Pascack Valley Regional High School District

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

Course Name: Biology

Born On: August, 2015
Revised On: August, 2020
Revised On: August, 2022
Current Revision: 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.

Biology Grade 9

Unit 1: Characteristic of Life / Scientific Investigation

Time Allotted: 3 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.

HS-LS4-2 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
Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system **Planning and Carrying Out Investigations** • 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. **Asking Questions and Defining Problems** • Ask questions that arise from examining models or a theory to clarify relationships. - *Connections to Nature of Science* Scientific Investigations 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** • 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. • 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. • 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.)* **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.	**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** • Feedback (negative or positive) can stabilize or destabilize a system. **Cause and Effect** • 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)
• *What does it mean to be living?* • *Where did that first life form come from?* • *How do you investigate a scientific question?* • *How can model organisms be used to test a hypothesis?* • *How are variables and controls important to a controlled experiment"* • *In what way does technology assist in scientific discovery?* • *What are the most effective ways to represent data?* • *What is your claim, evidence and reasoning (CER) and why is it important to share it with others?*	**Students will be able to:** • Design & conduct controlled scientific experiments. • Determine the most effective ways to represent data. • Construct scientific conclusions using the "Claim, Evidence, & Reasoning" format. • Identify characteristics of living organisms. • Defend a position on whether something is considered living or not.	**Laboratory Investigations:** *Inquiry investigations where students will analyze data and construct claims based upon evidence:* • **Inquiry investigation (Inquiry cube)** • **Oreo Double Stuff lab:** Students use metric measurements to collect data on the amount of filling in a regular stuffed oreo and compare it to the filling in a double stuffed oreo. They must defend their claim based on the class averages if they feel the oreos are being marketed correctly or if they are being cheated of filling. • **Daphnia Monster Investigation:** students design and carry out their own investigation on the daphnia model organism to see the effects of various energy drinks (sugar, ginseng, 12, caffeine, monster) to see the effect on their heart rate. Students must use the microscope to see the heartbeat. • **Is it Living or Not?** Students argue based on evidence if a flame or virus is living or nonliving. • **"What is Life?"** Students circulate	• Create a graph of data from scientific data • Construct a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it • Defend a position on whether or not something is living or not • Summative written assessment • Biology Benchmark #1

		among stations to analyze the various toys to determine the various characteristics of life *Application of scientific and technical skills:* • **Graphing Practice:** have students practice graphing by hand and in Excel/Google Sheets using real life data provided by the teacher. (Facebook users, time of the mile, CO_2 trends) then have students apply their graphing skills to the oreo lab and the daphnia lab where they must graph their own data. *Scientist Spotlights:* • **Dr. Geerat Vermeij** – how a blind paleontologist studies fossil evidence through touch. • **"To Sea with A Blind Scientist"** by Dr. Geerat Vermeij • **Temple Grandin** – Animal Behaviorist with Autism Spectrum Disorder	
Resources/Materials	**http://getrealscience.org/wp-content/uploads/2011/09/Activity-1-Inquiry-Cube.pdf** **https://www.spps.org/site/handlers/filedownload.ashx?moduleinstanceid=21023&dataid=13686&FileName=oreo_cookie_lab.pdf** **https://interactives.ck12.org/plix/biology/** **https://wardsworld.wardsci.com/biology/when-fleas-take-energy-drinks-a-biology-activity**		
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. **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. **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.		

	RST.9-10.5 - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. ***Connections to NJSLS – Mathematics:*** **MP.2** - Reason abstractly and quantitatively. **MP.4**- Model with mathematics. **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. **HSN.Q.A.2**- Define appropriate quantities for the purpose of descriptive modeling. **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

	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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity.	● Give the characteristics prior to the lab and have them reinforce what they represent. ● Provide alternative choices (i.e. verbal or	● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve	● Don't give the students the characteristics prior to the lab and through inquiry allow students to develop the characteristics based on the clues

● Assign a native language partner.	visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management. ● Work with a partner.	techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements.

