

Pascack Valley Regional High School District

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

Course Name: Biology Enhanced

Born On: August, 2026
Board Approval: 8/24/26

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:

2026 NJSL-Science: Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. Global climate change has already resulted in a wide range of impacts across New Jersey and in many sectors of its economy. The addition of academic standards that focus on climate change is important so that all students will have a basic understanding of the climate system, including the natural and human-caused factors that affect it. The underpinnings of climate change span across physical, life, as well as Earth and space sciences. The goal is for students to understand climate science as a way to inform decisions that improve quality of life for themselves, their community, and globally and to know how engineering solutions can allow us to mitigate impacts, adapt practices, and build resilient systems.

Dissection Law

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

Biology Enhanced		
Unit Title	Approx # of weeks	Months
<i>Benchmark #1</i>		
Ecology	5 Weeks	August - October
Chemistry of Life	4 weeks	October- November
Cell Systems & Homeostasis	4 weeks	December- January
Cell Energy & Climate Change	5 weeks	January - February
<i>Benchmark #2</i>		
Molecular Genetics	4 weeks	February - March
Cell Division and Cancer	3 weeks	March - April
Mendelian Genetics & Human Genetics	4 weeks	April - May
Natural Selection & Evolution	3 weeks	May-June
<i>Benchmark #3</i>		

Biology Enhanced
Unit 1: Ecology
Anchoring Phenomena: Can Genetically Modified Mosquitoes Help People Without Harming Ecosystems? Should genetically modified (GMO) mosquitoes be released to reduce mosquito-borne diseases if they may also affect local food webs?

Related Phenomena:

- Question for class: Where do you think your drinking water comes from? [video clip of Flint, Michigan](#) describing issues with water quality
 - Erin Brockovich clip
 - Water Quality/Climate Change

Pacing: 5 weeks**New Jersey Student Learning Standards (NJSLS)**

HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-6 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.

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

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.	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.	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

Constructing Explanations and Designing Solutions

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

Engaging in Argument from Evidence

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

Asking Questions and Defining Problems

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

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence

- 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.

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.

how a model at one scale relates to a model at another scale.

Systems and System Models

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

Stability and Change

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

Cause and Effect

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

Connections to Engineering, Technology, and Applications of Science

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

- Modern civilization depends on major technological systems.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated.
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering

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.

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.

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.

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.

	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. <i>(secondary)</i>	
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Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
How do organisms interact with each other and their environment to maintain balance in an ecosystem? <i>(food webs, symbiosis, competition, biotic/abiotic factors)</i> What happens when ecosystems are disrupted, and how can biodiversity be protected or restored?	Student will be able to: Students will be able to explain the concept of carrying capacity and how it limits the size of populations in an ecosystem. Students will be able to identify biotic (e.g., predation, competition, disease) and abiotic (e.g., resource availability) factors that influence carrying capacity.	<u>Laboratory Investigations & Activities:</u> <i>Inquiry investigation where students will analyze data and construct claims based upon evidence:</i> <u>Intro activity: Marshmallow Tower Beach House Worksheet & Slideshow</u> - Students use spaghetti and marshmallows to construct a	- Plan and carry out an ecological investigation. (formative) - Creating a graph of data collected from daphnia lab that connects water quality to heart rate (formative) - Analyzing graph of population data and being able to determine exponential and logistic

<i>(human impact, conservation, ecological succession)</i> ● How does the flow of energy and cycling of matter support life in an ecosystem? <i>(energy pyramids, photosynthesis, respiration, nutrient cycles)</i> ● In what ways are humans connected to and responsible for the health of the planet's ecosystems? <i>(sustainability, climate change, ecological footprint)</i>	● Students will be able to describe how the finite nature of resources affects population growth and species abundance. ● Students will be able to analyze how ecosystems can maintain relatively stable population levels through complex interactions under stable conditions. ● Students will be able to distinguish between ecosystem resilience and ecosystem disruption in response to natural or human-induced disturbances. ● Students will be able to evaluate the impacts of anthropogenic changes—such as pollution, invasive species, and climate change—on ecosystems and biodiversity. ● Students will be able to explain the importance of biodiversity for ecosystem function, productivity, and human well-being. ● Students will be able to propose strategies for sustaining biodiversity to ensure long-term ecosystem health and human benefit. ● Create or revise a model that will provide a solution to an environmental problem such as oil spill, acid rain, or global warming. ● Write a CER lab report that states the claim, evaluates evidence that	model beach house that should withstand the force of a strong fan that represents climate change. ● Mosquito GMO Article - Students will debate about the role of mosquitoes and their role in the ecosystem as a way to understand foodwebs and foodchains. ● Ecological Sapienza Garden Scavenger Hunt - Students will make observations about their local environment. Making connections between the abiotic and biotic aspects of an ecosystem, as well as visualizing relationships between living things. ● Ecology Notesheet & PPT Students will complete a guided notesheet with topics of population growths, biogeochemical cycles, community interactions, and food chains and food webs. ● Ecology POGIL Activities ● Landmark Lab- Daphnia Water Pollution Lab Students will use a model	growth (Formative) ● Constructing a scientific explanation that defends a claim with evidence and providing scientific reasoning to support how to survive the longest with limited resources. (Formative) ● Modeling food webs and food chains and determining effects when changes are made (formative) ● Summative written assessment ● LinkIt A (Benchmark) Alternative Assessment Options: ● Students create a labeled food web or ecosystem model and explain how changes to one organism affect the stability of the entire ecosystem. ● Students complete a Claim-Evidence-Reasoning (CER) response using data from the Daphnia water quality investigation to explain how environmental changes impact living organisms.
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	supports the claim, and provides reasoning. ● Create a graph of data on Google Sheets	organism to investigate the effect of different samples of water quality on heart rate. ● Energy Pyramid Survival- Students simulate being stranded on an island with certain food resources and must determine using the law of 10% how they can survive the longest. (Intro PPT) ● PBS Shark Symbiosis Activity- students view real examples of symbiotic relationships between aquatic animals and must determine their relationships. ● Succession Simulation- students will virtually model the difference between primary and secondary succession. <i>Activities that create models of biological concepts:</i> ● Carrying Capacity Exploration-How Many Coyotes Can Come to Dinner? Students simulate being predators and prey and	● Students create an infographic or digital presentation explaining one human impact on biodiversity (e.g., pollution, invasive species, habitat loss, or climate change) and propose one evidence-based solution. ● Students develop a public service announcement (poster, brochure, video, or slideshow) explaining how communities can reduce human impacts on local ecosystems and protect biodiversity. ● Students analyze the GMO mosquito phenomenon and construct an evidence-based argument supporting or opposing the use of genetically modified mosquitoes to reduce mosquito-borne diseases while considering ecological trade-offs.
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		determine how many organisms an ecosystem can support. • <u>Ball of Yarn Simulation of Food Chains/Web-</u>The class simulates the flow of energy through an ecosystem with balls of yarn and organism cards • <u>Food Web activity-</u> 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. <i>Scientist Spotlights</i> <u>Rachel Carson</u> – How ‘Silent Spring’ Ignited the Environmental Movement.	
Interdisciplinary Connections	ELA RI.AA.9–10.7. Describe and evaluate the argument and specific claims in an informational text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and reasoning. W.AW.9–10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. SL.PE.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. Mathematics		

	F.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities. Students analyze population-growth graphs and identify intervals of increasing growth, slowing growth, and stabilization near carrying capacity. F.IF.B.6: Calculate and interpret the average rate of change of a function over a specified interval and estimate the rate of change from a graph. Students interpret changes in population size and laboratory data over time. F.LE.A.1: Distinguish between situations that can be modeled with linear functions and with exponential functions. Students compare patterns of linear and exponential population growth and contrast them with logistic growth limited by carrying capacity. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. Students use technology to graph and analyze the relationship between water quality and Daphnia heart rate or between environmental factors and population size. N.Q.A.1: Use units to understand problems and choose and interpret scales and origins in graphs and data displays. Students select appropriate scales, label units, and construct accurate graphs of ecological data. S.ID.C.9: Distinguish between correlation and causation. Students evaluate whether ecological data support a causal claim or demonstrate only an association. Social Studies 6.3.12.GeoGI.1: Collaborate to propose sustainable solutions that address environmental challenges at local, regional, or global scales. 6.1.12.GeoHE.16.a: Evaluate the environmental and public health consequences of human activity. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.3.12.HCDM.1: Analyze the relationship between individual behaviors, environmental factors, and public health. Visual & Performing Arts 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision.
Career Readiness, Life Literacies, and Key Skills	9.1.12.PB.2: Prioritize financial decisions by considering alternatives and possible consequences. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a). 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). 9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice). 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. 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.

