><br>• *"Were the Babies Switched -Blood Typing Lab"* - demonstrate use of a punnett square to predict outcomes of crosses that involve human blood types. Students also identify the types of antigens located on cell membranes to classify blood groups and recognize what happens to the blood when different blood groups are mixed together.<br><br>• *"Sex-Linked Traits"*- calculate probability and identify genotype and phenotype of offspring where the trait is located on the sex-chromosomes<br><br>• *"Polygenic Inheritance Mini-Lab"*- calculate probability of offspring using non-Mendelian patterns of inheritance where the trait is controlled by more than one gene.<br><br>• *"Pedigree Practice Problems"* - predict the pattern of inheritance of a trait through analysis of family pedigree charts. | Punnett Square using a test cross.<br>● Solve Punnett square word problems using mathematical and computational thinking to determine genotype and phenotype of offspring and differentiate between and determine probabilities of incomplete dominance, codominance, multiple alleles, polygenic, sex-linked traits.<br>● Use mathematical and computational thinking to interpret genetic data.<br>● Graph and analyze data depicting the distribution of traits in a given population (i.e., class traits).<br>● Analyze and interpret blood type data to determine paternity. |

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| | | *Scientist Spotlights*:<br>• **Dr. Julie Makani** – Principal investigator for the Sickle Pan-African research Consortium in Tanzania.<br>• **Dr. Derek Braun** – Deaf scientist who teaches & performs genetic research.<br><br>*Diversity, Equity, and Inclusion:*<br>• **Genetics, History, and the American Eugenics Movement** – *How can we, as a society, take advantage of the promise of genetics while avoiding the mistakes of the past?* | |
| **Resources/Materials** | - **Explore Learning**<br>- Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence. | | |

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| | **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br>**SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.<br><br>***Connections to NJSLS - Mathematics***<br>**MP.2**: Reason abstractly and quantitatively |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively. |

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| | Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics). |

**Modifications**

| Multi-Lingual Learners | Special Education | At-Risk | Gifted and Talented |
|---|---|---|---|
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds for the design process.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements.<br>● Engage in a more complex laboratory investigation or activity. |

**Honors Biology**

**Unit 7: Evolution**

**Time Allotted: 3 Weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HS-LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
**HS-LS4-2**: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
**HS-LS4-3:** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
**HS-LS4-4**: Construct an explanation based on evidence for how natural selection leads to adaptation of population.

**HS-LS4-5**: Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
**HS-ESS1-6.** Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
**HS-ESS2-7**. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

## Science & Engineering Practices

**Analyzing and Interpreting Data**

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

**Obtaining, Evaluating, and Communicating Information**

- Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

**Constructing Explanations and Designing Solutions**

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

**Engaging in Argument from Evidence**

- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.

## Disciplinary Core Ideas

**LS4.B: Natural Selection**

- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.

**LS4.C: Adaptation**

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.
- Adaptation also means that the distribution of traits in a population can change when conditions change.
- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.
- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species.
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.

**LS4.A: Evidence of Common Ancestry and Diversity**

- Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such

## Cross-Cutting Concepts

**Patterns**

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

**Cause and Effect**

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Stability and Change**

- Much of science deals with constructing explanations of how things change and how they remain stable.

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*Connections to Nature of Science*

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

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| • Construct an oral and written argument or counter-arguments based on data and evidence.<br><br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>-<br>*Connections to Nature of Science*<br><br>**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**<br>• A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.<br>• Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. | information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.<br><br>**ESS1.C: The History of Planet Earth**<br>• Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history.<br><br>**PS1.C: Nuclear Processes**<br>• Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. *(secondary)*<br><br>**ESS2.D: Weather and Climate**<br>• Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.<br><br>**ESS2.E Biogeology**<br>• The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. | |

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
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| • *How does natural selection encourage inter and intraspecific diversity over time?*<br>• *Is evolution just speculation? What evidence is there?*<br>• *How can survival of the fittest lead to changes in the species? How is this related to variation?*<br>• *How do environmental changes affect the distribution/disappearance of species?*<br>• *Why is evolution significant in today's world?* | **Students will be able to:**<br>• Recognize how heritable characteristics can strongly influence how likely an individual is to survive and reproduce.<br>• Describing how evolution involves changes in the genetic make-up of whole populations over time, not changes in the genes of an individual organism<br>• Analyze natural selection simulations and use the data generated to describe how | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will analyze data and construct claims based upon evidence/Activities that create models of biological concepts:*<br>• *"Evolution by Natural Selection"* - simulate the process of natural selection and analyze the trends in allele frequency by varying the conditions required for natural selection to occur.<br><br>• "Anole Lizard- Natural Selection CER"-analyze data that describes the effects of natural selection in a lizard | • Creating a graph of data from scientific data<br>• Constructing a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it<br>• Defend opinions with scientific research<br>• Use mathematical and computational thinking to interpret data.<br>• Graph and analyze data<br>• Assessment of skills such as Problem Solving, |