Biology Grade 9

Unit 2: The Chemical Basis of Life

Time Allotted: 3-4 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
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. • Design a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. **Planning and Carrying Out Investigations** • 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. - *Connections to Nature of Science* **Scientific Investigations** • 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** • Systems of specialized cells within organisms help them perform the essential functions of life. • 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.)* • 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. **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.C: Optimizing the Design Solution** • 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** • 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. **Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system. **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.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
● *What is the chemical basis of life?* ● *What are the major and minor elements that are found in living things?* ● *What are the unique characteristics of water?* ● *How do the characteristics of water aid living things?* ● *What are the functions of life's basic molecules (proteins, lipids, carbohydrates?)* ● *How does the structure of the different molecules (carbohydrates, lipids, proteins) affect their function?* ● *How are enzymes essential for survival in living things?*	**Students will be able to:** ● Determine why the chemical composition of water allows it to have many biologically significant properties by observing phenomena of water ● Determine (macromolecules) are often composed of long chains (polymers) of simple repeating building blocks (monomers). ● Model the structure of organic molecules to see the relationship to its function. ● Defend a position using evidence from biological molecules: carbohydrates, lipids, proteins, and nucleic acids. ● Determine which factors affect enzyme activity by collecting evidence and analyzing the results.	**Laboratory Investigations/Activities:** *Application of scientific and technical skills:* ● **Water Lab:** In this inquiry-activity, students visit stations to explore the major properties of water, which include cohesion, adhesion, capillary action, surface tension, boiling point and freezing point that show the universal importance of water to living things. Skills learned are collaboration, taking and recording accurate measurements, qualitative and quantitative observations, and constructing explanations based on data collected. ● **Breakfast Cereal/Michael Phelps**: Students analyze the nutritional facts labels of several different breakfast cereal. Skills learned are data collection and forming conclusions based on the data collected on macromolecule ingredients listed on the labels. The Michael Phelps daily diet article stimulates interest in how important nutritional content is to a training Olympic athlete and prompts students to think about their own nutritional choices.	● Design and carry out an investigation to determine the effects of temperature, pH and other factors on enzyme activity. ● Write a CER to support their claim with evidence. ● Carry out an investigation to determine the properties of water and lab questions to connect to biological organisms. ● Analyze and interpret data on a food label/ diet. ● Carry out an investigation to determine the presence of biological molecules in various substances. CER to defend the Murder and a Meal claim. ● Write and present claims and findings about what properties make water such an important molecule for living things

		Inquiry investigation where students will analyze data and construct claims based upon evidence: ● **<u>Murder and Meal Lab:</u>** Students investigate a fictional crime that occurred in their town. Students analyze the victim's stomach contents for the presence of biological molecules using chemical indicators. They will use the lab data to make a claim about where the victim ate her last meal. ● **<u>Liver Enzyme Lab:</u>** Students plan and carry out investigations to determine which factors (i.e. temperature, pH, etc. affect enzyme activity. *Activities that create models of biological concepts:* ● **<u>Hula Hoop/Tennis Ball Electrons</u>**: In this demo, student volunteers use the hula hoop to represent electron orbits of atoms. The tennis ball "electrons" are either shared and transferred, to visually represent covalent or ionic chemical bonds. ● **<u>Protein Folding Kits</u>**- Use a foam toober to attach various amino acid side groups to create a 3D model of a protein. Students will fold their model while following	● Write and present claims and findings about factors that affect liver enzyme reactions ● Write and present claims and findings using evidence to defend a Murder and a Meal claim ● Graph liver enzyme data ● Interpret graphs about water properties (ex. Compare boiling points of various liquids, compare different salt concentrations on boiling points) ● Analyze graphs about pH and enzyme activity ● Summative written assessment

		the tertiary structure rules, to see the final functional shape of their protein. Skills learned include creating a model and understanding that form directs function. • **Design your own Energy Bar:** Students will design their own energy bar/energy drink and justify their choice of ingredients. Skills include constructing scientific explanations. *Scientist Spotlight:* • **Dr. Carolyn Bertozzi** – 2022 Nobel Prize in Chemistry. Developed the science needed to utilize "click chemistry" in living organisms. • **Dr. Ruth Smith Lloyd** – First African American Woman in the US to earn her doctorate degree in Anatomy. Studied endocrinology/sex-hormones.	
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.biologycorner.com/worksheets/enzyme_lab.html		
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. **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. **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.		

	RST.9-10.5 - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. **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. ***Connections to NJSLS – Mathematics:*** **MP.2:** Reason abstractly and quantitatively. **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

	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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate steps aloud before lab/project activity. ● Assign a native language partner.	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions. ● Work or take a test in a different setting, such as a quiet room with few distractions. ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management. ● Work with a partner.	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve study techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex project or laboratory protocol.