Computer Science and Design Thinking	8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change. 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.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback. 8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
- Assign a native language partner. - Provide illustrated vocabulary cards for ecology terms (ecosystem, biodiversity, carrying capacity, invasive species, trophic level, niche, succession). - Pre-teach academic vocabulary using photographs, diagrams, and real-world examples. - Provide bilingual glossaries or translation supports for scientific terminology. - Use sentence frames for CER writing. - Allow students to explain ecological relationships using labeled diagrams before writing complete explanations. - Display labeled images of designs and parts. - Use body movement and gestures to further explain concepts to students. - Restate design steps aloud	- Provide partially completed food webs, energy pyramids, and carbon cycle diagrams. - Chunk complex ecological readings into smaller sections with guiding questions. - Provide graph templates with labeled axes for population growth and biodiversity data. - Use color-coded ecosystem models to reinforce organism interactions. - Allow digital graphing tools (Google Sheets or Desmos) in place of hand-drawn graphs when appropriate. - Provide extended time for data analysis, CER writing, and laboratory reports. - Offer alternative methods to demonstrate understanding (oral explanation, recorded presentation, annotated diagram, or physical model). - Provide alternative choices (i.e. verbal or visual) to demonstrate	- Provide guided notes highlighting key ecological concepts. - Model one complete CER response before independent practice. - Use teacher-created anchor charts illustrating food chains, food webs, and energy transfer. - Scaffold multi-step laboratory procedures with visual checklists. - Provide frequent formative check-ins during graphing and data analysis activities. - Reduce the number of data points required for initial graphing practice while maintaining the learning objective. - 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 research outside of project requirements. - Engage in a more complex design challenge.

before project activity.	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 (when appropriate)	classroom activities. • Provide peer mentoring to improve techniques.	
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Biology Enhanced		
Unit 2: Chemistry of Life		
Anchoring Phenomena: What is the best way to eat and drink to achieve your goals? Michael Phelps, Dwayne Johnson, Caitlin Clark & LeBron James		
Ideas: - Students are broken into groups and assigned a short article that examines the diet of one of 4 elite athletes (Michael Phelps, Caitlin Clark, LeBron James, & Dwayne Johnson) during training season. Students ‘code’ the foods in the diet based on 3 major nutrients- carbohydrates (starch/sugar), protein, and lipids. Each group records a list of items they “notice” and record some “wonder” questions to fuel curiosity about this unit. The anchoring phenomenon would circle back to these ideas when the students are asked to take a photo of their own meals and describe the biomolecules of their diet. - For properties of water, begin with a compilation video of ‘belly flops’ and ask the students to fill out some “notice” and “wonder” observations on a piece of paper		
Pacing: 4 weeks		
New Jersey Student Learning Standards (NJSLS)		
HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.		
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.		
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.	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. (<i>Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.</i>) - 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	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

----- 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.	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.	be described in terms of energy and matter flows into, out of, and within that system.
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Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
<i>What is the chemical basis of life?</i> <i>What are the major and minor elements that are found in living things?</i> <i>What are the unique characteristics of water?</i> <i>How do the characteristics of water aid living things?</i> <i>What are the functions of life's basic molecules (proteins, lipids, carbohydrates?)</i> <i>How does the structure of the different molecules (carbohydrates, lipids, proteins) affect their function?</i> <i>How are enzymes essential for survival in living things?</i>	<u>Students will be able to:</u> Students will be able to describe the physical and chemical properties of water that make it essential to Earth's systems. Students will be able to explain how water's ability to absorb, store, and release energy influences Earth's climate and surface conditions. Students will be able to identify how water's properties—such as dissolving and transporting materials—support life processes and geologic activity. Students will be able to explain how water contributes to biological	<u>Laboratory Investigations/Activities:</u> <i>Application of scientific and technical skills:</i> Water Lab: In this inquiry-activity, students visit stations to explore the major properties of water, which include cohesion, adhesion, capillary action, surface tension, boiling point and freezing point that show the universal importance of water to living things. Skills learned are collaboration, taking and recording accurate measurements, qualitative and quantitative observations, and constructing explanations based on data collected. Breakfast Cereal: Students analyze the nutritional facts labels of several different breakfast cereal. Skills learned are data	- Design and carry out an investigation to determine the effects of temperature, pH and other factors on enzyme activity. (formative) - Write a CER to support their claim with evidence. (formative) - Carry out an investigation to determine the properties of water and lab questions to connect to biological organisms. (formative) - Analyze and interpret data on a food label/ diet. (formative) - Carry out an investigation to determine the presence of biological molecules in various substances. CER to defend the Murder and a Meal claim. (formative)

	molecule formation and cellular processes. ● Students will be able to describe how carbon, hydrogen, and oxygen atoms form sugar molecules and serve as the building blocks for amino acids and other biomolecules. ● Students will be able to illustrate how simple molecules like sugars are used to form complex molecules such as proteins and DNA that are essential for life. ● Students will be able to connect the molecular composition of water and sugars to larger biological processes like cell formation and energy transfer. ● 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.	collection and forming conclusions based on the data collected on macromolecule ingredients listed on the labels. As part of the lab, students measure out the amount of sugar in a serving of Snapple Peach Ice Tea and Gummy Bears- two commonly seen snacks eaten at the school. It is a jarring visual. <i>Inquiry investigation where students will analyze data and construct claims based upon evidence:</i> ● <u>Murder and Meal Lab:</u> Students investigate a fictional crime that occurred in their town. Students analyze the victim's stomach contents for the presence of biological molecules using chemical indicators. They will use the lab data to make a claim about where the victim ate her last meal. ● <u>Milk Lab:</u> This lab is helpful to denature and isolate casein protein from skim milk and sparks a conversation about nutrients. ● <u>Liver Enzyme Lab:</u> Students plan and carry out investigations to determine which factors (i.e. temperature, pH, etc. affect enzyme activity. <i>Activities that create models of</i>	● Write and present claims and findings about what properties make water such an important molecule for living things (formative) ● Write and present claims and findings about factors that affect liver enzyme reactions (formative) ● Write and present claims and findings using evidence to defend a Murder and a Meal claim (formative) ● Graph liver enzyme data (formative) ● Interpret graphs about water properties (ex. Compare boiling points of various liquids, compare different salt concentrations on boiling points) (formative) ● Analyze graphs about pH and enzyme activity (formative) ● Summative written assessment: <i>Assessment focus: "How do the molecular structures of carbohydrates, lipids, proteins, and nucleic acids explain why different athletes have different nutritional needs?"</i>
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		<i>biological concepts:</i> ● <u>Hula Hoop/Tennis Ball Electrons:</u> In this demo, student volunteers use the hula hoop to represent electron orbits of atoms. The tennis ball “electrons” are either shared and transferred, to visually represent covalent or ionic chemical bonds. ● <u>Protein Folding Kits-</u> Use a foam toober to attach various amino acid side groups to create a 3D model of a protein. Students will fold their model while following the tertiary structure rules, to see the final functional shape of their protein. Skills learned include creating a model and understanding that form directs function. ● <u>Design your own Energy Bar:</u> Students will design their own energy bar/energy drink and justify their choice of ingredients. Skills include constructing scientific explanations. <i>Scientist Spotlight:</i> ● <u>Dr. Carolyn Bertozzi – 2022 Nobel Prize in Chemistry.</u> Developed the science needed to utilize “click chemistry” in living organisms. ● <u>Dr. Ruth Smith Lloyd – First African American Woman in the US to earn her doctorate degree</u>	Alternative Assessment Options: ● Students design an evidence-based nutrition plan for an athlete participating in a specific sport and justify their food choices by explaining the role of carbohydrates, lipids, proteins, nucleic acids, and water in maintaining body function. ● Students create a physical or digital model illustrating the structure and function of one biological macromolecule and explain how its structure supports its function within living organisms. ● Students complete a CER response explaining how carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur combine to form biologically important molecules essential for life. ● Students create an infographic or multimedia presentation comparing the four major biological
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		in Anatomy. Studied endocrinology/sex-hormones.	macromolecules, including their structure, function, food sources, and importance to cellular processes.
Interdisciplinary Connections	ELA RI.CR.9–10.1: Substantially engage with nonfiction text by making relevant, evidence-based inferences and drawing conclusions. RI.IT.9–10.3: Analyze how an author unfolds ideas, events, or explanations to develop claims, reasoning, and evidence. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. SL.PE.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. Math N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. N.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling. F.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. Social Studies 6.1.12.GeoHE.16.a: Explain why natural resources (i.e., fossil fuels, food, and water) continue to be a source of conflict and analyze how the United States and other nations have addressed issues concerning the distribution and sustainability of natural resources and climate change. 6.3.12.GeoGI.1: Collaborate to propose sustainable solutions that address environmental challenges at local, regional, or global scales. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.3.12.HCDM.1: Analyze the relationship between individual behaviors, environmental factors, and public health. Visual & Performing Arts 1.5.12.prof.Cr1a: Use multiple approaches to begin creative endeavors.		

	1.5.12.prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision.		
Career Readiness, Life Literacies, and Key Skills	9.1.12.PB.2: Prioritize financial decisions by considering alternatives and possible consequences.		
	9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.		
	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.		
Computer Science and 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).		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
● Display labeled diagrams and visual models of carbohydrates, lipids, proteins, nucleic acids, and water molecules. ● Pre-teach biomolecule and chemistry vocabulary using illustrated vocabulary cards and bilingual glossaries when appropriate. ● Provide sentence frames for CER writing and scientific explanations. ● Use color-coded molecular models to reinforce the structure and function of biological molecules. ● Pair students with supportive lab partners during investigations and collaborative activities.	● Provide guided notes with partially completed diagrams of biomolecules and water molecules. ● Provide scaffolded graphic organizers comparing the structure and function of the four major biological macromolecules. ● Allow students to manipulate physical or digital molecular models to demonstrate understanding. ● Provide enlarged diagrams and high-contrast visuals during laboratory investigations.	● Provide guided practice identifying biomolecules before independent application. ● Model one complete CER response before assigning independent CER writing. ● Provide graphic organizers that connect molecular structure to biological function. ● Use teacher-created anchor charts summarizing the characteristics and functions of carbohydrates, lipids, proteins, and nucleic acids. ● Provide partially completed data tables during laboratory investigations. ● Use frequent formative check-ins	● Compare nutritional requirements of different athletes using evidence from current scientific literature. ● Investigate how biomolecular structure influences performance, metabolism, or disease. ● Research emerging applications of biomolecules in biotechnology, medicine, or sports science. ● Design and evaluate an evidence-based meal plan for an athlete participating

