Kenilworth Public Schools

Curriculum Guide

Content Area: Honors Biology
Grade: 9-10
BOE Approved: 5/11/15

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Submitted by: Marie Gallina
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Honors Biology – Grade 9 Scope and Sequence

Unit 1- Introduction to Biology	Unit 2- Ecosystems: Interactions, Energy, and Dynamics	Unit 3- Molecules to Organisms: Structures and Processes	Unit 4- Photosynthesis & Cellular Respiration	Unit 5- Cell Growth, Development & Reproduction	Unit 6- Genetics	Unit 7- Biological Evolution: Unity and Diversity
Weeks 1-2	Weeks 3-10	Weeks 11-18	Weeks 19-22	Weeks 23-26	Weeks 27-34	Weeks 35-38
Unit Description: Biology is the study of life. In this unit, students will discuss the process of thinking scientifically. Before laboratory activities can occur, safety producers and practices will be discussed. What "life" means and the characteristics shared by all living things will be examined.	*Unit Description:* All organisms are interdependent upon one another. They interact with other biotic and abiotic factors in their environment. In this unit, students will review basic concepts in ecology. Population growth, food chains and food webs will be explained to show the continual flow of energy and matter. Threats to ecosystems and ecological issues, such as climate change, will be discussed. Solutions to these ecological problems will be	*Unit Description:* Cells are the basic unit of life. In this unit, students will identify the organic molecules that make up the cells of most living organisms. The structure and function of major cell organelles will be explained. The maintaining of homeostasis in organisms will be described and demonstrated.	*Unit Description:* Sustaining life requires energy. In this unit, students will learn about ATP, the cellular unit for energy. The structures, function, and reactions that comprise photosynthesis will be explained. A comparison will be made between aerobic cellular respiration with anaerobic fermentation and how they are used to keep energy flowing.	*Unit Description:* All cells come from pre-existing cells. In this unit, students will investigate how and why cells divide. Asexual and sexual reproduction will be compared. Cells can be compared at different stage of the cell cycle and become specialized for various functions. The impact that errors have during cell division, such as cancer, will be discussed.	*Unit Description:* All living things contain genetic material. Genetic material must be passed from parent to offspring for life to continue through generations. In this unit, students will discuss the importance of DNA. It carries the encoded instructions for protein synthesis. Mendelian genetics will be used to show how traits are inherited. Environmental and genetic causes of gene mutation will be discussed. Modern genetic technology	*Unit Description:* Evolution takes place when new species arise from pre-existing species. In this unit, students will learn the main points behind natural selection as well as the impact it has on the environment. Various mechanisms of evolution will be explained. The process by which natural selection eliminated unfavorable traits and gives rise to adaptations will be illustrated.

	developed.				will be discussed.	
Unit Targets: • Connect scientific concepts (qualitative and quantitative) and use them to build scientific arguments. • Participate in the scientific community in the classroom. • Describe the elements involved in designing experiments. • Describe the characteristics of life. • Demonstrate proper laboratory safety practices. • Discuss LGBTQ scientists and other persons that have made contributions to the biological community.	*Unit Targets:* • Contrast between abiotic and biotic factors. • Identify the role of different organisms in an ecosystem. • Describe the effect of interdependence on organisms in their environment. • Explain niche and competition shape a community. • Contrast between the different types of species interactions and symbiotic relationships. • Design a food web for an ecosystem. • Describe how matter and energy can cycle through an ecosystem. • Distinguish between primary and secondary succession. • Explain biodiversity.	*Unit Targets:* • Identify the major elements in living organisms. • Differentiate between the 4 macromolecules: carbohydrates, lipids, proteins, and nucleic acids. • Explain the role of enzymes in chemical reactions. • Experiment with the different organic molecules / macromolecules. • State the 3 parts of the cell theory. • Distinguish between animal & plant cells, eukaryotic & prokaryotic cells. • Explain the role of cell membranes as a selective barrier. • Compare the use of passive and active transport to move molecules through a membrane. • Predict a cell's	*Unit Targets:* • Explain why almost all organisms depend on photosynthesis. • Summarize how the light reaction and Calvin cycle work together to create the continuous cycle of photosynthesis. • Explain how environmental factors influence photosynthesis. • Summarize the main steps of cellular respiration. • Contrast aerobic and anaerobic respiration. • Discuss how photosynthesis and cellular respiration are used together to power ecosystems. • Calculate the efficiency of generating ATP in cellular respiration.	*Unit Targets:* • Distinguish between cell growth, division, and differentiation. • Compare and contrast asexual and sexual reproduction. • Describe the consequences of random genetic mutations during cell division. • Distinguish between haploid and diploid cells. • Contrast cell division in eukaryotes and prokaryotes. • Describe the stages of the cell cycle. • Explain how the cell cycle is controlled. • Explain the steps of mitosis. • Explain the steps of meiosis. • Explain how variation is created	*Unit Targets:* • DNA contains information that determines the sequence of amino acids added to a growing protein. • Summarize the experiments that led to the discovery of DNA and inherited material. • Identify the structure of DNA. • Summarize the process of DNA replication. • View how random alterations the genetic code may help, harm, or have no effect on an organism. • Predict the possible offspring of a genetic cross. • Predict the probability of inheriting a trait or disorder. • Contrast the autosome and sex chromosomes. • Compare the	*Unit Targets:* • Estimate how closely related species are based on scientific evidence. • Explain the different categories of evidence that support the theory of evolution. • Summarize the results of experiments that led to the disproval of spontaneous generation. • List the characteristics that describe the first forms of life on Earth. • Explain the theory of endosymbiosis. • Explain how modern cells have evolved. • Relate the concepts of adaptation and fitness to the theory of natural selection.