Biology Grade 9

Unit 3: Cells and Cell Transport

Time Allotted: 2-3 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-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 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
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. • Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. **Developing and Using Models Modeling** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Planning and Carrying Out Investigations** • 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. - *Connections to Nature of Science* **Scientific Investigations** • 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** • Systems of specialized cells within organisms help them perform the essential functions of life. • 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.)* • 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. • 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. **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.	**Structure and Function** • 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. **Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system. **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 . - *Connections to Engineering, Technology, and Applications of Science* • 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)
● *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?* ● *How were the first cells identified and what technologies helped to discover them?* ● *What are stem cells and what roles do they play in the body?* ● *What is the structure of the cell membrane and how does it help aid in its function?* ● *How does the cell membrane control what enters and leaves the cell?* ● *How is homeostasis maintained in different environments?*	**Students will be able to:** ● Utilize a microscope to observe and analyze cells. ● Defend which organelles are most important for a cell and what happens when they malfunction. ● Research and argue the pros and cons of stem cells. ● Model how a cell maintains homeostasis in various environments.	**Laboratory Investigations/Activities:** *Application of scientific and technical skills* ● **Microscope Lab:** Students will demonstrate the ability to use a microscope and will create, process and observe wet mount slides. *Inquiry investigation where students will analyze data and construct claims based upon evidence* ● **Cell Size Lab with Agar Cubes** - Students collect evidence and construct claims to determine which cell will be able to survive the best using different sized agar cubes and dye. ● **Osmosis with Eggs Lab** - Students will subject raw eggs with the shell removed to different solutions to determine the osmotic movement of water. ● **Selective Permeability Activity** - students will design and carry out an investigation to try determine the selective permeability of plastic bags to starch and iodine. ● Diffusion STEM Gizmo: Students virtually investigate	● Create graphs of data from scientific evidence. ● Construct a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it. ● Defend opinions with scientific research. ● Carry out an investigation to determine the effect of various solutions on a cell. ● Create and present original analogies for cell organelles. ● Lab analysis and scientific explanation (CER) of egg cell size data to determine cell environment- hypertonic, hypotonic, isotonic. ● Calculate surface area:volume ratios and analyze which cell size would be most efficient at diffusing materials. ● Summative written assessment.

		types of cell transport and apply this to the diagnosis and treatment of a dog who can not seem to gain weight. *Effective Communication Skills:* • **Cell Analogies** - students will creatively represent the function of an organelle and then present it to the class and explain their representation • **Organelle/Disease Presentation** - students will research and present how the improper functioning of a single organelle contributes to a problem for the entire organism. *Scientist Spotlight*: • **Dr. Ben Barres** – Neuroscience Pioneer & Gender Champion. - **Stanford Medicine article**– Ben Barres & his work on glial cells *Diversity, Equity, and Inclusion*: • The importance of Increasing the Diversity of Cells Used in Medical Research	
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. **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. **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.		

	RST.9-10.5 - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. **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. **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. **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. ***Connections to NJSLS – Mathematics:*** **MP.4:** Model with mathematics. **MP.2**: Reason abstractly and quantitatively **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. **HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. **HSS-ID.A.1:** Represent data with plots on the real number line.

	HSS-IC.B.6: Evaluate reports based on data
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu/snacks/agar-cell-diffusion https://www.exploratorium.edu/snacks/naked-egg https://www.teachengineering.org/activities/view/usm_membranes_activity1
Career Readiness, Life Literacies, and Key Skills	**9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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.

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

Biology Grade 9

Unit 4: Cell Energy

Time Allotted: 3-4 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
Developing and Using Models Modeling • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. • Use a model based on evidence to illustrate the relationships between systems or between components of a system. • Develop a model to describe unobservable mechanisms. • Develop a model to describe phenomena. **Constructing Explanations and Designing Solutions** • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including	**LS1.A: Structure and Function** • 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. **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • 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. • 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. **LS1.C: Organization for Matter and Energy Flow in Organisms** • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. • 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	**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 **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. • Matter is conserved because atoms are conserved in physical and chemical processes. • The transfer of energy can be tracked as energy flows through a natural system

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. **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.	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. • 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. --- *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)
• *How does the structure of mitochondria aid in the process of cellular respiration?* • *What are the major steps involved in the breakdown of sugar into ATP?* • *How do organisms break down sugar without oxygen?*	**Students will be able to:** • Utilize an online simulation of a calorimeter to compare different calories that are found in food • Create and interpret models of cell energy processes • Measure heart rate with	**Laboratory Investigations/Activities:** *Inquiry investigation where students will analyze data and construct claims based upon evidence :* Cellular Respiration:: • Virtual Calorimeter Lab: Students measure amount of calories in various foods and analyze how different animals utilize calories in	• Carry out investigations to measure heart rate with and without exercise and analyze data • Measure and compare the types and quantities of pigments found in

