Pascack Valley Regional High School District

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

Course Name: Biological Science

Born On: August, 2015
Revised On: August, 2020
Revised On: August, 2022
Current Revision: August, 2023
Board Approval: 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.

Biological Science 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. ● Use model organisms to test a hypothesis	**Laboratories Investigations:** *Inquiry investigation where students will analyze data and construct claims*: ● Paper towel lab- Students will determine which of four types of paper towels (Brawny, Bounty, Viva, and the school brand) is the most absorbent. Students are required to submit a lab report containing the following information: hypothesis, materials and methods, table, excel graph and a conclusion paragraph. ● Checks lab- Students will use the power of observation to develop a possible scenario from a series of bank checks that span several decades as they receive more and more additional information *Effective Communication Skills:* ● Apple a Day - students take claims such as "an apple a day keeps the doctor away" and research the validity of the statement. They then design an experiment to test it and create data and graphs in order to practice designing and implementing an experiment. *Analyzing and interpreting data*: ● Graphing-students must determine the best way to represent their data collected from experiments *Analyzing claims using media:* ● MythBusters-Does fecal bacteria grow on a toothbrush when it is left	● Create a graph of data from scientific observations ● Construct a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it ● Defend a position on whether something is living or not ● Assessment of written and verbal mastery of unit-specific vocabulary. ● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test. ● Biology Benchmark #1

		out in the bathroom? Students dissect and identify the parts of a controlled experiment prior to designing their own. Characteristics of Life: *Effective Communication Skills* ● Postcard to an Alien: Students create postcards that demonstrate their knowledge of the characteristics of life ● Characteristics of Life Virtual Stations lab - determine if something is living based on various real world examples. ● Is it alive argument?: Students must Defend a position on whether or not something is living or not (fire, computer, virus) *Activities that create models of biological concepts:* ● "Homer"ostasis: students must maintain a constant temperature, water color and concentration of body fluid in a leaky plastic "homer" cup to model the concept of homeostasis. *Scientist Spotlights:* ● **Dr. Geerat Vermeij** – how a blind paleontologist studies fossil evidence through touch. ● **Temple Grandin** – Animal Behaviorist with Autism Spectrum Disorder	
Resources/Materials	https://www.ngsslifescience.com/science.php/science/biology_lesson_plans https://bountytowels.com/en-us/tips-articles/paper-towel-science-experiments-for-kids		

	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/
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 NJSLS – ELA*** **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.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.	● Give the characteristics prior to the lab and have them reinforce what they represent.	● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support	● Don't give the students the characteristics prior to the lab and through inquiry allow students to develop

● 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	classroom activities. ● Provide peer mentoring to improve techniques.	the characteristics based on the clues ● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements.

Biological Science 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:** *Inquiry investigation where students will analyze data and construct claims* Chemistry: ● Water Challenge - students visit stations to explore the major properties of water, which include cohesion, adhesion, capillary action, surface tension, boiling point and freezing point, pH, that show the universal importance of water to living things. ● Mystery Powder Gizmo: students are given various unknown powders such as corn starch, flour and salt and how to compare their chemical properties to determine what they are. ● Red Cabbage Indicator Lab: Students use three different methods: Pasco pH Sensors, pH paper, and red/blue litmus paper to determine the pH of various substances. These different methods allow for students to collect qualitative and quantitative data. **Laboratory Investigations:** Biochemistry *Inquiry investigation where students will analyze data and construct claims* ● Factors Affecting Enzyme	● 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 ● Write and present claims and findings about factors that affect liver enzyme reactions ● Write and present claims and findings using evidence to defend a claim ● Graph liver enzyme data ● Interpret graphs about water properties (ex. Compare boiling points of various liquids, compare different salt

		Activity Virtual Lab - Students will conduct a simulation to assess the various conditions that affect enzymatic activity including temperature, pH, and enzyme and substrate concentrations. ● Identifying Nutrients Gizmo- students will virtually test unknown foods with chemical tests to identify macromolecules. ● Murder and Meal Lab: 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. ● Students test milk before and after "Lactaid" enzyme added to demonstrate how enzyme breaks down milk sugar lactose. *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	concentrations on boiling points) ● Analyze graphs about pH and enzyme activity ● Assessment of written and verbal mastery of unit-specific vocabulary. ● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.