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| | environmentally favored traits are perpetuated over generations resulting in species survival, while less favorable traits decrease in frequency or may lead to extinction<br><br>● Explain how the millions of different species on Earth today are related by common ancestry using evidence<br>● Use natural selection and its evolutionary consequences to provide a scientific explanation for the fossil record of ancient life forms, and the molecular similarities observed among the diverse species of living organisms<br>● Discuss how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process<br>● Predict possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, pollution) | population in response to an extreme cold event to create a CER.<br><br>● *"Types of Selection Graphing Activity"*- construct explanations after graphing data to determine the type of selection being portrayed- directional, stabilizing, or selective<br>● "*Speciation of Daphne Major"* - construct explanations from data to determine if speciation occurred as a result of reproductive isolation of two divergent lineages of finches.<br><br>● *"Are Bats Birds"*- analyze data as molecular evidence from the protein database, UniProt, to compare the amino acid sequences of the hemoglobin protein between bats, birds and other mammals.<br><br>***Effective Communication Skills:***<br>● *"Adaptation Project"* - Students will pick an organism and explain 3 different adaptations that help that organism survive. They will then make up a fictitious adaptation and explain how that would further benefit the organism.<br><br>*Scientist Spotlights:*<br>● **Dr. Geerat Vermeij** – how a blind paleontologist studies fossil evidence through touch. (*Building off unit 1)* | Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test<br>● Assessment of written and verbal mastery of unit-specific vocabulary.<br>● Assessment of modeling skills by drawing and labeling diagrams, making analogies, building a 3D structure, and/or making observational sketches.<br>● Laboratory investigations pertaining to concepts in evolution<br>● Projects |
| **Resources/Materials** | - **Uniprot- protein database**<br>- **Explore Learning**<br>- Bozeman Science<br>- **National Center for Case Study for Teaching in Science** | | |

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| | - **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br><br>***Connections to NJSLS – Mathematics*:**<br>**MP.2**: Reason abstractly and quantitatively<br>**MP.4:** Model with mathematics.<br>**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. |

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| | **HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling.<br>**HSS-ID.A.1:** Represent data with plots on the real number line.<br>**HSS-IC.B.6:** Evaluate reports based on data |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

| Modifications | | | |
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| **Multi-Lingual Learners** | **Special Education** | **At-Risk** | **Gifted and Talented** |
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds for the design process.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements.<br>● Engage in a more complex project or laboratory investigation. |

| **Honors Biology** |
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| **Unit 8: Ecology** |
| **Time Allotted: 3 Weeks** |
| **New Jersey Student Learning Standards (NJSLS)** |
| **HSLS 1-5**: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.<br>**HSLS 2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.<br>**HSLS 2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.<br>**HSLS 2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.<br>**HSLS 2-4:** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.<br>**HSLS 2-5:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.<br>**HSLS 2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.<br>**HSLS 2-7:** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*<br>**HSLS 2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.<br>**HSLS 4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. |

**HSLS 4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
**HSLS 4-6:** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
**HS-ESS3-1:** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
**HS-ESS3-3:** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
**HS-ESS2-4.** Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
**HS-ESS2-6.** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
**HS-ESS3-4.** Evaluate or refine a technological solution that reduces the impact of human activities on natural systems
**HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
**HS-ETS1-3**. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
|---|---|---|
| **Developing and Using Models**<br>• Use a model based on evidence to illustrate the relationships between systems or between components of a system.<br>• Develop a model based on evidence to illustrate the relationships between systems or components of a system.<br><br>**Using Mathematics and Computational Thinking**<br>• Use mathematical and/or computational representations of phenomena or design solutions to support explanations. | **LS1.C: Organization for Matter and Energy Flow in Organisms**<br>• The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.<br><br>**LS2.A: Interdependent Relationships in Ecosystems**<br>• Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.<br><br>**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**<br>• Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.<br>• Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.<br>• Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally | **Energy and Matter**<br>• Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.<br>• Energy drives the cycling of matter within and between systems.<br>• Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.<br>• The total amount of energy and matter in closed systems is conserved. |

- Create or revise a simulation of a phenomenon, designed device, process, or system.
- Create a computational model or simulation of a phenomenon, designed device, process, or system.