• *How does the chloroplast aid in the process of photosynthesis?* • *What role do pigments play in gathering energy during photosynthesis?* • *What are the major steps involved in turning light energy into stored chemical energy (glucose)?* • *How are photosynthesis and cellular respiration related?* • *How does photosynthesis support both the organism that is performing it and other life forms on Earth?*	and without exercise and interpret data, draw conclusions • Analyze and interpret data pertaining to cell energy processes. • Design experiments that demonstrate how plants and animals undergo processes that create and utilize cellular energy. • Design experiments to determine the factors that influence photosynthesis. • Measure and compare the types and quantities of pigments found in plant leaves. • Model an ecosystem and use scientific probes to measure carbon dioxide and oxygen levels of animals and plants and their interactions.	foods using a virtualcalorimeter- http://www.wiley.com/college/trefil/0470118547/vdl/lab_calorimeter/ • Exercise/Heart Rate Lab: Students carry out investigations to measure heart rate with and without exercise and analyze data • Wall Squats Competition/ Tennis Ball Lactic Acid squeeze: Students carry out investigations to measure the amount of "burn" felt doing various activities and analyze data. • Cell Respiration STEM Case Lab: Explore Learning Gizmo: Students utilize knowledge of inputs and outputs of cellular respiration in an effort to determine what type of poison was used on the CIA agent • Alcohol Fermentation Lab: Utilizing fermentation tubes, measure and analyze the amount of CO_2 that is generated by yeast with and without sugar Photosynthesis: • Spinach Chromatography Lab: Measure and compare the types and quantities of pigments found in plant leaves. • Grow plants in different light (online) and/or with Wisconsin Fast Plants: Determine which color light helps plants grow best	plant leaves. • Determine which color light helps plants grow best and defend their claim with a CER • Collect and analyze data from laboratory investigations of photosynthesis and/or cellular respiration • Use a mathematical model to describe the cycling of matter and flow of energy among organisms in an ecosystem. Identify important quantities in the cycling of matter and flow of energy among organisms in an ecosystem and map their relationships using tools. Analyze those relationships mathematically to draw conclusions, reflecting on the results and improving the model if it has not served its purpose. • Develop and write an explanation, based on evidence, for the cycling of matter and flow of energy in aerobic and

		and defend their claim with a CER • Spinach and Cockroach Lab with Probes CO_2: Collect and analyze CO_2 data from spinach and cockroach in light and dark, together and alone; investigating when they are doing photosynthesis and/or cellular respiration • Photosynthesis STEM Case Lab: Students explore factors that affect photosynthesis and investigate why coral reefs are bleaching in an aquatic ecosystem *Climate change*: • **Photosynthesis & Emission-Free Energy** • **Engineering Photosynthesis as a solution to Climate Change**	anaerobic conditions by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples. • Cite specific textual evidence to support an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • Summative written assessment
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu https://www.wiley.com/college/trefil/0470118547/vdl/lab_calorimeter/ https://www.pasco.com/resources/lab-experiments/773 https://fastplants.org/grow-fast-plants-2/		
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.		

	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. **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. **RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. **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. ***Connections to NJSLS – Mathematics:*** **MP.:** Model with mathematics **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

	9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.IML.7**: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. **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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Provide adequate scaffolds for the projects and laboratory investigations.. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions ● Work or take a test in a different setting, such as a quiet room with few distractions. ● Sit where they learn best (for example, near the teacher). ● Use an alarm to help with time management. ● Work with a partner.	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex project, laboratory experiment or design challenge.

Biology Grade 9
Unit 5: 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 Analyze 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 • Use a model to provide mechanistic accounts of phenomena. **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. • 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. *Connections to Nature of Science*	**ESS2.D: Weather and Climate** • 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 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.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system 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. ***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.

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.	**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)*	*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?* • *What are the social implications of climate change (transportation, food, population, etc.)?* • *What are the effects of climate change?* • *How do lifestyles affect climate change?* • *What changes in our daily lives would result in lower carbon emissions?* • *What does climate change mean for our future?*	**Students will be able to:** • Construct an explanation 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 • 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.	**Laboratory Investigations/Activities:** *Inquiry investigation where students will analyze data and construct claims based upon evidence :* • **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. • **CO_2 graphing activities-** Students will graph data that show	• Research and present about relationships among Earth systems and how these relationships are being modified due to human activity. • Design and create a prototype of an Algae farm that is able to trap CO_2 released by a candle to grow algae • Design and cook a meatless burger and then present a research project on the impact of human activities on the environment • Biology Benchmark #2

	• Develop a model of an algae as a prototype for trapping carbon dioxide.	evidence of climate change based on CO_2 trends over time. *Effective Communication Skills:* • **"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. *Diversity, Equity, and Inclusion:* • *Students will review the following resources to collect evidence illustrating how climate change disproportionately impacts socially vulnerable populations throughout the world.* - **The Role of the Scientific Community in Strengthening Disability-Inclusive Climate Resilience** - **Climate Change and the Health of People with Disabilities**	

		- **Disproportionate Impacts of Climate Change on Socially Vulnerable Populations**	
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu 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. **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. **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. **RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.		
Interdisciplinary Connections	***Connections to ELA/Literacy***		

	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. **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. **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. **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. **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. ***Connections to NJSLS – Mathematics*:** **MP.2:** Reason abstractly and quantitatively. **MP.4**:Model with mathematics. **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. **HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.IML.7**: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **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). **9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions.

	9.1.12.CFR.3: Research companies with corporate governance policies supporting the common good and human rights. **9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity.	● Provide adequate scaffolds. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Lead the class in the deciphering of new learning. ● Engage in a more complex project or laboratory protocol.

● Assign a native language partner.	● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management ● Work with a partner.		

Biology Grade 9

Unit 6: DNA and Cell Cycle

Time Allotted: 4-5 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
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. **Developing and Using Models** • Use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • Systems of specialized cells within organisms help them perform the essential functions of life. • 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. **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	**Structure and Function** • 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. **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.

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.

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.