		endocrinology/sex-hormones.	
Resources/Materials	http://images.pcmac.org/SiSFiles/Schools/AL/AutaugaCounty/PrattvilleHigh/Uploads/DocumentsCategories/Documents/Copy_of_Properties_of_Water_Lab_2012a.pdf (Properties of Water lab) https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=433 (Mystery Powders) http://www.bch.cuhk.edu.hk/vlab2/#2/slide4 (Factors affecting enzymes) https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=452 https://sciencespot.net/Media/FrnsScience/MurderMeal.pdf https://www.pgsd.org/cms/lib07/PA01916597/Centricity/Domain/185/LAB_Enzymatic%20Activity%20of%20Lactase.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.		
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.
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. **9.2.12.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.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.

Biological Science 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-LS-1-3: 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:** Cells *Application of scientific and technical skills*: ● Microscope Lab-students will demonstrate the ability to use a microscope and will create and stain wet mount slides ● Spongelab Build A Cell Competitive Virtual Lab- Students will compete to build animal, plant, and bacterial cells while correctly labelling the functions of the organelles *Inquiry investigation where students will analyze data and construct claims*: ● Cell Size Lab with Agar Cubes - Students will try to determine which cell will be able to survive the best using different sized agar cubes and dye *Effective Communication Skills:* ● Buy-Cell Commercial Presentation- Students create and perform a TV commercial promoting the cell structure of a chosen organelle. *Activities that create models of biological concepts:* ● Plant and Animal model: students will draw, color and label a plant and animal cell. **Laboratory Investigations:** Cell Environments: *Inquiry investigation where students will*	● 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. ● Assessment of written and verbal mastery of unit-specific vocabulary. ● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.

		analyze data and construct claims: • Cell Membrane Selective Permeability Activity - students will try to determine the selective permeability of plastic bags to starch and iodine • Plasmolysis Lab- Students investigate the concept of plasmolysis as it relates to potato slices. • Cell Homeostasis Virtual Lab - Students will subject cells to different extracellular environments to determine what happens osmotically to each cell. *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	
Resources/Materials	https://www.biologyjunction.com/microscopeuselab.htm http://www.spongelab.com/game_pages/bac.cfm https://www.exploratorium.edu/snacks/agar-cell-diffusion https://www.youtube.com/watch?v=hxZFU2LBfgA (Diffusion Demo) http://sciencenetlinks.com/lessons/plasmolysis-in-elodea-plant-cells/ https://video.esc4.net/video/assets/Science/Biology/Gateway%20Resources/cell%20homeostasis%20virtual%20lab%20-%20activity/index.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.
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.9-10.4**. 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.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

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.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). **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

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	● Provide adequate scaffolds for the design process. ● Provide alternative choices (i.e. verbal or visual) to	● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support	● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional

students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	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	classroom activities. ● Provide peer mentoring to improve techniques.	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 students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural	**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 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.	**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 **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

world operate today as they did in the past and will continue to do so in the future. **Asking Questions and Defining Problems** • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. **PS3.D: Energy in Chemical Processes and Everyday Life** • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (*secondary*) • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *(secondary)* **ETS1.A: Defining and Delimiting Engineering Problems** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	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?* • *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*	**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 and without exercise and interpret data, draw conclusions • Analyze and interpret data pertaining to cell energy processes. • Design experiments that demonstrate how plants and	**Laboratory Investigations:** Cellular Respiration: *Inquiry investigation where students will analyze data and construct claims:* • Plants and Snails Gizmo: students have to determine how many plants are needed to keep snails alive in a closed system. • Virtual Calorimeter Lab: Students measure amount of calories in various foods and analyze how different animals utilize calories in foods using a virtual calorimeter- • Cell Energy Virtual Simulation: Students will attempt to balance	• 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 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