	• Describe how humans have affected resources, biodiversity, and other ecological areas. • Evaluate possible solutions to current ecological problems.	response under certain environmental conditions.		in meiosis.	difference inheritance patterns. • Analyze pedigrees to determine how genetic traits and disorders are inherited. • Discuss new genetic technology uses and its possible ethical and social issues.	

Honors Biology – Grade 9 Unit 1

Unit Title: Introduction to Biology

Unit Summary: Biology is the study of life. In this unit, students will discuss the process of thinking scientifically. Before laboratory activities can occur, safety producers and practices will be discussed. What "life" means and the characteristics shared by all living things will be examined.

Primary Interdisciplinary Connections: Social Studies, Art

Career Readiness, Life Literacies, and Key Skills: Career Awareness and Planning, Financial Literacy, Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness

Learning Targets

NJSLS Standards: HS-LS2-8

Computer Science and Design Thinking Standards: 8.1.12.NI.2

Climate Change Standards: --

ELA Companion Standards: RST.9-10.8, RST.11-12.1, RST.11-12.8

Content Statements:

1	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Big Idea: Biology is the study of living things. Science utilizes process supported by evidence.

Unit Essential Questions:

- How would a scientist go about solving a problem in their everyday life?
- How are organisms classified?
- How do we find explanations for events in the natural world?
- What is biology?

Unit Enduring Understandings:

- Evidence is used for building, refining and/or critiquing scientific explanations.
- Scientific knowledge builds upon itself over time.
- The growth of scientific knowledge involves critique and communication – social practices that are governed by a core set of values and norms.
- Organisms can be classified into a hierarchical system.

Unit Learning Targets

Students will…

- Connect scientific concepts (qualitative and quantitative) and use them to build scientific arguments.
- Participate in the scientific community in the classroom.

- Describe the elements involved in designing experiments.
- Describe the characteristics of life.
- Demonstrate proper laboratory safety practices.
- Discuss LGBTQ scientists and other persons that have made contributions to the biological community.

Evidence of Learning

Summative Assessment: Unit test

Formative Assessments:

- Quizzes
- Homework
- Labs
- Projects

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Characteristics of life project • Scientific thinking lab • Lab safety demonstration	Weeks 1-2
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate): -Google Classroom -Pear Deck -FlipGrid -Kahoot -Kami	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:

• Use of visual and multisensory formats
• Use of assisted technology
• Use of prompts
• Modification of content and student products
• Testing accommodations
• Authentic assessments

Examples of Strategies and Practices that Support Gifted & Talented Students:
• Adjusting the pace of lessons
• Curriculum compacting
• Inquiry-based instruction
• Independent study
• Higher-order thinking skills
• Interest-based content
• Student-driven instruction
• Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:
• Pre-teaching of vocabulary and concepts
• Visual learning, including graphic organizers
• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Honors Biology – Grade 9 Unit 2