● Provide translated or simplified laboratory procedures when appropriate. ● 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.	● Chunk complex scientific readings into smaller sections with comprehension checks. ● Provide extended time for laboratory investigations, CER writing, quizzes, and summative assessments. ● Allow alternative methods of demonstrating understanding (oral explanation, annotated diagrams, digital presentation, or model construction). ● Provide digital copies of notes compatible with text-to-speech software. ● Provide adequate scaffolds for the design process. ● 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.	during laboratory activities and molecular modeling. ● Provide scaffolded reading guides for nutrition and biomolecule articles. ● 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.	in a specific sport using molecular and nutritional principles. ● Construct detailed molecular models illustrating the relationship between structure and function. ● Analyze current research involving protein structure, enzyme function, or molecular engineering and present findings to the class. ● 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.
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Biology Enhanced		
Unit 3: Cell Systems and Homeostasis		
Anchoring Phenomena: "When a person gets the flu, they often develop a fever, feel tired, and lose their appetite—yet all of these symptoms are part of the body's way of protecting itself." Student facing question: <i>"Why does our body raise its temperature and make us feel tired when we're sick with the flu?"</i> Use this phenomenon to guide investigations into how multiple organ systems (immune, nervous, circulatory) interact and how feedback loops (like raising body temperature) maintain homeostasis during illness. Related Phenomena: • Show students a video on the skin shooter gun and have them write a notice/wonder chart • Open discussion about stem cells and unspecialized versus specialized cells • Intro to cellular homeostasis could be the prompt <i>"Do you feel more hydrated or less hydrated after drinking a Snapple?"</i>		
Pacing: 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-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.		
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.	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: <i>This Disciplinary Core Idea is also addressed by HS-LS3-1.</i>) • 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	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 ----- <i>Connections to Engineering, Technology, and Applications of Science</i>

----- 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.		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.	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)
<i>What are stem cells and what roles do they play in the body?</i> <i>What is the structure of the cell membrane and how does it help aid in its function?</i> <i>How does the cell membrane control what enters and leaves the cell?</i> <i>How is homeostasis maintained in different environments?</i> <i>How does the hierarchical organization of cells into tissues, organs, and systems allow multicellular organisms to function and survive?</i>	Student will be able to: Students will be able to describe the hierarchical organization of multicellular organisms, from cells to tissues, organs, and organ systems. Students will be able to explain how each level of biological organization is made up of parts that contribute to the function of the next level. Students will be able to define feedback mechanisms and describe their role in maintaining homeostasis in living systems. Students will be able to differentiate between positive and negative feedback and give examples of each in biological systems.	Laboratory Investigations/Activities: <i>Application of scientific and technical skills</i> <u>Cell Structure & Function:</u> Students will demonstrate the ability to use a microscope and will create, process and observe wet mount slides. <i>Inquiry investigation where students will analyze data and construct claims based upon evidence</i> <u>Osmosis with Eggs Lab:</u> Students will subject raw eggs with the shell removed to different solutions to determine the osmotic movement of water. <u>Diffusion Discovery Lab</u> – In this inquiry, students explore various functions of cell membrane semi permeability. <u>Diffusion STEM Gizmo:</u> Students	- Create graphs of data from scientific evidence. (formative) - Construct a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it. (formative) - Research and communicate information about body systems in a gallery walk. (formative) - Carry out an investigation to determine the effect of various solutions on a cell. (formative) - Lab analysis and scientific explanation

	● Students will be able to analyze how feedback mechanisms help organisms maintain stable internal conditions despite changes in the external environment. ● Students will be able to identify real-world examples of feedback mechanisms (e.g., body temperature regulation, blood sugar levels) and explain how they work. ● Students will be able to provide examples of cellular homeostasis compared to holistic body homeostasis	virtually investigate types of cell transport and apply this to the diagnosis and treatment of a dog who cannot seem to gain weight. <i>Effective Communication Skills:</i> ● Body Systems poster gallery walk In this hands-on biology lesson, students model the hierarchical organization of multicellular organisms—from cells to organ systems. Working in groups, they create visual or 3D models of a body system and explain how each level supports overall function. A gallery walk and peer feedback deepen understanding of how systems interact. ● Homerostasis: in this lab, students attempt to keep a model of a person “Homer” at equilibrium for water concentration and volume as well as temperature. ● Digestion to Diffusion Worksheet: Connects the food we eat to their smallest chemical components and absorption into the blood. Also depicts change in insulin as result and discusses homeostasis. <i>Scientist Spotlight:</i> ● Dr. Ben Barres – Neuroscience Pioneer & Gender Champion.	(CER) of egg cell size data to determine cell environment- hypertonic, hypotonic, isotonic. (formative) ● Summative written assessment <i>Alternative Assessment Options:</i> ● Constructing a labeled model illustrating interactions among body systems during illness. ● Creating an infographic explaining homeostasis and feedback mechanisms. ● Recording a video explanation of the influenza phenomenon. ● Completing an oral CER explaining how multiple organ systems maintain homeostasis. ● Designing a digital concept map illustrating interactions among the immune, nervous, circulatory, and endocrine systems. ● Creating an annotated diagram explaining diffusion, osmosis, and membrane transport
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		- Stanford Medicine article– Ben Barres & his work on glial cells <i>Diversity, Equity, and Inclusion:</i> • The importance of Increasing the Diversity of Cells Used in Medical Research	
Interdisciplinary Connections	ELA RI.CR.9–10.1: Substantially engage with nonfiction text by making relevant, evidence-based inferences and drawing conclusions. RI.IT.9–10.3: Analyze how an author unfolds ideas, events, or explanations to develop claims, reasoning, and evidence. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. SL.PE.9–10.1: Initiate and participate effectively in a range of collaborative discussions with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Mathematics N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. F.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. S.ID.C.9: Distinguish between correlation and causation. Social Studies 6.1.12.HistoryCC.13.a: Evaluate the effectiveness of public health initiatives in addressing societal challenges. 6.1.12.GeoHE.16.a: Explain why natural resources (i.e., food and water) continue to be a source of conflict and analyze issues concerning distribution, sustainability, and public health. 6.3.12.CivicsPD.1: Develop and evaluate solutions to local, national, or global issues by analyzing public policy and considering multiple perspectives. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness.		

	2.3.12.HCDM.2: Provide examples of how drugs and medication mimic or block the action of certain cells in the body, and how abusing drugs can affect the human body. 2.3.12.HCDM.7: Analyze how medical advances, vaccinations, and disease prevention strategies improve individual and public health. Visual & Performing Arts 1.5.12prof.Cr1a: Use multiple approaches to begin creative endeavors. 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision. 1.5.12prof.Pr5a: Develop and refine artistic techniques and work for presentation.		
Career Readiness, Life Literacies, and Key Skills	● 9.1.12.RM.3: Analyze the relationship between risk and protective factors and how they influence decision-making. ● 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. ● 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. ● 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. ● 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving. ● 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. ● 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue. ● 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.		
Computer Science and Design Thinking	● 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real-world phenomena. ● 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.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented

● Display labeled diagrams of cell structures, organ systems, and feedback mechanisms. ● Pre-teach academic vocabulary using illustrated vocabulary cards for terms such as homeostasis, diffusion, osmosis, selectively permeable membrane, negative feedback, positive feedback, and equilibrium. ● Provide bilingual glossaries or translated vocabulary supports when appropriate. ● Use color-coded diagrams to illustrate interactions among the immune, nervous, circulatory, and endocrine systems. ● Provide sentence frames for CER writing and scientific explanations. ● Allow students to demonstrate understanding through labeled diagrams or oral explanations before completing written responses. ● Pair students with supportive lab partners during microscopy, diffusion, and osmosis investigations. ● Provide visual laboratory procedures with photographs or diagrams for each investigation.	● Provide guided notes with partially completed diagrams of cells, organ systems, and feedback loops. ● Provide scaffolded graphic organizers comparing passive transport, active transport, diffusion, osmosis, and homeostasis. ● Use enlarged microscope images or digital microscope simulations when appropriate. ● Provide partially completed data tables for diffusion and osmosis laboratory investigations. ● Chunk laboratory procedures into smaller steps with frequent teacher check-ins. ● Provide extended time for laboratory investigations, CER writing, quizzes, and summative assessments. ● Allow alternative methods of demonstrating understanding such as oral presentations, annotated diagrams, digital models, or recorded explanations. ● Provide digital copies of notes compatible with text-to-speech software.	● Provide guided practice interpreting diffusion and osmosis diagrams before independent work. ● Model one complete CER response using homeostasis data before assigning independent CER writing. ● Use teacher-created anchor charts illustrating body systems, feedback loops, and membrane transport. ● Provide scaffolded reading guides for articles related to influenza, homeostasis, and medical research. ● Use graphic organizers to connect organ systems involved in maintaining homeostasis. ● Provide partially completed body system concept maps. ● Use frequent formative check-ins during laboratory investigations and modeling activities. ● Reduce the amount of data analyzed during initial laboratory practice while maintaining the learning objective. ● Incorporate student choice ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Investigate disorders that disrupt homeostasis (e.g., diabetes, cystic fibrosis, autoimmune disorders) and present evidence-based explanations. ● Analyze current scientific research related to homeostasis, immunology, or biomedical engineering. ● Design and evaluate an investigation that examines factors affecting diffusion or osmosis. ● Develop a systems model illustrating interactions among multiple organ systems during illness. ● Compare positive and negative feedback mechanisms in multiple physiological systems. ● Research advances in regenerative medicine, stem cell biology, or biomedical technologies related to maintaining homeostasis. ● Lead peer discussions during body systems
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● 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.	● Allow students to complete the Diffusion Gizmo with teacher-guided checkpoints. ● 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.		modeling or laboratory investigations. ● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements. ● Engage in a more complex laboratory activity or project.
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Biology Enhanced

Unit 4: Cell Energy / Climate Change

Anchoring Phenomena: Scientists at the Mauna Loa Observatory have measured a consistent year-to-year increase in atmospheric carbon dioxide, along with seasonal fluctuations in carbon dioxide levels.