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.

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?* • *How is genetic information stored in DNA?* • *How does the DNA structure relate its replication?* • *How does DNA contribute to the traits that make you who you are?*	**Students will be able to:** • Analyze and interpret cell cycle data. • Develop and use a model of cell cycle to illustrate function and malfunction. • Create a mathematical model to demonstrate the	**Laboratory Investigations/Activities:** **I. Cell Cycle:** *Activities that create models of biological concepts and effectively communicate ideas:* • **Cancer Project:** Students have an abundance of free choice options	• Develop and use a model of cell cycle to illustrate function and malfunction. • Analyze and interpret cell cycle data. • Create a mathematical model to demonstrate

● *Do mutations affect the overall survival of a species?* ● *How does gene regulation affect our daily functions?* ● *How can we manipulate Protein Synthesis to advance quality of human life?* ● *Why do cells need to divide and how do they do it?* ● *How do cells control the cell cycle and what happens when those controls break down?* ● *How are the steps of mitosis important for equal division of nuclear material?* ● *How can we reduce our chances of getting cancer?*	importance of cell size. ● Construct explanations pertaining to different forms of cancer and design treatments. ● Obtain, evaluate, and communicate information pertaining to cancer. ● Analyze and interpret data/evidence obtained from DNA experiments (i.e., Griffith, Avery, Hershey, & Chase) ● Model DNA structure, replication, transcription, & translation ● Explain/argue the need for replication (support the argument with evidence) ● Model the flow of information from DNA to protein ● Construct an amino acid sequence using the codon chart ● Model mutations and construct explanations supported by evidence as to how they can be beneficial, harmful, or neutral.	on ways to represent concepts related to the cell cycle and cancer through movies, PSAs, brochures, models, comic strips, and more. *Inquiry investigation where students will analyze data and construct claims* ● **<u>Agar Cubes</u>**: Using cubes made from agar (or paper blocks filled with sand) students measure and compare the rate of diffusion of materials through the agar according to the size of the cube. They then calculate the surface area and volume ratio. *Inquiry investigation where students will analyze data and construct claims based upon evidence and apply scientific and technical skills* ● **<u>Onion Root Tip Lab</u>**: Students will observe and analyze (cell models) slides of onion cells and determine which phase of mitosis the cells are in**.** **<u>II. DNA & Protein Synthesis</u>** *Application of scientific and technical skills* ● **<u>DNA extraction</u>**: extracting DNA from an organism such as a strawberry or human cheek cells. ● **<u>Electrophoresis Lab</u>**: “In Search of My Father”-Edvotek. Using gel	the importance of cell size. ● Construct explanations pertaining to different forms of cancer and design treatments. ● Obtain, evaluate, and communicate information pertaining to cancer. ● Analyze and interpret data/evidence obtained from DNA experiments (i.e., Griffith, Avery, Hershey, & Chase) ● Model DNA structure, replication, transcription, & translation ● Explain/argue the need for replication (support the argument with evidence) ● Model the flow of information from DNA to protein ● Construct an amino acid sequence using the codon chart ● Model mutations and construct explanations supported by evidence as to how they can be beneficial, harmful, or neutral.

		electrophoresis to separate biological molecules like DNA and proteins. *Activities that create models of biological concepts:* ● **DNA Kinnex:** Students use repeating monomers to create a model of double helix DNA. ● **CHNOPS:** Students model protein synthesis by deciphering a code to transcribe then translate into a protein that gives a fictional creature genetic traits. ● **Codon Bingo**: Students get boards with Amino Acid codes. When given the DNA code they must convert to RNA and use the codon chart to determine the amino acid. *Inquiry investigation where students will analyze data and construct claims based upon evidence* ● Protein Synthesis STEM Case- Students virtually investigate protein synthesis and provide a diagnosis and treatment for what is causing a child to have immune system disease. ● **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.	● Obtain and evaluate information and use it to argue a point of view on a controversial biological, societal, and ethical issue.

		Scientist Spotlights: • **Dr. Sara Rankin** – a neurodiverse scientist/professor of Leukocyte and stem cell biology. - **Neurodiversity Celebration** – Dr. Sara Rankin. • **Dr. Dave Bryant and Dr. Amy Tibbo** – LGBTQ+ cancer research scientists • **Dr. Rosalind Franklin** – How her stolen data led to the discovery of the structure of DNA.	
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu https://www.exploratorium.edu/snacks/agar-cell-diffusion		
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. **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. **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. **RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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.		

	WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. ***Connections to NJSLS – English Language Arts*:** **SL.11-12.5** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. ***Connections to NJSLS - Mathematics*** **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **9.1.12.EG.6**: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. **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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Provide adequate scaffolds. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons. ● Get a written list of instructions. ● Work or take a test in a different setting, such as a quiet room with few distractions.	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal, and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of lab requirements.