Unit Title: Ecosystems: Interactions, Energy, and Dynamics	
Unit Summary: All organisms are interdependent upon one another. They interact with other biotic and abiotic factors in their environment. In this unit, students will review basic concepts in ecology. Population growth, food chains and food webs will be explained to show the continual flow of energy and matter. Threats to ecosystems and ecological issues, such as climate change, will be discussed. Solutions to these ecological problems will be developed.	
Primary Interdisciplinary Connections: Mathematics, Social Studies, Art	
Career Readiness, Life Literacies, and Key Skills: Career Awareness and Planning, Financial Literacy, Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness, Technology Literacy, Information and Media Literacy	
Learning Targets	
NJSLS Standards: HS-LS4-6, HS-LS2-1, HS-LS2-2, HS-LS2-3, HS-LS2-4, HS-LS2-5, HS-LS2-6, HS-LS2-7, HS-LS2-8	
Computer Science and Design Thinking Standards: 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.1.12.DA.6, 8.2.12.ED.1, 8.2.12.ED.4, 8.2.12.ITH.3, 8.2.12.NT.1, 8.2.12.ETW.1, 8.2.12.ETW.3, 8.2.12.ETW.4	
Climate Change Standards: HS-ESS3-1, HS-ESS3-4, HS-ESS3-3, HS-ESS3-6	
ELA Companion Standards: RST.9-10.8, RST.11-12.1, RST.11-12.7, RST.11-12.8, WHST.9-12.2, WHST.9-12.7	
Content Statements:	
1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
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.
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.
7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Big Idea: All organisms depend on their environment to meet their basic needs. Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.

Unit Essential Questions:	**Unit Enduring Understandings:**
• How is ecosystem stability disrupted by human intervention? • How can one change their lifestyle to conserve natural resources? • Why is it important to understand challenges in a species' environment to understand the species' evolution? • How do living and nonliving things interact in an ecosystem? • How can change in one part of an ecosystem affect other parts of the ecosystem? • What factors can affect the diversity and size of a population?	• Organisms depend on each other and their environment to meet their basic needs. • All ecosystems display interdependence. The organisms depend on all factors of the environment to meet their basic needs and to survive. If the ecosystem changes, an organism's needs may not be met. • Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms. • Stability in an ecosystem can be disrupted by natural or human interactions. • Cooperation and competition are important in biological systems. • Climate change has developed over time heavily due in part to huma interaction.

Unit Learning Targets

Students will…

- Contrast between abiotic and biotic factors.
- Identify the role of different organisms in an ecosystem.
- Describe the effect of interdependence on organisms in their environment.
- Explain niche and competition shape a community.
- Contrast between the different types of species interactions and symbiotic relationships.
- Design a food web for an ecosystem.
- Describe how matter and energy can cycle through an ecosystem.
- Distinguish between primary and secondary succession.
- Explain biodiversity.
- Describe how humans have affected resources, biodiversity, and other ecological areas.
- Evaluate possible solutions to current ecological problems.

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5)

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1)
- Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)
- Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

Disciplinary Core Ideas

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. (HS-LS2-1), (HS-LS2-2)

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. (HS-LS2-3)
- 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. (HS-LS2-4)
- 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. (HS-LS2-5)

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 more or less 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. (HS-LS2-2), (HS-LS2-6)

- 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. (HS-LS2-7)

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. (HS-LS2-8)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(secondary to HS-LS2-7)*
- 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 to HS-LS2-7)* (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

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 to HS-LS2-5)*

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary to HS-LS2-7).*

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8)

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2)

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. (HS-LS2-5)

Energy and Matter

- Energy cannot be created or destroyed—it only moves between one place and another place, between

objects and/or fields, or between systems. (HS-LS2-4)
- Energy drives the cycling of matter within and between systems. (HS-LS2-3)

Stability and Change
- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6), (HS-LS2-7)

Connections to Nature of Science
Scientific Knowledge is Open to Revision in Light of New Evidence
- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-2), (HS-LS2-3)
- 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. (HS-LS2-6), (HS-LS2-8)

Evidence of Learning

Summative Assessment: Unit test, projects

Formative Assessments:

- Quizzes
- Homework
- Labs

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Graphing population practice • Food web design & analysis • Population bean lab • Species interactions lab • Environment solution project	Weeks 3-10
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate): -Google Classroom -Pear Deck -FlipGrid -Kahoot -Kami	

Differentiating Instruction: Students with Disabilities, English Language Learners,

and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:
• Use of visual and multisensory formats
• Use of assisted technology
• Use of prompts
• Modification of content and student products
• Testing accommodations
• Authentic assessments

Examples of Strategies and Practices that Support Gifted & Talented Students:
• Adjusting the pace of lessons
• Curriculum compacting
• Inquiry-based instruction
• Independent study
• Higher-order thinking skills
• Interest-based content
• Student-driven instruction
• Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:
• Pre-teaching of vocabulary and concepts
• Visual learning, including graphic organizers
• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Honors Biology – Grade 9 Unit 3