- Student observations of [atmospheric CO2](#) taken from Moana Loa climate station (Notice/Wonder)

Related Phenomena:

- **For Cell Respiration:** *“Is using supplemental oxygen in athletic events giving the body an unfair advantage — or is it just science helping performance?”*
- **For Photosynthesis/climate change:** *“Why are bigger storms happening more often—and what does that have to do with photosynthesis and carbon dioxide?”*
- CR: As an introduction to cellular respiration, show a video called [“Climbing Everest”](#). Students will create a notice/wonder chart
- PS: Show clip of video [“How to Grow a Planet”](#). Students will create a notice/wonder chart
- Climate change: Show students NOAA data on [“billion dollar weather events”](#) and have them answer the prompt questions

Pacing: 5 weeks

New Jersey Student Learning Standards (NJSLS)

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

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 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.	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. - 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. (<i>secondary</i>) - The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (<i>secondary</i>) 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.	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 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. <i>Connections to Nature of Science</i>

		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 do photosynthesis and cellular respiration work together to support life and cycle carbon through Earth’s systems? - Why do organisms rely on different forms of respiration in different environments, and how does this affect their survival and function? - In what ways do human activities like burning fossil fuels and deforestation disrupt natural carbon cycling and impact Earth’s climate? - 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	Students will be able to describe the process of photosynthesis and identify the reactants (carbon dioxide and water) and products (sugars and oxygen). Students will be able to explain how light energy is converted into stored chemical energy through photosynthesis. Students will be able to describe how chemical elements are rearranged during chemical reactions to form new compounds in living systems. Students will be able to explain the role of cellular respiration in breaking down food molecules to release energy for cellular functions.	Laboratory Investigations/Activities: <i>Inquiry investigation where students will analyze data and construct claims based upon evidence:</i> <u>Cellular Respiration:</u> Exercise/Heart Rate Lab: Students carry out investigations to measure heart rate with and without exercise and analyze data Wall Squats Competition & Lance Armstrong Article Tennis Ball Lactic Acid Lab Students carry out investigations to measure the amount of “burn” felt doing various activities and analyze data. Cell Respiration STEM Case Lab: Explore Learning Gizmo: Students utilize knowledge of inputs and outputs of cellular respiration to determine what type of poison was used on the CIA agent	- Carry out investigations to measure heart rate with and without exercise and analyze data (formative) - Measure and compare the types and quantities of pigments found in plant leaves. (formative) - Determine which color light helps plants grow best and defend their claim with a CER (formative) - Collect and analyze data from laboratory investigations of photosynthesis and/or cellular respiration (formative) - Use a mathematical model to describe the cycling of matter and

would result in lower carbon emissions? • <i>What does climate change mean for our future?</i>	• Students will be able to distinguish between aerobic and anaerobic respiration and identify the conditions under which each occurs. • Students will be able to analyze how energy flows through systems of interacting molecules and how it is used to maintain body functions, such as muscle activity and body temperature. • Students will be able to explain how photosynthesis and cellular respiration work together as part of the carbon cycle. • Students will be able to illustrate how carbon is cycled among the biosphere, atmosphere, oceans, and geosphere through biological and physical processes. • Students will be able to connect environmental changes and geologic events to shifts in population size and human societal development over time. • Students will be able to analyze how human activities, such as fossil fuel combustion and deforestation, contribute to increased atmospheric	• Alcohol Fermentation Lab: Utilizing fermentation tubes, measure and analyze the amount of CO₂ that is generated by yeast with and without sugar <u>Photosynthesis:</u> • Spinach Chromatography Lab: Measure and compare the types and quantities of pigments found in plant leaves. • Grow plants in different light (online) and/or with Wisconsin Fast Plants: Determine which color light helps plants grow best and defend their claim with a CER • Spinach and Cockroach Lab with Probes CO₂: Collect and analyze CO₂ data from spinach and cockroach in light and dark, together and alone; investigating when they are doing photosynthesis and/or cellular respiration • Photosynthesis STEM Case Lab: Students explore factors that affect photosynthesis and investigate why coral reefs are bleaching in an aquatic ecosystem <u>Climate change:</u> • Trends and oscillations • Environmental Impact • Photosynthesis & Emission-Free Energy	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. (formative) • 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. (formative) • Cite specific textual evidence to support an explanation for the cycling of matter and flow of energy in aerobic
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	carbon dioxide and impact climate. ● Students will be able to illustrate how carbon moves through the biosphere, atmosphere, oceans, and geosphere via various Earth system processes. ● Students will be able to explain how photosynthesis and cellular respiration provide energy necessary for life processes. ● Students will be able to describe the role of photosynthesis and cellular respiration in the carbon cycle. ● Students will be able to evaluate the impact of natural hazards (e.g., volcanic eruptions, earthquakes, droughts) on human populations and historical events. ● Students will be able to explain how changes in resource availability (e.g., water, fertile land, minerals) have influenced patterns of human settlement, development, and migration. ● Students will be able to connect environmental changes and geologic events to shifts in population size and	● <u>Engineering Photosynthesis as a solution to Climate Change</u> ● ENGINEERING/MODELING ACTIVITY (TBD) <i>Diversity, Equity, and Inclusion:</i> ● <i>Students will review the following resources to collect evidence illustrating how climate change disproportionately impacts socially vulnerable populations throughout the world.</i> - <u>The Role of the Scientific Community in Strengthening Disability-Inclusive Climate Resilience</u> - <u>Climate Change and the Health of People with Disabilities</u> - <u>Disproportionate Impacts of Climate Change on Socially Vulnerable Populations</u>	and anaerobic conditions, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (formative) ● Summative written assessment ● Linkit! Form B (Benchmark) Alternative Assessment Options: ● Students create a model illustrating the relationship among photosynthesis, cellular respiration, and the carbon cycle, and explain how matter and energy move through living systems. ● Students complete a (CER) response using Mauna Loa atmospheric carbon dioxide data to explain why carbon dioxide levels fluctuate seasonally while increasing over time. ● Students develop an infographic or digital presentation explaining how human activities influence the carbon
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	human societal development over time.		cycle and evaluate one evidence-based strategy for reducing atmospheric carbon dioxide. ● Students analyze the cyanide poisoning phenomenon and construct a scientific explanation describing how cyanide disrupts cellular respiration and prevents cells from producing ATP. ● Students create a public awareness brochure, video, or slideshow explaining the importance of photosynthesis and cellular respiration in maintaining Earth's carbon cycle and supporting life.
Interdisciplinary Connections	ELA RI.CR.9–10.1: Substantially engage with nonfiction text by making relevant, evidence-based inferences and drawing conclusions. RI.IT.9–10.3: Analyze how an author unfolds ideas, events, or explanations to develop claims, reasoning, and evidence. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. SL.PE.9–10.1: Initiate and participate effectively in a range of collaborative discussions with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.		

	Mathematics N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. F.IF.B.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. S.ID.C.9: Distinguish between correlation and causation. Social Studies 6.1.12.GeoHE.16.a: Explain why natural resources (i.e., fossil fuels, food, and water) continue to be a source of conflict and analyze how the United States and other nations have addressed issues concerning the distribution and sustainability of natural resources and climate change. 6.3.12.CivicsPD.1: Develop and evaluate solutions to local, national, or global issues by analyzing public policy and considering multiple perspectives. 6.3.12.GeoGI.1: Collaborate to propose sustainable solutions that address environmental challenges at local, regional, or global scales. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.3.12.HCDM.1: Analyze the relationship between individual behaviors, environmental factors, and public health. 2.3.12.HCDM.2: Provide examples of how drugs and medication mimic or block the action of certain cells in the body, and how abusing drugs can affect the human body. Visual & Performing Arts 1.5.12prof.Cr1a: Use multiple approaches to begin creative endeavors. 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision. 1.5.12prof.Pr5a: Develop and refine artistic techniques and work for presentation.
Career Readiness, Life Literacies, and Key Skills	9.1.12.RM.3: Analyze the relationship between risk and protective factors and how they influence decision-making. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 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. 9.4.12.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.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change. 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.		
Computer Science and Design Thinking	8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real-world phenomena, including climate change. 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.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
● Display labeled diagrams of chloroplasts, mitochondria, the carbon cycle, and the photosynthesis and cellular respiration equations. ● Pre-teach academic vocabulary using illustrated vocabulary cards for terms such as ATP, glucose, chloroplast, mitochondria, cellular respiration, photosynthesis, carbon cycle, carbon dioxide, climate change, and fossil fuels. ● Provide bilingual glossaries or translated vocabulary supports when appropriate. ● Use color-coded diagrams to illustrate the movement of	● Provide guided notes with partially completed diagrams of photosynthesis, cellular respiration, and the carbon cycle. ● Provide scaffolded graphic organizers comparing photosynthesis and cellular respiration. ● Use color-coded models to reinforce the flow of matter and energy. ● Provide partially completed data tables and graph templates for Mauna Loa carbon dioxide data analysis.	● Provide guided practice interpreting carbon cycle diagrams before independent work. ● Model one complete CER using Mauna Loa atmospheric carbon dioxide data before assigning independent writing. ● Use teacher-created anchor charts illustrating the relationships among photosynthesis, cellular respiration, ATP production, and the carbon cycle. ● Provide scaffolded reading guides for climate change and cellular respiration articles. ● Provide graphic organizers connecting photosynthesis,	● Analyze authentic climate datasets from NOAA, NASA, or the Mauna Loa Observatory and compare trends over multiple decades. ● Evaluate current scientific research on carbon sequestration, renewable energy, or climate mitigation strategies. ● Design and defend an evidence-based proposal for reducing atmospheric carbon dioxide while considering ecological,

carbon and energy through biological and Earth systems. ● Provide sentence frames for CER writing and scientific explanations. ● Pair students with supportive lab partners during laboratory investigations and data analysis activities. ● Provide visual laboratory procedures with photographs or diagrams for each investigation. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before project activity. ● Assign a native language partner.	● Chunk complex scientific readings into smaller sections with guiding questions. ● Provide extended time for laboratory investigations, CER writing, quizzes, and summative assessments. ● Allow alternative methods of demonstrating understanding such as oral presentations, annotated diagrams, digital models, or recorded explanations. ● Provide digital copies of notes compatible with text-to-speech software. ● 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	cellular respiration, and atmospheric carbon dioxide. ● Use frequent formative check-ins during graphing and data analysis activities. ● Reduce the amount of data analyzed during initial graphing activities while maintaining the learning objective. ● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	economic, and societal trade-offs. ● Investigate how toxins such as cyanide inhibit cellular respiration at the molecular level and present findings using scientific literature. ● Develop a systems model illustrating interactions among photosynthesis, cellular respiration, climate change, and the global carbon cycle. ● 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.
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| | time management.
• Work with a partner. | | |
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Biology Enhanced