	• Sit where they learn best (for example, near the teacher). • Use an alarm to help with time management. • Work with a partner		

Biology Grade 9
Unit 7: 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 • 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.	**LS1.A: Structure and Function** • Systems of specialized cells within organisms help them perform the essential functions of life. • 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. **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.	**Structure and Function** • 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. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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.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.	**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. - *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 does the formation of gametes lead to genetic variation?* • *What happens when a mistake occurs in Meiosis?* • *How can you determine the probability of traits passed on from parents to offspring?* • *What is the relationship between genotypes and phenotypes?* • *How can you recognize various patterns of inheritance?*	**Students will be able to:** • Model how each parent contributes gametes that combine to form a zygote with a combination of traits from both parents. • Investigate how meiosis creates gametes with half the chromosome number and increases genetic variation. • Explore how Mendel's experiments contribute to	**Laboratory Investigations/Activities:** *Inquiry investigation where students will analyze data and construct claims based upon evidence :* • **"Make a Baby" Activity**: Student pairs flip a coin to represent the gametes of parents. They collect data on their baby's traits and then create a picture of the baby. • "Meowsis" STEM Case Gizmo ExploreLearning: Students explore how gametes are formed during meiosis and then must determine	• Construct a karyotype from an amniocentesis by ordering homologous chromosomes; interpret the karyotype to determine the presence of a genetic disorder. • Model how genetic information flows from generation to generation via meiosis

● *What are the different types of genetic disorders and how are they inherited?*	our understanding of genetics. ● Calculate the probability of various genetic traits ● Examine chromosomes and create a karyotype of an individual with a genetic disorder. ● Research and present information about various types of human genetic disorders ● Develop and interpret pedigree charts. ● Research a family trait and create a pedigree chart that traces the patterns through multiple generations. ● Explore certain genetic disorders that are more common among certain groups of people.	why a male cat that displays calico fur colors. • **Inventory of Your Traits Activity:** Students examine their own physical traits, record their data and compare with others in the class. Calculate the most common traits and relate to whether dominant or recessive. • **Blood Type- Murder and Genetics Lab:** Students determine the blood types of the suspects and build a pedigree chart in order to determine who killed Capt Relish • **"SpongeBob" Punnett Squares Problems**: Solve Punnett square word problems using mathematical and computational thinking to determine genotype and phenotype of offspring. • **"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. • **Karyotype Lab:** Student pairs are given an male and female chromosomes to examine and create karyotype. They then interpret and determine what traits and genetic disorders they are carrying. They can then research the disorder the child has. *Effective Communication Skills:*	and fertilization and that each parent contributes an equal amount of genetic information. ● Obtain, evaluate, and communicate information on a genetic disorder and determine the inheritance pattern. ● Develop and interpret pedigree charts ● Analyze and compare evidence for different types of inheritance. ● Predict the results of a monohybrid/dihybrid Punnett Square using a test cross. ● 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. ● Use mathematical and

		• **Presentation on Genetic Disorder:** Students research a human genetic disorder and prepare a presentation to share with class. • **Family Pedigree Project:** Students choose a trait and record it through several generations. Research the trait and describe how it is represented in their family • **Dragon Genome Project:** Students are given dragon parents with different traits, they create possible gametes and then randomly pair up the gametes to make dragon babies Create colorful posters displaying the traits and present. *Scientist Spotlights*: • **Dr. Julie Makani** – Principal investigator for the Sickle Pan-African research Consortium in Tanzania. • **Dr. Derek Braun** – Deaf scientist who teaches & performs genetic research. *Diversity, Equity, and Inclusion:* • **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?*	computational thinking to interpret genetic data. ● Graph and analyze data depicting the distribution of traits in a given population (i.e., class traits). ● Analyze and interpret blood type data to determine paternity.
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/		

	https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu http://www.biology.arizona.edu/human_bio/activities/karyotyping/karyotyping.html https://www.biologyjunction.com/GeneticDisorderProject.htm
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. **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. **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. **RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to NJSLS – English Language Arts*** **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. **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. **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. **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.

	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. ***Connections to NJSLS - Mathematics*** **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **9.1.12.CFR.1**: Compare and contrast the role of philanthropy, volunteer service, and charities in community development and quality of life in a variety of cultures. **9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. **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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions ● Work or take a test in a different setting, such as a quiet room with few distractions ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management ● Work with a partner	● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex laboratory investigation or activity.

Biology Grade 9

Unit 8: 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	Disciplinary Core Ideas	Cross-Cutting Concepts
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	**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	**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.

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.
- Construct an oral and written argument or counter-arguments based on data and evidence.

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.
- Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.

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 information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.

ESS1.C: The History of Planet Earth

- 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.

PS1.C: Nuclear Processes

- 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)*

ESS2.D: Weather and Climate

- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.

ESS2.E Biogeology

- 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.