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?*	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.	photosynthesis and cellular respiration by altering the amount of fish, plants, dissolved oxygen and light intensity. ● Fermentation Lab: Utilizing fermentation tubes, measure and analyze the amount of CO_2 that is generated by yeast with and without sugar **Laboratory Investigations:** Photosynthesis *Inquiry investigation where students will analyze data and construct claims:* ● Spinach Chromatography Lab: Measure and compare the types and quantities of pigments found in plant leaves. ● Grow plants in different light: Determine which color light helps plants grow best 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 *Climate change*: ● **Photosynthesis & Emission-Free Energy** ● **Engineering Photosynthesis as a solution to Climate Change**	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 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. ● Assessment of written and verbal mastery of unit-specific vocabulary. ● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.
Resources/Materials	https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=641 https://www.biologysimulations.com/cell-energy-sim https://www.wiley.com/college/trefil/0470118547/vdl/lab_calorimeter/ http://www.bch.cuhk.edu.hk/vlab2/animation/fermentation/index.html https://www.biologyjunction.com/chromatography_lab.htm https://www.education.com/science-fair/article/light-affects-plant-growth/ http://www2.nau.edu/lrm22/lessons/photosynthesis/photosynthesis.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.
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.:** 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.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.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.

Biological Science 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.	**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.	**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

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

Connections to Nature of Science

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

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

ESS3.D: Global Climate Change
- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.

ETS1.B: Developing Possible Solutions
- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary)*

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.

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**: *Inquiry investigation where students will analyze data and construct claims/ Activities that create models of biological concepts:* • **Algae Farm Engineering** - Students engineer an algae farm by first creating a prototype to concentrate CO2 to grow algae. A candle is used as the CO2 source and using plastic materials, funnels, tape and various materials students will build prototypes to best capture the CO2. • **Global Warming Lab:** Students create models of the atmosphere and investigate using CO2 probes how the addition of heat and water affect the temperature in the closed	• 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

	• Develop a model of an algae as a prototype for trapping carbon dioxide.	system • **Climate Change Virtual Lab:** Students will pretend to be the leader of a country and make policies to reduce carbon emissions while still maintaining enough popularity to be reelected *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**	• Biology Benchmark #2
Resources/Materials	http://ciese.org/curriculum/engineering/bio_module_eng_9-13-12.pdf http://climatechangeeducation.org/hands-on/equipment/pasco/ https://scied.ucar.edu/games-sims-weather-climate-atmosphere		
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 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. **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. **9.4.12.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). **8.2.12.NT.1**: Explain how different groups can contribute to the overall design of a product.

Modifications			
Multi-Lingual Learners	**Special Education**	**At-Risk**	**Gifted and Talented**
● 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 ● 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 lab requirements.

Biological Science 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 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. **Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. **Cause and Effect** • Empirical evidence is required to differentiate between cause and

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.

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.

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?* • *Do mutations affect the overall survival of a species?* • *How does gene regulation affect our daily functions?*	**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 importance of cell size. • Construct explanations	**Laboratory Investigations:** DNA *Activities that create models of biological concepts:* *Application of scientific and technical skills:* • DNA model: Students create accurate 3-dimensional models of DNA • Extract Strawberry DNA Lab: Use special techniques to extract DNA from strawberries.	• 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 the importance of cell size. • Construct explanations pertaining to different

• *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?*	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.	**Laboratory Investigations:** Protein Synthesis: *Activities that create models of biological concepts:* • Protein Synthesis Gizmo- Students go through the process of synthesizing proteins through RNA transcription and translation. • Taco Protein Synthesis - Students will use their knowledge of protein synthesis to decode a DNA strand to find out what type of taco to build. **Laboratory Investigations:** Mitosis/Cancer *Inquiry investigation where students will analyze data and construct claims*: • Breast Cancer Lab: Students learn how breast cancer is diagnosed and treated. They then must diagnose and treat three women to see if they have breast cancer. • Time for Mitosis: Students count the number of onion root tip cells in the four phases of mitosis and in interphase and determine the time required for each phase. • Cell Size Lab with Agar Cubes - Students will try to determine which cell will be able to survive the best using different sized agar cubes and dye. • HHMI - Eukaryotic Cells and Cancer - students explore the phases, checkpoints, and protein regulators of the cell cycle in the interactive. • **A Look at Cancer Alley, Louisiana** – students analyze real-world data to learn more about Cancer Alley and take concrete actions to address	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. • Obtain and evaluate information and use it to argue a point of view on a controversial biological, societal, and ethical issue.