Unit 5: Molecular Genetics

Anchoring Phenomena: Animals can be genetically modified to glow in the dark.

- Student observations of glow in the dark cat/chicken/sheep/mice/etc. (notice/wonder)

Related Phenomena:

- For DNA intro: Use the GM twins [Chinese CRISPR](#)
[Nature vs Nurture](#) Spectrum Activity, are your genes your destiny? Post-discussion video on identical twin studies
[DNA Artist](#)- Faces from gum
- For Protein Synthesis: Use [Jimmy Kimmel](#) GMO video clip
- For GMO: Arctic Apples (Apples that do not brown)

Pacing: 4 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-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.

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	LS1.A: Structure and Function • Systems of specialized cells within organisms help them perform the essential functions of life. • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. 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	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.

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.

(fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.

LS3.A: Inheritance of Traits

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

LS3.B: Variation of Traits

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

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

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

Developing and Using Models

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

Asking Questions and Defining Problems

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

Engaging in Argument from Evidence

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

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.

Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
● <i>Is DNA your destiny?</i> ● <i>How is genetic information stored in DNA?</i> ● <i>How does the DNA structure relate its replication?</i> ● <i>How does DNA contribute to the traits that make you who you are?</i> ● <i>Do mutations affect the overall survival of a species?</i> ● <i>How does gene regulation affect our daily functions?</i> ● <i>How can we manipulate protein synthesis to advance quality of human life?</i>	● Students will be able to explain how systems of specialized cells work together to perform essential life functions in multicellular organisms. ● Students will be able to describe the structure and function of DNA as the genetic material in cells. ● Students will be able to define genes as specific segments of DNA that code for proteins. ● Students will be able to explain how proteins, coded by genes, carry out most cellular functions. ● Students will be able to describe how chromosomes are composed of long DNA	<i>Application of scientific and technical skills</i> ● DNA extraction: extracting DNA from an organism such as a strawberry or human cheek cells. ● Electrophoresis Lab: “In Search of My Father”-Edvotek. Using gel electrophoresis to separate biological molecules like DNA and proteins. <i>Activities that create models of biological concepts:</i> ● DNA Kinnex: Students use repeating monomers to create a model of double helix DNA. ● CHNOPS: Students model protein synthesis by deciphering a code to transcribe then translate into a protein that gives a fictional	<i>Please link assessment examples when available</i> ● Analyze and interpret data/evidence obtained from DNA experiments (i.e., Griffith, Avery, Hershey, & Chase) (formative) ● Model DNA structure, replication, transcription, & translation (formative) ● Explain/argue the need for replication (support the argument with evidence) (formative) ● Model the flow of information from DNA to protein ● Construct an amino acid sequence using the

	molecules containing many genes. ● Students will be able to analyze how gene expression can vary between different cell types despite having identical DNA. ● Students will be able to distinguish between coding regions of DNA and non-coding regions with regulatory, structural, or unknown functions. ● Students will be able to explain how meiosis and crossing over create genetic variation during sexual reproduction. ● Students will be able to identify mutations as changes in DNA that can arise from errors in replication or environmental factors. ● Students will be able to describe how genetic mutations can contribute to variation and may be inherited if they are viable.	creature genetic traits. ● Codon Bingo: Students get boards with Amino Acid codes. When given the DNA code they must convert to RNA and use the codon chart to determine the amino acid. <i>Inquiry investigation where students will analyze data and construct claims based upon evidence</i> ● Protein Synthesis STEM Case- Students virtually investigate protein synthesis and provide a diagnosis and treatment for what is causing a child to have immune system disease. <i>Scientist Spotlights:</i> ● Dr. Rosalind Franklin – How her stolen data led to the discovery of the structure of DNA.	codon chart (formative) ● Model mutations and construct explanations supported by evidence as to how they can be beneficial, harmful, or neutral. (formative) ● Obtain and evaluate information and use it to argue a point of view on a controversial biological, societal, and ethical issue. (formative) ● Summative Written Exam Alternative Assessment Options: ● Students create a labeled model illustrating the structure of DNA and explain how genetic information is used to produce proteins. ● Students complete a CER using teacher-provided evidence to explain how a mutation can affect protein structure and function and determine whether the mutation is beneficial, harmful, or neutral. ● Students develop an infographic or digital
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			presentation explaining the process of DNA replication, transcription, and translation using labeled diagrams and scientific vocabulary. ● Students analyze a genetic engineering case study (e.g., CRISPR, genetically modified organisms, or Arctic apples) and develop an evidence-based explanation describing the benefits, risks, and ethical considerations. ● Students create a storyboard, comic strip, slideshow, or short video illustrating how genetic information flows from DNA to RNA to proteins and how this process determines observable traits.
Interdisciplinary Connections	ELA RI.CR.9–10.1: Substantially engage with nonfiction text by making relevant, evidence-based inferences and drawing conclusions. RI.IT.9–10.3: Analyze how an author unfolds ideas, events, or explanations to develop claims, reasoning, and evidence. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.		

	SL.PE.9–10.1: Initiate and participate effectively in a range of collaborative discussions with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Mathematics N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. S.ID.C.9: Distinguish between correlation and causation. Social Studies 6.3.12.CivicsPD.1: Develop and evaluate solutions to local, national, or global issues by analyzing public policy and considering multiple perspectives. 6.3.12.HistorySE.14.a: Explore the role of innovation and scientific advancement in addressing global challenges. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.3.12.HCDM.7: Analyze how medical advances, vaccinations, and disease prevention strategies improve individual and public health. Visual & Performing Arts 1.5.12prof.Cr1a: Use multiple approaches to begin creative endeavors. 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision.
Career Readiness, Life Literacies, and Key Skills	9.1.12.RM.3: Analyze the relationship between risk and protective factors and how they influence decision-making. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 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. 9.4.12.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.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions. 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue.
Computer Science and Design Thinking	8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real-world phenomena.

	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.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
● Display labeled diagrams of DNA structure, chromosomes, genes, RNA, and protein synthesis. ● Pre-teach academic vocabulary using illustrated vocabulary cards for terms such as DNA, RNA, gene, chromosome, mutation, transcription, translation, codon, amino acid, protein synthesis, and CRISPR. ● Provide bilingual glossaries or translated vocabulary supports when appropriate. ● Use color-coded models to distinguish DNA, mRNA, tRNA, amino acids, and proteins. ● Provide sentence frames for CER writing and biotechnology discussions. ● Pair students with supportive lab partners during DNA modeling and Codon Bingo activities. ● Provide visual directions with diagrams for all molecular modeling activities. ● Use body movement and gestures to further explain concepts to students. ● Restate design steps aloud before	● Provide guided notes with partially completed diagrams of DNA structure and protein synthesis. ● Provide scaffolded graphic organizers comparing DNA replication, transcription, and translation. ● Use color-coded codon charts and protein synthesis flowcharts. ● Provide partially completed DNA sequences during transcription and translation practice. ● Chunk multi-step molecular processes into smaller learning segments with frequent teacher check-ins. ● Provide extended time for Codon Bingo, mutation analysis, CER writing, quizzes, and summative assessments. ● Allow alternative methods of demonstrating understanding such as oral presentations, annotated diagrams, digital models, or recorded explanations.	● Provide guided practice using codon charts before independent protein synthesis activities. ● Model one complete transcription and translation example before assigning independent practice. ● Use teacher-created anchor charts illustrating the flow of genetic information from DNA to RNA to proteins. ● Provide scaffolded reading guides for biotechnology and genetics articles. ● Provide graphic organizers connecting DNA, genes, proteins, mutations, and observable traits. ● Use frequent formative check-ins during DNA modeling and mutation analysis activities. ● Provide partially completed mutation practice examples before independent analysis. ● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal, and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	● Investigate current applications of CRISPR, gene therapy, or precision medicine using scientific literature. ● Analyze authentic DNA sequences and predict the effects of different mutation types on protein structure and function. ● Research current ethical issues involving biotechnology and develop an evidence-based position supported by peer-reviewed scientific sources. ● Design and evaluate a hypothetical gene-editing solution for a genetic disorder while considering ethical, societal, and scientific implications. ● Compare multiple biotechnology applications and evaluate their benefits, limitations, and long-term impacts.

project activity. ● Assign a native language partner.	● Provide digital copies of notes compatible with text-to-speech software. ● 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		● Lead peer discussions during biotechnology case studies or ethical debates. ● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of lab requirements.
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Biology Enhanced		
Unit 6: Cell Division & Cancer		
Anchoring Phenomena: Cancer Statistics Analysis “Who gets cancer and why? What can we do about it?” using this introduction		
Related Phenomena: How old are the cells in your body? Elephant p53 Article		
Pacing: 3 weeks		
New Jersey Student Learning Standards (NJSLS)		
HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. 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 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
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. Asking Questions and Defining Problems - Ask questions that arise from examining models or a theory to clarify relationships.	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.	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 correlation and make claims about specific causes and effects.