**Constructing Explanations and Designing Solutions**

- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

**Engaging in Argument from Evidence**

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.

**PS3.D: Energy in Chemical Processes**

- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *(secondary)*

**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

**LS2.D: Social Interactions and Group Behavior**

- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.

**LS4.C: Adaptation**

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

**LS4.D: Biodiversity and Humans**

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(secondary)*
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning, and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)*

**ESS1.B: Earth and the Solar System**

- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. *(secondary)*

**Scale, Proportion, and Quantity**

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

**Systems and System Models**

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

**Stability and Change**

- Much of science deals with constructing explanations of how things change and how they remain stable.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

**Cause and Effect**

- Empirical evidence is required to differentiate between cause and correlation and make

- Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.

**Asking Questions and Defining Problems**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

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*Connections to Nature of Science*

**Scientific Knowledge is Open to Revision in Light of New Evidence**

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

**ESS2.A: Earth Materials and Systems**

- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.

**ESS2.D: Weather and Climate**

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.

**ESS3.A: Natural Resources**

- Resource availability has guided the development of human society.

**ESS3.B: Natural Hazards**

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.

**ESS3.C: Human Impacts on Earth Systems**

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

**ETS1.A: Defining and Delimiting Engineering Problems**

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

**ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary)*

claims about specific causes and effects.

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*Connections to Engineering, Technology, and Applications of Science*

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- Modern civilization depends on major technological systems.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated.
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

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*Connections to Nature of Science*

**Science is a Human Endeavor**

- Science is a result of human endeavors, imagination, and creativity.

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
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| ● *How and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?*<br>● *How is matter and energy transferred in living systems?*<br>● *How are organisms dependent on each other?*<br>● *How can change in one part of an ecosystem affect change in other parts of the ecosystem?*<br>● *How do humans have an impact on the diversity and stability of ecosystems?*<br>● *How can we feed a growing world population without increasing global warming?* | **Students will be able to:**<br>● Develop an understanding of the interdependence of organisms.<br>● Defend position and make recommendations to peers as to how to control an invasive species<br>● Analyze the relationship between predator and prey using graphs and mathematical reasoning.<br>● Compare and contrast two types of population growth curves-<br>● exponential growth and logistical growth<br>● Estimate the size of a population using the mark and recapture and random sampling technique<br>● Examine factors that have influenced the distribution and development of human society; these factors include climate, natural resource availability, and natural disasters<br>● Compare and contrast the two types of limiting factors in population growth- density dependent and density independent while examining the carrying capacity of a population<br>● Use models to explain how nutrients are cycled through the ecosystem<br>● Evaluate the evidence to make | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will analyze data and construct claims based upon evidence :*<br>• *"Ecological Pyramid POGIL"*- examine how energy flows through an ecosystem and propose ecological explanations by analyzing data obtained from a pyramid of energy, numbers and biomass.<br>• *"Are Invading Frogs Harmful"* case study that analyzes and interprets data to determine how to control an invasive species- a population of bullfrogs. Students defend their case to their committee of peers.<br>• *"Deer Predation or Starvation"*- graph data to examine the relationship between a predator and prey and identify your stance on the balance of nature hypothesis.<br>• *"Population Growth Activity"*- use mathematical reasoning and models to understand carrying capacity and the growth of various types of populations and determine whether exponential or logistic growth occurs.<br>• *"How do Biologists Estimate Population Size"* - estimate the size of a sample population using the mark-recapture technique and compare that technique to other methods of population estimating such as random sampling. | ● Plan and carry out ecological investigation.<br>● Creating a graph from population data and being able to determine exponential and logistic population growth<br>● Constructing a scientific explanation that defends a balance of nature hypothesis<br>● Constructing a scientific explanation that defends a way to control a population of invasive species<br>● Use *models* to interpret thecycling of matter and flow of energy through systems.<br>● Create and interpret population growth curves<br>● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test<br>● Assessment of written and verbal mastery of unit-specific vocabulary.<br>● Assessment of modeling skills by drawing and labeling diagrams, making analogies, building a 3D structure, and/or making observational sketches. |