		environmental injustice. *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	https://www.youtube.com/watch?v=vPGKv53zSRQ (Strawberry Extraction) https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=442 https://www.hannasd.org/cms/lib2/PA01001586/Centricity/Domain/662/Taco%20Protein%20Synthesis%20Lab.pdf https://www.decodingcancer.org/resources http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html https://www.biointeractive.org/classroom-resources/eukaryotic-cell-cycle-and-cancer Exploring Related Careers		
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 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.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.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 ● 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 lab requirements.

Biological Science 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. **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	**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. **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.	**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. **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. -

correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	• 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.	*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?* • *What are the different types of genetic disorders and how are they inherited?* • *How can we avoid the mistakes of the past so that society can benefit from advances in healthcare without the fear of unethical treatment?*	**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 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	**Laboratory Investigations:** *Inquiry investigation where students will analyze data and construct claims* • Blood Type Lab: Students determine the blood types of a potential long-lost child who shows up to claim his share of the inheritance with the other children after the death of the parents. Does he belong to the family or not? • "SpongeBob" Punnett Squares Problems: Solve Punnett square word problems using mathematical and computational thinking to determine genotype and phenotype of offspring. • Paper Family lab - Students in pairs determine their genotype and phenotype for 12 different traits. They then make a "virtual family" of four children by passing on their genes and determine the phenotypes of each of their children. They make colorful drawings of each of the traits of their children. *Effective Communication Skills*	• 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 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.

	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.	• 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 • Genetic Disorder Presentations: Students research a human genetic disorder and prepare a presentation to share with class. *Activities that create models of biological concepts:* ● Polygenic Heights Baby: students will model polygenic inheritance by creating offspring with various heights. The class data will show a bell curve. *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?*	● 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 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. ● Cite evidence and examples to argue how we, as a society, can take advantage of the promise of genetics while avoiding the mistakes of the past?
Resources/Materials	http://www2.mbusd.org/staff/pware/labs/BloodTypeLab.pdf http://goodhue.ss16.sharpschool.com/UserFiles/Servers/Server_128080/File/Secondary/Science/FamilyPedigreeProject.pdf		

	https://www.nthurston.k12.wa.us/cms/lib/WA01001371/Centricity/Domain/2015/Genetic%20Disorder%20Project%202104.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.
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
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** 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.

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	● 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.

	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		● Engage in a more complex laboratory investigation or activity.

Biological Science 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.	**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	**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

Obtaining, Evaluating, and Communicating Information

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

Constructing Explanations and Designing Solutions

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

Engaging in Argument from Evidence

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

differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.

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

LS4.A: Evidence of Common Ancestry and Diversity

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

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.

- -

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.

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.	**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.	

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:** *Inquiry investigation where students will analyze data and construct claims:* • Variations within species lab - Students measure the length of 15 femurs and long axis of 20-25 lima beans. Students graph class average data. *Activities that create models of biological concepts*: • NOVA Evolution Virtual Lab: This simulation game seeks to demonstrate the evolutionary relationships of many different organisms. • Camouflage Virtual Lab: Students will pretend to be a predator and will attempt to catch different colored prey on different colored backgrounds. • Natural Selection Lab: Students model variation of bird beaks and prey color. Predicting how the color of prey determine changes in population • Thumb Adaptation - This activity seeks to demonstrate the importance of an opposable thumb for primate evolution. Students will perform various tasks and then re-	• 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 • Laboratory investigations pertaining to concepts in evolution • Assessment of written and verbal mastery of unit-specific vocabulary. • Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test. • Assessment of research, problem solving, and/or presentation skills by completing the project, including supporting