- 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.A: Inheritance of Traits - Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. LS3.B: Variation of Traits - In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. - Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors. LS1.C: Organization for Matter and Energy Flow in Organisms - The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. - As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ETS1.A: Defining and Delimiting Engineering Problems - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. - Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be	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. ----- <i>Connections to Engineering, Technology, and Applications of Science</i> 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.
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		addressed through engineering. These global challenges also may have manifestations in local communities.	
Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
• <i>Why do cells need to divide and how do they do it?</i> • <i>How do cells control the cell cycle and what happens when those controls break down?</i> • <i>How are the steps of mitosis important for equal division of nuclear material?</i> • <i>How can we reduce our chances of getting cancer?</i>	• Students will be able to explain how systems of specialized cells work together to carry out the essential functions of life. • Students will be able to describe DNA as the genetic material found in all cells and explain its role in storing genetic information. • Students will be able to define genes as specific segments of DNA that provide instructions for building proteins. • Students will be able to explain how proteins carry out most cellular functions and contribute to the traits of an organism. • Students will be able to describe how chromosomes are composed of long DNA molecules that contain many genes. • Students will be able to explain that all cells in an organism have the same genetic content, but gene	<i>Activities that create models of biological concepts and effectively communicate ideas:</i> • Cancer Project: Students have an abundance of free choice options on ways to represent concepts related to the cell cycle and cancer through movies, PSAs, brochures, models, comic strips, and more. <i>Inquiry investigation where students will analyze data and construct claims</i> • Agar Cubes: Using cubes made from agar (or paper blocks filled with sand) students measure and compare the rate of diffusion of materials through the agar according to the size of the cube. They then calculate the surface area and volume ratio. <i>Inquiry investigation where students will analyze data and construct claims based upon evidence and apply scientific and technical skills</i> • Onion Root Tip Lab: Students will observe and analyze (cell models)	• Develop and use a model of cell cycle to illustrate function and malfunction. (Formative) • Analyze and interpret cell cycle data. (Formative) • Create a mathematical model to demonstrate the importance of cell size. (Formative) • Construct explanations pertaining to different forms of cancer and design treatments. • Obtain, evaluate, and communicate information pertaining to cancer. (Formative) • Obtain and evaluate information and use it to argue a point of view on a controversial biological, societal, and ethical issue. (Formative) • Summative Written Assessment

	expression can vary depending on the cell type and regulatory mechanisms. ● Students will be able to distinguish between coding regions of DNA that produce proteins and non-coding regions that have regulatory, structural, or unknown functions. ● Students will be able to describe how meiosis and crossing over during sexual reproduction increase genetic variation. ● Students will be able to explain how mutations can result from errors in DNA replication or environmental influences. ● Students will be able to identify mutations as a source of genetic variation and explain how some mutations can be inherited if they are viable.	slides of onion cells and determine which phase of mitosis the cells are in. ● <u>A Look at Cancer Alley, Louisiana</u> – students analyze real-world data to learn more about Cancer Alley and take concrete actions to address environmental injustice. <i>Scientist Spotlights:</i> ● <u>Dr. Sara Rankin</u> – a neurodiverse scientist/professor of Leukocyte and stem cell biology. ● <u>Neurodiversity Celebration</u> – Dr. Sara Rankin. ● <u>Dr. Dave Bryant and Dr. Amy Tibbo</u> – LGBTQ+ cancer research scientists	Alternative Assessment Options: ● Students create a labeled model illustrating the stages of the cell cycle and mitosis and explain how cell division supports growth, repair, and maintenance in multicellular organisms. ● Students complete a CER using teacher-provided evidence to explain how mutations in cell cycle regulatory genes can lead to uncontrolled cell division and cancer. ● Students develop an infographic, brochure, or digital presentation explaining one type of cancer, including its causes, risk factors, methods of prevention, and available treatment options. ● Students analyze a case study comparing normal cells and cancer cells and construct an evidence-based explanation for how changes in the cell cycle contribute to tumor
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			formation. Students evaluate a current cancer treatment (e.g., chemotherapy, radiation therapy, immunotherapy, or targeted therapy) and develop a claim supported by scientific evidence explaining how the treatment targets rapidly dividing cells or specific cellular processes.
Interdisciplinary Connections	ELA RI.CR.9–10.1: Cite a range of thorough textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what an informational text says explicitly and inferentially. RI.IT.9–10.3: Analyze how an author unfolds ideas throughout the text, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. SL.PE.9–10.1: Initiate and participate effectively in a range of collaborative discussions with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Mathematics N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. S.ID.C.9: Distinguish between correlation and causation. Social Studies 6.3.12.CivicsPD.1: Develop and evaluate solutions to local, national, or global issues by analyzing public policy and considering multiple perspectives. 6.3.12.HistorySE.14.a: Explore the role of innovation and scientific advancement in addressing global challenges.		

	Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.3.12.HCDM.7: Analyze how medical advances, vaccinations, screening, and disease prevention strategies improve individual and public health. Visual & Performing Arts 1.5.12prof.Cr1a: Use multiple approaches to begin creative endeavors. 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision.		
Career Readiness, Life Literacies, and Key Skills	9.1.12.RM.3: Analyze the relationship between risk and protective factors and how they influence decision-making. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 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.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue.		
Computer Science and Design Thinking	8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real-world phenomena. 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.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
● Provide labeled diagrams of the cell cycle, mitosis, and cytokinesis with key vocabulary in English and the student's native language. ● Use color-coded chromosome models and visual animations to reinforce each stage of mitosis. ● Pre-teach academic vocabulary (chromosome, chromatid, spindle fiber, cytokinesis, differentiation, tumor, mutation, cancer) using visuals and word banks. ● Model the steps of mitosis with hands-on manipulatives before	● Provide guided notes outlining the stages of the cell cycle and mitosis. ● Chunk complex diagrams and cancer case studies into manageable sections. ● Use graphic organizers to compare normal cell division and cancer cell division. ● Provide extended time for laboratory investigations, projects, and assessments. ● Offer alternative assessment choices such as models,	● Use interactive cell cycle models and animations before introducing abstract concepts. ● Reinforce learning with repeated practice sequencing the stages of mitosis. ● Provide partially completed diagrams and guided graphic organizers. ● Use teacher-provided evidence for CER writing assignments. ● Incorporate frequent formative assessments such as exit tickets, matching activities, and quick checks for understanding.	● Investigate how mutations in tumor suppressor genes and proto-oncogenes contribute to cancer development using scientific literature. ● Analyze authentic cancer incidence or survival data to identify trends and support evidence-based conclusions. ● Research emerging cancer treatments such as immunotherapy, CAR-T cell

independent practice. ● Pair students with supportive peers during laboratory activities and cancer case study discussions. ● Provide sentence frames for CER responses and scientific explanations. ● Allow students to demonstrate understanding through labeled diagrams, oral explanations, or digital presentations. ● 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.	diagrams, or oral presentations. ● Provide frequent teacher check-ins during modeling activities and laboratory investigations. ● Reduce distractions during assessments and allow flexible seating as needed. ● Provide adequate scaffolds. ● 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	● Connect cancer biology to real-world examples, current medical treatments, and healthy lifestyle choices to increase engagement. ● Provide opportunities for small-group instruction and peer collaboration. ● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal, and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	therapy, targeted therapy, or precision medicine and evaluate their effectiveness. ● Design and defend an evidence-based proposal for improving cancer prevention, early detection, or treatment using engineering design principles. ● Lead small-group discussions analyzing the Elephant p53 phenomenon and how comparative genomics informs cancer research. ● Evaluate ethical issues surrounding genetic testing, personalized medicine, and cancer research using peer-reviewed scientific sources. ● Develop an extended laboratory investigation or presentation incorporating additional scientific research beyond course expectations. ● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of lab requirements.
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Biology Enhanced		
Unit 7: Mendelian Genetics & Human Genetics		
Anchoring Phenomena: In 2017, Illinois twins were born with drastically different skin tones. ● Show photo/video (first 40 seconds only) of twins with drastically different skin tones and have them write their notice and wonder. ○ “Why do children often look similar to their parents but never exactly the same?” Related Phenomena: ● <i>How can you have a trait that neither of your parents has?</i>		
Pacing: 4 weeks		
New Jersey Student Learning Standards (NJSLS)		
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. HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.		
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 correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	LS1.A: Structure and Function ● Systems of specialized cells within organisms help them perform the essential functions of life. ● All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. LS3.A: Inheritance of Traits ● Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species’ characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.	Structure and Function ● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. Cause and Effect ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. 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).