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| | a claim to support that changing conditions may result in a new ecosystem (ecological succession).<br>● Design, evaluate, and/or refine a solution to a complex real-world problem, climate change, based on scientific knowledge and student generated sources of evidence. | • *"Succession Activity"*- using 2 models of succession, identify how different ecosystems develop over time.<br>• *"What is Biological Magnification"*- examine the effects of how a toxic substance impacts all levels of the food chain.<br>• "*Nutrient Cycles"* use models to explain how nutrients that contain carbon and nitrogen are recycled through ecosystems.<br>• *"Food and Global Warming"*- analyze data about the effects of climate change, global warming, and greenhouse gases on the food supply and propose a solution to feed the world's population without increasing global warming.<br>*Scientist Spotlights*<br>• **Rachel Carson** – How 'Silent Spring' Ignited the Environmental Movement. | |
| **Resources/Materials** | - **Explore Learning**<br>- Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. | | |

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| | **RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.<br>**WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br><br>***Connections to NJSLS – Mathematics*:**<br>**MP.2:** Reason abstractly and quantitatively.<br>MP.4-Model with mathematics.<br>**HSN.Q.A.2:** 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.<br>**HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling.<br>**HSN.Q.A.3**: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.<br>**HSS-ID.A.1**: Represent data with plots on the real number line.<br>**HSS-IC.A.1:** Understand statistics as a process for making inferences about population parameters based on a random sample from that population. |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. |

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| | **9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions.<br>**9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

| **Modifications** | | | |
|---|---|---|---|
| **Multi-Lingual Learners** | **Special Education** | **At-Risk** | **Gifted and Talented** |
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before | ● Provide adequate scaffolds for the design process.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes |

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| project activity.<br>● Assign a native language partner. | ● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | techniques. | additional research outside of project requirements.<br>● Engage in a more complex design challenge. |

**Honors Biology**

**Unit 9: Human Activity and Climate Change**

**Time Allotted: 2 weeks**

**New Jersey Student Learning Standards (NJSLS)**

**HS-ESS3-1** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

**HS-ESS3-6** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

**HS-ESS3-5 A**nalyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

**HS-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

**HS-ETS1-3** Evaluate a solution to a complex real-world problem-based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
|---|---|---|
| **Developing and Using Models**<br>● Use a model to provide mechanistic accounts of phenomena.<br><br>**Constructing Explanations and Designing Solutions**<br>● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and | **ESS2.D: Weather and Climate**<br>● Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in | **Cause and Effect**<br>● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.<br><br>**Systems and System Models**<br>● When investigating or describing a system, the boundaries and initial conditions of the system |

the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

**Using Mathematics and Computational Thinking**

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.

**Analyzing and Interpreting Data**

- Analyze data using computational models in order to make valid and reliable scientific claims.

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*Connections to Nature of Science*

**Scientific Investigations Use a Variety of Methods**

- Science investigations use diverse methods and do not always use the same set of procedures to obtain data.
- New technologies advance scientific knowledge.
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based on empirical evidence.
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

which these gases are absorbed by the ocean and biosphere. *(secondary)*

**ESS3.A: Natural Resources**

- Resource availability has guided the development of human society.

**ESS3.B: Natural Hazards**

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.

**ESS3.C: Human Impacts on Earth Systems**

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

**ESS3.D: Global Climate Change**

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.

**ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary)*

need to be defined and their inputs and outputs analyzed and described using models.

**Stability and Change**

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Feedback (negative or positive) can stabilize or destabilize a system.

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***Connections to Engineering, Technology, and Applications of Science***

**Influence of Science, Engineering, and Technology on Society and the Natural World**

- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Modern civilization depends on major technological systems.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

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*Connections to Nature of Science*

**Science Addresses Questions About the Natural and Material World**

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
|---|---|---|---|
| • *What causes climate change?*<br>• *What are the social implications* | **Students will be able to:**<br>• Construct an explanation | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will* | • Research and present about relationships among |