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)
● *Is evolution just speculation? What evidence is there?* ● *How can survival of the fittest lead to changes in the species? How is this related to variation?* ● *How do environmental changes affect the distribution/disappearance of species?* ● *Why is evolution significant in today's world?*	**Students will be able to:** ● Communicate scientific information in multiple forms that common ancestry and biological evolution are supported by multiple lines of empirical evidence. ● Understand the role each line of evidence has relating to common ancestry and biological evolution. ● Observe patterns in multiple lines of empirical evidence at different scales and provide evidence for causality in explanations of common ancestry and biological evolution.	**Laboratory Investigations/Activities:** *Inquiry investigation where students will analyze data and construct claims based upon evidence :* ● **Evidence of Evolution Stations** - Students will move around the room to different stations. Each station will contain a type of evidence that evolution has taken place. The students will have to construct an explanation for the connection of the station being evidence of evolution. *Activities that create models of biological concepts:* ● **Moth Natural Selection -** This student centered activity demonstrates the principle of camouflage whereby the students select moths off of different colored backgrounds. ● **Bird Beak -** This student centered activity demonstrates the process of natural selection whereby students use different tools to simulate different shaped beaks to pick up items. ● **Thumb Adaptation** - This activity seeks to demonstrate the importance of an opposable thumb for primate evolution. Students will perform various	● Creating a graph of data from scientific data ● Constructing a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it ● Defend opinions with scientific research ● Use mathematical and computational thinking to interpret data. ● Graph and analyze data ● Summative Test/Quiz ● Laboratory investigations pertaining to concepts in evolution ● Projects

		tasks and then re-perform the same tasks with their thumb taped to their hand. ***Effective Communication Skills:*** • **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. *Scientist Spotlights:* • **Dr. Geerat Vermeij** – how a blind paleontologist studies fossil evidence through touch. (*Building off unit 1)*	
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu https://www.biologycorner.com/worksheets/pepperedmoth.html		
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. **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. **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. **RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).		

	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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. **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. **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. ***Connections to NJSLS – Mathematics*:** **MP.2**: Reason abstractly and quantitatively **MP.4:** Model with mathematics. **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. **HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. **HSS-ID.A.1:** Represent data with plots on the real number line. **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.

	9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions ● Work or take a test in a different setting, such as a quiet room with few distractions. ● Sit where they learn best (for example, near the teacher) ● Use an alarm to help with time management. ● Work with a partner.	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex project or laboratory investigation.

Biology Grade 9
Unit 9: 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. **HSLS 2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. **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. **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. **HSLS 2-4:** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. **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. **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.
HSLS 2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. *
HSLS 2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HSLS 4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on 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-ESS3-1: 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-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 • Use a model based on evidence to illustrate the relationships between systems or between components of a system. • Develop a model based on evidence to illustrate the relationships between systems or components of a system. **Using Mathematics and Computational Thinking** • Use mathematical and/or computational representations of phenomena or design solutions to support explanations.	**LS1.C: Organization for Matter and Energy Flow in Organisms** • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. **LS2.A: Interdependent Relationships in Ecosystems** • 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. **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. • 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. • 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 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	**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. • Energy drives the cycling of matter within and between systems. • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. • 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.

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 claims about specific causes and effects.

- 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.

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)*

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.

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)
• *How can change in one part of an ecosystem affect change in other parts of the ecosystem?* • *How do matter and energy link organisms to each other and their environments?* • *How do humans have an impact on the diversity and stability of ecosystems?*	**Students will be able to:** • Plan and carry out an investigation examining how CO_2 and O_2 cycle between abiotic and biotic systems. • Design a model ecosystem that illustrates inputs and outputs of matter and the transfer of energy. • Ask questions and use mathematical representations to examine ecological data. • Evaluate the evidence to make a claim to support that changing conditions may result in a new ecosystem (ecological succession). • Create and interpret an age structure diagram graph. • Create or revise a model that will provide a solution to an environmental problem such as oil spill, acid rain, or global warming.	**Laboratory Investigations/Activities:** *Inquiry investigation where students will analyze data and construct claims based upon evidence :* • **Energy Pyramid Survival-** Students simulate being stranded on an island with certain food resources and have to determine using the law of 10% how they can survive the longest. • **PBS Shark Symbiosis Activity-** students view real examples of symbiotic relationships between aquatic animals and have to determine their relationships • **Succession Simulation-** students will virtually model the difference between primary and secondary succession. *Activities that create models of biological concepts*: • **Carrying Capacity Exploration- How Many Coyotes Can Come to Dinner?** Students simulate being predators and prey and determine how many organisms an ecosystem can support. • **Ball of Yarn Simulation of Food Chains/Web-**The class simulates the flow of energy through an ecosystem with balls of yarn and organism cards • **Food Web activity-** Using clues	• Plan and carry out an ecological investigation. • Creating a graph from population data and being able to determine exponential and logistic growth • Constructing a scientific explanation that defends a claim with evidence and providing scientific reasoning to support how to survive the longest with limited resources. • Modeling food webs and food chains and determining effects when changes are made • Create and interpret an age structure diagram graph. • Summative written assessment • Biology Benchmark #3

		about behavior, students construct a model of an aquatic food web. They evaluate the effects of removing or adding organisms at various trophic levels. *Scientist Spotlights* • **Rachel Carson** – How 'Silent Spring' Ignited the Environmental Movement.	
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu https://www.pbs.org/wgbh/nova/labs/lab/evolution/		
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. **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. **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. **RST.9-10.5** - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research.		