		perform these tasks with their thumb taped to their hand. • Why does Evolution matter now? - *Students will watch a real-world example of how multi-drug resistant tuberculosis is becoming a problem in today's world due to the evolution of the bacteria.* *Scientist Spotlights:* • **Dr. Geerat Vermeij** – how a blind paleontologist studies fossil evidence through touch. (*Building off unit 1)*	documentation.
Resources/Materials	https://www.connectionsacademy.com/content/media/112886_ScienceLab_VariationLab.pdf https://www.biologysimulations.com/natural-selection http://p1cdn1static.sharpschool.com/UserFiles/Servers/Server_4702937/File/lynne%20huskey/Opposable%20Thumb%20Adaptation.pdf https://nj.pbslearningmedia.org/resource/tdc02.sci.life.evo.whymatters/evolving-ideas-why-does-evolution-matter-now/#.XyimmZNKhQI		
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.9-10.2**. 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.

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.

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

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Developing and Using Models • 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. • 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	**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 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.	**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. **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—

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.
- 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

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)*

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.

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.

- -

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

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.	**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)*	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	**Laboratory Investigations/Activities:** *Analyzing and interpreting data*: • Predator prey lab: Graphing lab of lynx and snowshoe hares. • Weather and egg production activity - students investigate the number of eggs produced by birds that lay their eggs on the ground vs the annual rainfall *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	• 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

	(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.	organisms an ecosystem can support. ● Food Web Simulation- Using clues about behavior, students construct a model of an aquatic food web. They evaluate the effects of removing or adding organisms at various trophic levels. ● Succession Simulation - students will virtually model the difference between primary and secondary succession. ● Ecological Sampling in a Meadow: Students use a model of a meadow and use quadrat sampling technique to collect data and calculate the density and frequency of plant species in the meadow ecosystem *Scientist Spotlights* ● **Rachel Carson** – How 'Silent Spring' Ignited the Environmental Movement.	determining effects when changes are made ● Create and interpret an age structure diagram graph. ● Assessment of written and verbal mastery of unit-specific vocabulary. ● Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test. ● Biology Benchmark #3
Resources/Materials	https://www.enr.gov.nt.ca/en/services/lynx/lynx-snowshoe-hare-cycle https://nj.pbslearningmedia.org/resource/lsps07.sci.life.eco.oceanfoodweb/antarctic-food-web-game/ https://biomanbio.com/HTML5GamesandLabs/EcoGames/succession_interactive.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.
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. **9.4.12.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. **9.2.12.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 distractions ● Sit where they learn best (for	● 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.

	example, near the teacher) • Use an alarm to help with time management • Work with a partner		

Biological Science 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. **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. -	**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. **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	**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 and interactions—including energy, matter, and information flows— within and between systems at different scales. -

Connections to Nature of Science		*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.	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.	**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 about the spreading of COVID-19	**Laboratory Investigations:** *Effective Communication Skills:* • Read **Fever** by Mary Beth Keene - Students will read an historical fiction novel based on the life of Mary Mallon "Typhoid Mary" and keep a blog on each of the units and design a Capstone project on one of several themes that appear in the book. *Inquiry investigation where students will analyze data and construct claims:* • **Disease Spread Virtual Gizmo-** Students observe how viruses can spread through a group of people. • **Virus Lytic Cycle Gizmo-** Students virtually release a lytic virus in a group of cells and observe how cells are infected over time and eventually destroyed. *Diversity, Equity, and Inclusion*: • "It's Time to Incorporate Diversity into our Basic Science and Disease	• Carry out an investigation that demonstrates how bacteria have evolved against various antibiotics by collecting and analyzing growth data • Compare and contrast the differences between viruses and bacteria especially in terms of prevention and treatment • Analyze data to determine how disease spread in a population • Assessment of written and verbal mastery of unit-specific vocabulary. • Assessment of skills such as Problem Solving, Creating and Interpreting Graphs, and/or Creating Scientific Explanations by taking quizzes as well as the Unit Test.

		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)	• Assessment of research, problem solving, and/or presentation skills by completing the project, including supporting documentation (*a wanted poster*) about bacteria and viruses .
Resources/Materials	https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=379 https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=448		
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.9-10.2**. 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. ● 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.

Additional Resources to promote DEI:

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