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| *of climate change (transportation, food, population, etc.)?*<br>• *What are the effects of climate change?*<br>• *How do lifestyles affect climate change?*<br>• *What changes in our daily lives would result in lower carbon emissions?*<br>• *What does climate change mean for our future?* | based on valid and reliable evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity<br><br>• Evaluate a solution by taking into account a range of constraints such as costs, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.<br><br>• Develop a model of an algae as a prototype for trapping carbon dioxide. | *analyze data and construct claims based upon evidence :*<br>• **Algae Farm Engineering Design Challenge**-Students engineer an algae farm by first creating a prototype to concentrate $CO_2$ to grow algae. A candle is used as the $CO_2$ source and using plastic materials, funnels, tape and various materials students will build prototypes to best capture the $CO_2$. THey must do research on $CO_2$ and materials before building and can redesign if the goal is not accomplished.<br>• **$CO_2$ graphing activities-** Students will graph data that show evidence of climate change based on $CO_2$ trends over time.<br><br>*Effective Communication Skills:*<br>• **"Less Meat Less Heat" Meatless Burger Cooking Competition and Presentation** Project: Students will create a research project about the effects of meat on the environment especially in relation to climate change. They then must create an original meatless veggie burger recipe that will be cooked in school and judged for the best burger. Furthermore, students will watch the documentary "The Game Changers" about athletes moving towards plant based diets.<br><br>*Diversity, Equity, and Inclusion:*<br>• *Students will review the following* | Earth systems and how these relationships are being modified due to human activity.<br>• Design and create a prototype of an Algae farm that is able to trap $CO_2$ released by a candle to grow algae<br>• Design and cook a meatless burger and then present a research project on the impact of human activities on the environment<br>• Biology Benchmark #3 |

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| | | *resources to collect evidence illustrating how climate change disproportionately impacts socially vulnerable populations throughout the world.*<br>- **The Role of the Scientific Community in Strengthening Disability-Inclusive Climate Resilience**<br>- **Climate Change and the Health of People with Disabilities**<br>- **Disproportionate Impacts of Climate Change on Socially Vulnerable Populations** | |
| **Resources/Materials** | Bozeman Biology (Video Lessons)<br>https://www.explorelearning.com/<br>https://phet.colorado.edu/en/simulations/category/biology<br>https://www.biointeractive.org/classroom-resources<br>https://interactives.ck12.org/plix/biology/<br>https://www.exploratorium.edu<br>http://ciese.org/curriculum/engineering/bio_module_eng_9-13-12.pdf | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. | | |

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| | **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br>**SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.<br><br>***Connections to NJSLS – Mathematics*:**<br>**MP.2:** Reason abstractly and quantitatively.<br>**MP.4**:Model with mathematics.<br>**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.<br>**HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling.<br>**HSN.Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.IML.7**: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.4.12.GCA.1:** Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).<br>**9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions.<br>**9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. |

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| | **9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively.<br>Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

**Modifications**

| Multi-Lingual Learners | Special Education | At-Risk | Gifted and Talented |
|---|---|---|---|
| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a | ● Incorporate student choice.<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Lead the class in the deciphering of new learning.<br>● Engage in a more complex project or laboratory protocol. |

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| | quiet room with few distractions<br>• Sit where they learn best (for example, near the teacher)<br>• Use an alarm to help with time management<br>• Work with a partner. | | |

**Honors Biology**

**Unit 10: Bacteria/ Virus**

**Time Allotted: if time permits**

**New Jersey Student Learning Standards (NJSLS)**

**HS-LS4-1** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
**HS-LS4-2** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
**HS-ETS1-4** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

| Science & Engineering Practices | Disciplinary Core Ideas | Cross-Cutting Concepts |
|---|---|---|
| **Obtaining, Evaluating, and Communicating Information**<br>• Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).<br><br>**Constructing Explanations and Designing Solutions**<br>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.<br><br>**Using Mathematics and Computational Thinking**<br>• Use mathematical models and/or computer simulations to predict the effects of a design | **LS4.A: Evidence of Common Ancestry and Diversity**<br>• Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.<br><br>**LS4.B: Natural Selection**<br>• Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.<br><br>**LS4.C: Adaptation**<br>• Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation | **Patterns**<br>• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.<br><br>**Cause and Effect**<br>• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.<br><br>**Systems and System Models**<br>• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. |

solution on systems and/or the interactions between systems.