	WHST.9-10.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. ***Connections to NJSLS – Mathematics*:** **MP.2:** Reason abstractly and quantitatively. MP.4-Model with mathematics. **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. **HSN.Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. **HSN.Q.A.3**: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSS-ID.A.1**: Represent data with plots on the real number line. **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving. **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **9.1.12.CFR.2**: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **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.

	Career Readiness, Life Literacies, and Key Skills Practices Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. ● Provide an outline of lessons ● Get a written list of instructions ● Work or take a test in a different setting, such as a quiet room with few	● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex design challenge.

	distractions. • Sit where they learn best (for example, near the teacher). • Use an alarm to help with time management. • Work with a partner		

Biology Grade 9
Unit 10: Bacteria/ Virus
Time Allotted: 2 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-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 • 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.	**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 information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. **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.	**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. **Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems

Using Mathematics and Computational Thinking • Use mathematical models and/or computer simulations to predict the effects of a design 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.	**LS4.C: Adaptation** • 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. **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.	and interactions—including energy, matter, and information flows— within and between systems at different scales. *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?* • *How are bacteria classified?* • *How do bacteria obtain genetic variation?* • *How are viruses classified* • *How do bacteria and viruses help and harm humans?*	**Students will be able to:** • Carry out an investigation that demonstrates how bacteria have evolved against various antibiotics • Create and present a project about bacteria and viruses • Compare and contrast the differences between viruses and bacteria especially in terms of prevention and treatment • Model how diseases spread in a population • Analyze and graph data	**Laboratory Investigations/Activities:** *Inquiry investigation where students will analyze data and construct claims based upon evidence :* • Bacterial Growth Lab - students can virtually or on petri dishes 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. *Effective Communication Skills:* • **Wanted Poster**- students research various bacteria and viruses and	• Carry out an investigation that demonstrates how bacteria have evolved against various antibiotics by collecting and analyzing growth data • Research and present a wanted poster about bacteria and viruses • Compare and contrast the differences between viruses and bacteria especially in terms of prevention and

	about the spreading of COVID-19	create a poster to present to the class. • **Viral Spread (pink) Lab**- Students observe how viruses can spread even among asymptomatic carriers. • **How Viruses Spread Gizmo-** students 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. • **Coronavirus/social distancing articles**- students read current event articles about the COVID-19 pandemic *Diversity, Equity, and Inclusion*: • "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)	treatment • Analyze data to determine how disease spread in a population • Summative written assessment
Resources/Materials	Bozeman Biology (Video Lessons) https://www.explorelearning.com/ https://phet.colorado.edu/en/simulations/category/biology https://www.biointeractive.org/classroom-resources https://interactives.ck12.org/plix/biology/ https://www.exploratorium.edu		
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. **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. **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.		

	RST.9-10.5 - Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **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. **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. **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. **WHST.9-10.2**. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-10.4**. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **WHST.9-10.9**. Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-10.7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Interdisciplinary Connections	***Connections to ELA/Literacy*** **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. **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. **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. **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. **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. ***Connections to NJSLS – Mathematics:*** **MP.2:** Reason abstractly and quantitatively. **MP.4:** Model with mathematics. **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. **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice. **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

	9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. **9.4.12.TL.2:** Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. **9.1.12.CFR.3**: Research companies with corporate governance policies supporting the common good and human rights. **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. **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. **Career Readiness, Life Literacies, and Key Skills Practices** Act as a responsible and contributing community member and employee Consider the environmental, social, and economic impacts of decisions. Demonstrate creativity and innovation. Utilize critical thinking to make sense of problems and persevere in solving them. Model integrity, ethical leadership, and effective management. Use technology to enhance productivity, increase collaboration, and communicate effectively. 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. **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. **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. **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). **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.	● Provide adequate scaffolds for the design process.	● Incorporate student choice. ● Invite parents, neighbors, friends, the	● Lead the class in the deciphering of new learning.

• Use body movement and gestures to further explain concepts to students. • Restate design steps aloud before project activity. • Assign a native language partner.	• Provide alternative choices (i.e. verbal or visual) to demonstrate proficiency. • Provide an outline of lessons. • Get a written list of instructions. • Work or take a test in a different setting, such as a quiet room with few distractions. • Sit where they learn best (for example, near the teacher) • Use an alarm to help with time management. • Work with a partner.	school principal and other community members to support classroom activities. • Provide peer mentoring to improve techniques.	• Create a more detailed report which includes additional research outside of project requirements. • 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