Unit Title: From Molecules to Organisms: Structure & Processes	
Unit Summary: Cells are the basic unit of life. In this unit, students will identify the organic molecules that make up the cells of most living organisms. The structure and function of major cell organelles will be explained. The maintaining of homeostasis in organisms will be described and demonstrated.	
Primary Interdisciplinary Connections: Mathematics, Social Studies, Art	
Career Readiness, Life Literacies, and Key Skills: Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness, Technology Literacy, Information and Media Literacy	
Learning Targets	
NJSLS Standards: HS-LS1-6, HS-LS2-4, HS-LS1-1, HS-LS1-2, HS-LS1-3	
Computer Science and Design Thinking Standards: 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.1.12.DA.6, 8.2.12.ED.1, 8.2.12.ED.2, 8.2.12.ITH.1, 8.2.12.NT.1, 8.2.12.NT.2, 8.2.12.ETW.1	
Climate Change Standards: --	
ELA Companion Standards: RST.11-12.1, WHST.9-12.2, WHST.9-12.5, WHST.9-12.7, WHST.11-12.8, WHST.9-12.9, SL.11-12.5	
Content Statements:	
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.
2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific function within multicellular organisms.
3	Plan and conduct and investigation to provide evidence that feedback mechanisms maintain homeostasis.
4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
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.
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.
Big Idea: An organism is made up of cells, why carry out all the functions of life.	

Unit Essential Questions:	**Unit Enduring Understandings:**
• Why are the unique properties of water important to organisms? • Why is chemistry an integral part of biology? • What are the 4 main types of organic compounds / macromolecules? • How are cell structures adapted to their functions? • How does a cell transport material across the plasma membrane? • How to enzymes catalyze chemical reactions? • How do factors such as pH and temperature affect enzyme function?	• The cell is the basic unit of life. • Processes that occur at the cellular level provide energy and basic structure organisms need to survive. • Cell processes are carried out by many type of molecules. • One of the most important molecules for living organisms are enzymes, a type of protein. • The internal and external environment of a cell can affect the function and efficiency of the cell and/or organism.

Unit Learning Targets

Students will…

- Identify the major elements in living organisms.
- Differentiate between the 4 macromolecules: carbohydrates, lipids, proteins, and nucleic acids.
- Explain the role of enzymes in chemical reactions.
- Experiment with the different organic molecules / macromolecules.
- State the 3 parts of the cell theory.
- Distinguish between animal & plant cells, eukaryotic & prokaryotic cells.
- Explain the role of cell membranes as a selective barrier.
- Compare the use of passive and active transport to move molecules through a membrane.
- Predict a cell's response under certain environmental conditions.

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4), (HS-LS1-5), (HS-LS1-7)

Planning and Carrying Out Investigations

Planning and carrying out in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- 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. (HS-LS1-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- 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. (HS-LS1-1)
- 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. (HS-LS1-6)

Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- 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. (HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*
- 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. (HS-LS1-2)
- 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. (HS-LS1-3)

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. (HS-LS1-4)

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. (HS-LS1-5)
- 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. (HS-LS1-6)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7)
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

Crosscutting Concepts

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. (HS-LS1-2), (HS-LS1-4)

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. (HS-LS1-5), (HS-LS1-6)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7)

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. (HS-LS1-1)

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

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. (HS-LS1-3)

Evidence of Learning

Summative Assessment: Tests, labs

Formative Assessments:

- Quizzes
- Homework
- Mini-labs
- Projects

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Macromolecule testing or modeling lab • Water activity • Microscope lab • Organelle project / diagrams • Plasma membrane engineering project	Weeks 11-18

• Diffusion lab • Diffusion and osmosis demonstrations	
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate): -Google Classroom -Pear Deck -Kahoot -Kami	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:
• Use of visual and multisensory formats
• Use of assisted technology
• Use of prompts
• Modification of content and student products
• Testing accommodations
• Authentic assessments

Examples of Strategies and Practices that Support Gifted & Talented Students:
• Adjusting the pace of lessons
• Curriculum compacting
• Inquiry-based instruction
• Independent study
• Higher-order thinking skills
• Interest-based content
• Student-driven instruction
• Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:
• Pre-teaching of vocabulary and concepts
• Visual learning, including graphic organizers
• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Honors Biology – Grade 9 Unit 4

Unit Title: Photosynthesis and Cellular Respiration

Unit Summary: Sustaining life requires energy. In this unit, students will learn about ATP, the cellular unit for energy. The structures, function, and reactions that comprise photosynthesis will be explained. A comparison will be made between aerobic cellular respiration with anaerobic fermentation and how they are used to keep energy flowing.