*Connections to Nature of Science*

**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

**ETS1.B: Developing Possible Solutions**

- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

*Connections to Nature of Science*

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

| Essential Questions | Student Learning Objectives | Suggested Tasks/Activities | Evidence of Learning (Assessment) |
|---|---|---|---|
| • *How do diseases spread and how can you prevent getting infected?*<br>• *How do bacteria obtain genetic variation?*<br>• *How do bacteria and viruses help and harm humans?* | **Students will be able to:**<br>• Carry out an investigation that demonstrates how bacteria have evolved against various antibiotics<br>• Compare and contrast the differences between viruses and bacteria especially in terms of prevention and treatment<br>• Model how diseases spread in a population<br>• Analyze and graph data about the spreading of COVID-19 | **Laboratory Investigations/Activities:**<br>*Inquiry investigation where students will analyze data and construct claims based upon evidence :*<br>• *"Bacteria Lab"*- students grow bacteria in various conditions to observe how they have evolved against various antibiotics. They can also observe bacteria growth rates at different temperatures and from different environments.<br>• *"Model of Viral Spread"* -students use a mathematical model to explore viral transmission and exponential growth. The model enables comparisons of viruses with different reproduction numbers (R0) numerically and graphically and challenges students to consider strategies for reducing R0 for a virus and the associated impacts and viral transmission.<br>• *"How Viruses Spread Gizmo"*- students | • Carry out an investigation that demonstrates how bacteria have evolved against various antibiotics by collecting and analyzing growth data<br>• Analyze data to determine how disease spread in a population<br>• Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test<br>• Assessment of written and verbal mastery of unit-specific vocabulary.<br>• Assessment of modeling skills by drawing and labeling |

| | | | |
|---|---|---|---|
| | | observe how diseases spread through a group of people. Transmission can be person-to-person, airborne, or foodbrone. Students observe how the R0 impacts the rate of disease.<br><br>*Diversity, Equity, and Inclusion*:<br>• "It's Time to Incorporate Diversity into our Basic Science and Disease Models" - Horwitz, R., Riley, E.A.U., Millan, M.T. *et al.* It's time to incorporate diversity into our basic science and disease models. *Nat Cell Biol* **23**, 1213–1214 (2021) | diagrams, making analogies, building a 3D structure, and/or making observational sketches. |
| **Resources/Materials** | - **Explore Learning**<br>- Bozeman Science<br>- **National Center for Case Study for Teaching in Science**<br>- **POGIL - Activities for AP Biology**<br>- Openstax Textbook<br>- Serendip Studio<br>- Excel | | |
| **ELA Companion Standards** | **RST.9-10.2** - Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.<br>**RST.9-10.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.<br>**RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.<br>**RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).<br>**RST.9-10.9** - Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.<br>**RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.<br>**WHST.9-10.1**. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.<br>**WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. | | |

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| | **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.<br>**WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. |
| **Interdisciplinary Connections** | ***Connections to NJSLS – English Language Arts***<br>**SL.9-10.1**. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.<br>**SL.9-10.2**. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.<br>**SL.9-10.3**. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.<br>**SL.9-10.4**. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.<br>**SL.9-10.5**. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.<br><br>***Connections to NJSLS – Mathematics:***<br>**MP.2:** Reason abstractly and quantitatively.<br>**MP.4:** Model with mathematics.<br>**HSS-IC.B.6:** Evaluate reports based on data |
| **Career Readiness, Life Literacies, and Key Skills** | **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas.<br>**9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.<br>**9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.<br>**9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.<br>**9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.<br>**9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.<br>**9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.<br><br>**Career Readiness, Life Literacies, and Key Skills Practices**<br>Act as a responsible and contributing community member and employee<br>Consider the environmental, social, and economic impacts of decisions.<br>Demonstrate creativity and innovation.<br>Utilize critical thinking to make sense of problems and persevere in solving them.<br>Model integrity, ethical leadership, and effective management.<br>Use technology to enhance productivity, increase collaboration, and communicate effectively. |

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| | Work productively in teams while using cultural/global competence. |
| **Computer Science & Design Thinking** | **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.<br>**8.2.12.ED.1:** Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.<br>**8.2.12.ED.4:** Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.<br>**8.2.12.ED.5:** Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).<br>**8.2.12.ED.6:** Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). |

**Modifications**

| Multi-Lingual Learners | Special Education | At-Risk | Gifted and Talented |
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| ● Display labeled images of designs and parts.<br>● Use body movement and gestures to further explain concepts to students.<br>● Restate design steps aloud before project activity.<br>● Assign a native language partner. | ● Provide adequate scaffolds for the design process.<br>● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency.<br>● Provide an outline of lessons<br>● Get a written list of instructions<br>● Work or take a test in a different setting, such as a quiet room with few distractions<br>● Sit where they learn best (for example, near the teacher)<br>● Use an alarm to help with time management<br>● Work with a partner | ● Incorporate student choice<br>● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities.<br>● Provide peer mentoring to improve techniques. | ● Lead the class in the deciphering of new learning.<br>● Create a more detailed report which includes additional research outside of project requirements.<br>● Engage in a more complex project or laboratory investigation. |

*Additional Resources to promote DEI*:

- Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity
- Race Matters
- Inclusive Teaching