	LS3.B: Variation of Traits - Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors. LS4.B: Natural Selection - Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. - The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. LS4.C: Adaptation - Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. - Adaptation also means that the distribution of traits in a population can change when conditions change.	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. ----- <i>Connections to Nature of Science</i> 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.
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Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
<i>How can you determine the probability of traits passed on from parents to offspring?</i> <i>What is the relationship between genotypes and phenotypes?</i>	Students will be able to explain how environmental factors can influence the expression of traits in organisms.	Laboratory Investigations/Activities: <i>Inquiry investigation where students will analyze data and construct claims based upon evidence:</i> <u>“Make a Baby” Activity:</u> Student pairs flip a coin to represent the	Construct a karyotype from an amniocentesis by ordering homologous chromosomes; interpret the karyotype

• <i>How can you recognize various patterns of inheritance?</i> • <i>How does the environment play a role in the phenotype?</i>	• Students will be able to describe how both genetic and environmental factors contribute to the variation of traits within a population. • Students will be able to analyze examples of traits that are influenced by environmental conditions (e.g., height, or weight). • Students will be able to explain how the probability of a trait appearing in a population depends on the interaction between genes and the environment. • Students will be able to evaluate how variation and distribution of traits in a population result from a combination of inherited genetic information and environmental influences.	gametes of parents. They collect data on their baby's traits and then create a picture of the baby. • "Meowsis" STEM Case Gizmo Explore Learning: Students explore how gametes are formed during meiosis and then must determine why a male cat that displays calico fur colors. • Inventory of Your Traits Activity: Students examine their own physical traits, record their data and compare with others in the class. Calculate the most common traits and relate to whether dominant or recessive. • Genetics II Picture Project: Students will use personal pictures of themselves and family to self-reflect on their own genetic traits and show evidence of how they inherited various genetic traits. • Blood Type- Murder and Genetics Lab: Students determine the blood types of the suspects and build a pedigree chart in order to determine who killed Capt Relish • "Meowsis" STEM Case Gizmo Explore Learning: Students explore how gametes are formed during meiosis and then must determine why a male cat that displays calico fur colors. • Karyotype Lab: Student pairs are given a male and female chromosomes to examine and create	to determine the presence of a genetic disorder. (formative) • Model how genetic information flows from generation to generation via meiosis and fertilization and that each parent contributes an equal amount of genetic information. (formative) • Obtain, evaluate, and communicate information on a genetic disorder and determine the inheritance pattern. (formative) • Develop and interpret pedigree charts (formative) • Analyze and compare evidence for different types of inheritance. (formative) • Predict the results of a monohybrid/dihybrid Punnett Square using a test cross. (formative) • Solve Punnett square word problems using mathematical and computational thinking
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		karyotype. They then interpret and determine what traits and genetic disorders they are carrying. They can then research the disorder the child has. <i>Effective Communication Skills:</i> • <u>Presentation on Genetic Disorder:</u> Students research a human genetic disorder and prepare a presentation to share with class. • <u>Family Pedigree Project:</u> Students choose a trait and record it through several generations. Research the trait and describe how it is represented in their family • <u>Dragon Genome Project:</u> Students are given dragon parents with different traits, they create possible gametes and then randomly pair up the gametes to make dragon babies. Create colorful posters displaying the traits and present. <i>Scientist Spotlights:</i> • <u>Dr. Julie Makani</u> – Principal investigator for the Sickle Pan-African research Consortium in Tanzania. • <u>Dr. Derek Braun</u> – Deaf scientist who teaches & performs genetic research.	to determine genotype and phenotype of offspring and differentiate between and determine probabilities of incomplete dominance, codominance, multiple alleles, polygenic, sex linked traits. (formative) • Use mathematical and computational thinking to interpret genetic data. (formative) • Graph and analyze data depicting the distribution of traits in a given population (i.e., class traits). (formative) • Analyze and interpret blood type data to determine paternity. (formative) • Summative Written Assessment Alternative Assessment Options: • Students create and analyze Punnett squares to predict inheritance patterns for multiple genetic traits and explain the probability of each
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			possible offspring genotype and phenotype. ● Students complete a CER using teacher-provided pedigree data to determine the inheritance pattern of a genetic disorder and support their conclusions with evidence. ● Students create an infographic, brochure, or digital presentation explaining an inherited genetic disorder, including its inheritance pattern, symptoms, available treatments, and genetic counseling options. ● Students analyze a family pedigree and determine possible genotypes of family members while explaining how evidence supports their conclusions. ● Students investigate a real-world genetics case study involving inherited traits or genetic disorders and develop an evidence-based
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			recommendation using pedigree analysis, Punnett squares, and probability.
Interdisciplinary Connections	ELA RI.CR.9–10.1: Cite a range of thorough textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what an informational text says explicitly and inferentially. RI.IT.9–10.3: Analyze how an author unfolds ideas throughout the text, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. SL.PE.9–10.1: Initiate and participate effectively in a range of collaborative discussions with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Mathematics N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. S.ID.C.9: Distinguish between correlation and causation. Social Studies 6.3.12.CivicsPD.1: Develop and evaluate solutions to local, national, or global issues by analyzing public policy and considering multiple perspectives. 6.3.12.HistorySE.14.a: Explore the role of innovation and scientific advancement in addressing global challenges. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.1.12.EH.2: Analyze how personal genetics, family history, and health behaviors influence an individual's overall health and wellness. Visual & Performing Arts 1.5.12prof.Cr1a: Use multiple approaches to begin creative endeavors. 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision.		
Career Readiness, Life Literacies, and Key Skills	9.1.12.RM.3: Analyze the relationship between risk and protective factors and how they influence decision-making. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 9.4.12.Cl.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.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue.		
Computer Science and Design Thinking	8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real-world phenomena. 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.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
● Provide color-coded Punnett squares, pedigree charts, and chromosome diagrams with bilingual vocabulary supports. ● Pre-teach genetics vocabulary (allele, genotype, phenotype, dominant, recessive, homozygous, heterozygous, pedigree, probability, inheritance) using visuals and word banks. ● Model how to complete Punnett squares and pedigree analyses through teacher think-alouds before independent practice. ● Provide sentence frames for CER responses and explanations of inheritance patterns. ● Pair students with supportive peers during pedigree analysis and genetics problem-solving activities. ● Allow students to demonstrate understanding through labeled diagrams, oral explanations, or digital presentations.	● Provide guided notes for inheritance patterns, Punnett squares, pedigrees, and probability calculations. ● Break multi-step genetics problems into smaller, sequential tasks. ● Use graphic organizers to compare dominant, recessive, codominant, and incomplete dominance inheritance patterns. ● Provide completed examples before assigning independent practice. ● Allow the use of reference charts, vocabulary guides, and Punnett square templates during practice activities. ● Provide extended time for assessments and alternative response formats when appropriate. ● Use frequent teacher check-ins during genetics	● Use hands-on manipulatives (allele cards, chromosome models, colored beads, or coins) to model inheritance before abstract calculations. ● Begin with single-trait Punnett squares before progressing to more complex inheritance problems. ● Provide partially completed Punnett squares and pedigree charts to scaffold learning. ● Use teacher-provided evidence for CER assignments and genetics case studies. ● Reinforce probability concepts through guided practice and repeated examples. ● Incorporate real-world examples of inherited traits and genetic disorders to increase engagement. ● Provide opportunities for small-group instruction, peer collaboration, and frequent formative assessments. ● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal, and other	● Investigate complex inheritance patterns including incomplete dominance, codominance, sex-linked inheritance, polygenic traits, and multiple alleles. ● Analyze authentic pedigree data and genetic case studies to determine inheritance patterns and predict future generations. ● Research current advances in human genetics, including genetic screening, gene therapy, CRISPR technology, and personalized medicine. ● Evaluate ethical issues surrounding genetic testing, reproductive technologies, and direct-to-consumer DNA testing using

● Provide translated directions and graphic organizers when appropriate. ● 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.	calculations and pedigree analysis. ● 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	community members to support classroom activities. ● Provide peer mentoring to improve techniques.	peer-reviewed scientific literature. ● Design and defend evidence-based solutions to contemporary genetic challenges through scientific argumentation and research. ● Develop extended investigations comparing Mendelian inheritance with non-Mendelian inheritance patterns using authentic genetic data. ● Present and defend conclusions using quantitative probability, pedigree analysis, and scientific evidence from multiple reliable sources. ● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of lab requirements.
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Biology Enhanced		
Unit 8: Natural Selection & Evolution		
Anchoring Phenomena: Over time, bacteria can become resistant to antibiotics. - Students are shown a video of Harvard Medical Team experiment depicting real time antibiotic resistant bacteria evolution. (notice/wonder) Related Phenomena: - How does bacterial evolution affect human health? TB real life example video activity - MRSA hospital infections - Herbicide-resistant superweeds - Insecticide-resistant mosquitoes - Peppered moths - Annual influenza vaccine changes		
Pacing: 3 weeks		
New Jersey Student Learning Standards (NJSLS)		
HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. 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 populations. 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		
Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts

Analyzing and Interpreting Data

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

Obtaining, Evaluating, and Communicating Information

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

Constructing Explanations and Designing Solutions

- Construct an explanation based on valid and reliable evidence obtained from a 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

LS4.B: Natural Selection

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

LS4.C: Adaptation

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

LS4.A: Evidence of Common Ancestry and Diversity

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

Patterns

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

Cause and Effect

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

Stability and Change

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

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.

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena - A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. - Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.	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. (<i>secondary</i>) ESS2.D: Weather and Climate - Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. ESS2.E Biogeology - The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth’s surface and the life that exists on it.		
Essential Questions	Student Learning Objectives	Suggested Tasks/Activities	Evidence of Learning (Assessment)
<i>Is evolution just speculation? What evidence is there?</i> <i>How can survival of the fittest lead to changes in the species? How is this related to variation?</i> <i>How do environmental changes affect the</i>	Students will be able to explain how group behavior can enhance survival and reproductive success for individuals and their genetic relatives. Students will be able to analyze DNA, amino acid sequences, anatomical features, and embryological evidence to infer	<i>Inquiry investigation where students will analyze data and construct claims based upon evidence:</i> <u>Evidence of Evolution Stations</u> - Students will move around the room to different stations. Each station will contain a type of evidence that evolution has taken place. The students will have to	- Creating a graph of data from scientific data (formative) - Constructing a scientific explanation that defends a claim with evidence and provide scientific reasoning to support it (formative)

<i>distribution/disappearance of species?</i> • <i>How can living in groups improve an organism's chances of survival and reproductive success?</i> • <i>Why is evolution significant in today's world?</i>	evolutionary relationships among species. • Students will be able to describe the conditions required for natural selection, including genetic and trait variation within a population. • Students will be able to explain how traits that increase survival and reproductive success become more common in a population over time. • Students will be able to identify and describe the four factors that contribute to evolution: species reproduction potential, genetic variation, competition for resources, and differential survival. • Students will be able to define adaptation and explain how natural selection leads to populations that are better suited to their environments. • Students will be able to evaluate how environmental changes can shift the distribution of traits in a population over generations. • Students will be able to describe how environmental changes—natural or human-induced—can lead to species expansion, divergence, decline, or extinction. • Students will be able to analyze evidence demonstrating how group behavior increases survival.	construct an explanation for the connection of the station being evidence of evolution. • Group Behavior and Survival Station Activity – Students will move around the room to different stations, each featuring a real-world example of cooperative behavior in organisms. At each station, students will analyze evidence and construct an explanation for how the group behavior increases an individual's or species' chances of survival and reproductive success. <i>Activities that create models of biological concepts:</i> • <u>Moth Natural Selection</u> - This student-centered activity demonstrates the principle of camouflage whereby the students select moths off of different colored backgrounds. • <u>Bird Beak</u> - This student centered activity demonstrates the process of natural selection whereby students use different tools to simulate different shaped beaks to pick up items. • <u>Thumb Adaptation</u> - This activity seeks to demonstrate the importance of an opposable thumb for primate evolution. Students	• Defend opinions with scientific research (formative) • Use mathematical and computational thinking to interpret data. (formative) • Graph and analyze data (formative) • Laboratory investigations pertaining to concepts in evolution (formative) • Projects (formative/summative) • Summative Test/Quiz • Linkit! C (Benchmark) Alternative Assessment Options: • Students develop a model illustrating how natural selection changes the frequency of traits within a population over multiple generations and use evidence to explain evolutionary change. • Students complete a CER using authentic data from antibiotic-resistant bacteria or another evolving population to explain how natural selection leads to
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	● Students will be able to explain how the inability of a species to adapt quickly enough to environmental changes can lead to extinction.	will perform various tasks and then re-perform the same tasks with their thumb taped to their hand. Effective Communication Skills: ● <u>Adaptation Project</u> - Students will pick an organism and explain 3 different adaptations that help that organism survive. They will then make up a fictitious adaptation and explain how that would further benefit the organism. Scientist Spotlights: ● Dr. Geerat Vermeij – how a blind paleontologist studies fossil evidence through touch. (<i>Building off unit 1</i>)	adaptation. ● Students create an infographic, public service announcement, or educational campaign explaining how the misuse of antibiotics contributes to antibiotic resistance and recommending strategies to reduce its spread. ● Students analyze evidence from fossils, homologous structures, DNA sequences, or embryological development to construct an evidence-based explanation supporting the theory of evolution. ● Students investigate a contemporary example of evolution (e.g., antibiotic resistance, pesticide resistance, herbicide resistance, or changes in influenza viruses) and develop an evidence-based explanation describing how environmental pressures influence natural selection and
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			population change over time.
Interdisciplinary Connections	ELA RI.CR.9–10.1: Cite a range of thorough textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what an informational text says explicitly and inferentially. RI.IT.9–10.3: Analyze how an author unfolds ideas throughout the text, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them. W.AW.9–10.1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient textual and non-textual evidence. W.SE.9–10.2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. SL.PE.9–10.1: Initiate and participate effectively in a range of collaborative discussions with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Mathematics N.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems. S.ID.B.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related. S.ID.C.9: Distinguish between correlation and causation. Social Studies 6.3.12.CivicsPD.1: Develop and evaluate solutions to local, national, or global issues by analyzing public policy and considering multiple perspectives. 6.3.12.HistorySE.14.a: Explore the role of innovation and scientific advancement in addressing global challenges. Health 2.1.12.PGD.1: Analyze factors that influence personal and community wellness. 2.3.12.HCDM.7: Analyze how medical advances, vaccinations, and disease prevention strategies improve individual and public health. Visual & Performing Arts 1.5.12prof.Cr1a: Use multiple approaches to begin creative endeavors. 1.5.12prof.Cr2a: Create and refine artistic ideas through experimentation, planning, and revision.		
Career Readiness, Life Literacies, and Key Skills	9.1.12.RM.3: Analyze the relationship between risk and protective factors and how they influence decision-making. 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.		

	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.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue.		
Computer Science and Design Thinking	8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real-world phenomena. 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.		
Modifications			
Multi-Lingual Learners	Students with Special Needs/504s	At-Risk	Gifted and Talented
● Provide labeled diagrams illustrating natural selection, adaptation, speciation, homologous structures, and evolutionary relationships with bilingual vocabulary supports. ● Pre-teach key vocabulary (adaptation, natural selection, variation, fitness, evolution, speciation, fossil, homologous, analogous, antibiotic resistance) using visuals and word banks. ● Use color-coded diagrams and graphic organizers to compare different types of evidence supporting evolution. ● Model data analysis using	● Provide guided notes outlining mechanisms of natural selection and evidence for evolution. ● Break complex evolutionary processes into smaller, sequential learning tasks. ● Use graphic organizers to compare natural selection, adaptation, and speciation. ● Provide partially completed data tables, graphs, and CER templates during investigations. ● Allow extended time for laboratory investigations, simulations, and assessments. ● Offer alternative assessment choices including models, diagrams, presentations, or oral explanations. ● Provide frequent teacher check-ins during analysis of evolutionary evidence and	● Begin with hands-on simulations (e.g., bird beaks, camouflage, antibiotic resistance) before introducing abstract evolutionary concepts. ● Reinforce vocabulary using visuals, repeated exposure, and real-world examples. ● Provide scaffolded graph interpretation and teacher-guided analysis of antibiotic resistance data. ● Use teacher-provided evidence for CER writing assignments. ● Connect evolution to current events such as antibiotic resistance, influenza, pesticide resistance, and conservation biology to increase engagement. ● Incorporate frequent formative assessments including exit tickets, sorting activities, and quick checks for understanding.	● Analyze authentic population genetics, fossil, or DNA sequence data to investigate evolutionary relationships and construct phylogenetic trees. ● Evaluate multiple lines of evidence supporting evolution, including molecular biology, comparative anatomy, embryology, biogeography, and the fossil record. ● Research contemporary examples of rapid evolution, including antibiotic resistance, antiviral resistance, pesticide resistance, climate-driven

the antibiotic resistance phenomenon before independent investigations. ● Pair students with supportive peers during simulations, laboratory investigations, and data analysis activities. ● Provide sentence frames for CER responses explaining evolutionary change using scientific evidence. ● Allow students to demonstrate understanding through labeled diagrams, oral explanations, or multimedia presentations. ● 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.	interpretation of data. ● 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.	● Provide opportunities for small-group instruction and peer collaboration during investigations. ● Incorporate student choice. ● Invite parents, neighbors, friends, the school principal and other community members to support classroom activities. ● Provide peer mentoring to improve techniques.	adaptation, or conservation genetics. ● Investigate how evolutionary principles are applied in medicine, agriculture, epidemiology, and biotechnology using peer-reviewed scientific literature. ● Design and defend evidence-based solutions to issues involving antibiotic stewardship, emerging infectious diseases, or biodiversity conservation. ● Compare competing evolutionary hypotheses using quantitative evidence and scientific argumentation. ● Develop and present an extended investigation incorporating authentic data analysis, scientific modeling, and evaluation of current evolutionary research. ● Lead the class in the deciphering of new learning. ● Create a more detailed report which includes additional research outside of project requirements.
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			Engage in a more complex project or laboratory investigation.
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Course Resources

Curriculum & Reference Materials

- New Jersey Student Learning Standards for Science (2026) - <https://www.nj.gov/education/standards/science/>
- [Complete unit vocab list and definitions](#)
- Claim-Evidence-Reasoning (CER) Framework - <https://cer.nsta.org/>
- Notice/Wonder Thinking Routine - <https://pz.harvard.edu/thinking-routines>
- Google Workspace (Google Docs, Slides, Sheets, Forms) - <https://workspace.google.com>
- The POGIL Project - <https://pogil.org>
- PBS LearningMedia - <https://www.pbslearningmedia.org>
- ExploreLearning Gizmos - <https://www.explorelearning.com>
- HHMI BioInteractive- <https://www.biointeractive.org>
- NOAA - <https://www.noaa.gov>
- United States Environmental Protection Agency (EPA) - <https://www.epa.gov>
- Nature Portfolio - <https://www.nature.com>
- Innovative Genomics Institute - <https://innovativegenomics.org>
- Stanford Medicine - <https://med.stanford.edu>
- Shape of Life - <https://www.shapeoflife.org>
- National Institutes of Health (NIH) - <https://www.nih.gov>
- Centers for Disease Control and Prevention (CDC) - <https://www.cdc.gov>
- Gizmo Interactives - www.explorelearning.com
- Harvard LabXChange - www.labxchange.org

- LinkIt!: www.linkit.com
- Youtube Videos: www.youtube.com
- Positive Physics: www.positivephysics.com
- Textbook: Campbell, Neil A., Brad Williamson, and Robin J. Heyden. *Biology: Exploring Life*. Pearson Prentice Hall, 2006.