Primary Interdisciplinary Connections: Mathematics, Physical Education, Art

Career Readiness, Life Literacies, and Key Skills: Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness, Technology Literacy, Information and Media Literacy

Learning Targets

NJSLS Standards: HS-LS1-5, HS-LS1-7, HS-LS2-3, HS-LS2-5

Computer Science and Design Thinking Standards: 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.1.12.DA.6, 8.2.12.ITH.2, 8.2.12.NT.2

Climate Change Standards: --

ELA Companion Standards: RST.11-12.1, WHST.9-12.2, WHST.9-12.5, SL.11-12.5

Content Statements:

1	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
2	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.
3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
4	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Big Idea: Energy is cycled throughout the ecosystem and is required for all living things.

Unit Essential Questions:

- How do organisms use photosynthesis to capture light energy from the sun?
- How are photosynthesis and cellular respiration connected?
- What structures / molecules are involved in cellular respiration?
- Why is it necessary for cells to have oxygen?

Unit Enduring Understandings:

- All organisms transfer matter and convert energy from one form to another.
- Matter and energy are needed to build and maintain structure in an organism.

Unit Learning Targets
Students will…

- Explain why almost all organisms depend on photosynthesis.
- Summarize how the light reaction and Calvin cycle work together to create the continuous cycle of photosynthesis.
- Explain how environmental factors influence photosynthesis.
- Summarize the main steps of cellular respiration.
- Contrast aerobic and anaerobic respiration.
- Discuss how photosynthesis and cellular respiration are used together to power ecosystems.
- Calculate the efficiency of generating ATP in cellular respiration

Evidence of Learning

Summative Assessment: Unit test

Formative Assessments:

- Quizzes
- Homework
- Labs

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Respiration running lab • Chromatography pigment lab • Label activity • Videos • Diagrams	Weeks 19-22
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate): -Google Classroom -Pear Deck -FlipGrid -Kahoot -Kami	

Differentiating Instruction:

Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:
- Use of visual and multisensory formats
- Use of assisted technology
- Use of prompts
- Modification of content and student products
- Testing accommodations
- Authentic assessments

Examples of Strategies and Practices that Support Gifted & Talented Students:
- Adjusting the pace of lessons
- Curriculum compacting
- Inquiry-based instruction
- Independent study
- Higher-order thinking skills
- Interest-based content
- Student-driven instruction
- Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:
- Pre-teaching of vocabulary and concepts
- Visual learning, including graphic organizers
- Use of cognates to increase comprehension
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- Scaffolding
- Word walls
- Sentence frames
- Think-pair-share
- Cooperative learning groups

Honors Biology – Grade 9 Unit 5

Unit Title: Cell Growth, Development & Reproduction

Unit Summary: All cells come from pre-existing cells. In this unit, students will investigate how and why cells divide. Asexual and sexual reproduction will be compared. Cells can be compared at different stage of the cell cycle and become specialized for various functions. The impact that errors have during cell division, such as cancer, will be discussed.

Primary Interdisciplinary Connections: Mathematics, Social Studies, Art

Career Readiness, Life Literacies, and Key Skills: Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness, Technology Literacy, Information and Media Literacy

Learning Targets

NJSLS Standards: HS-LS3-1, HS-LS3-2, HS-LS3-3, HS-LS1-4

Computer Science and Design Thinking Standards: 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.1.12.DA.6, 8.2.12.ITH.3, 8.2.12.EC.1

Climate Change Standards: --

ELA Companion Standards: RST.11-12.1, RST.11-12.9, WHST.9-12.1, SL.11-12.5

Content Statements:

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.
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.
3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Big Idea: New cells come from pre-existing cells, which allows for the specialization of cells.

Unit Essential Questions:	**Unit Enduring Understandings:**
• Why do cells undergo division? • What are the stages of the cell cycle? • How do cells divide? • How does a cell control the process of cell division? • What are the differences between asexual and sexual reproduction? • What happen when cell growth is	• Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell. • The differentiation/specialization of cells in multicellular organisms is due to the different patterns of gene expression, not because of difference of the genes themselves. • Sorting and recombination of genes in sexual reproduction result in a great variety of possible

uncontrolled? • How does a multicellular organism develop from a single cell?	gene combination from the offspring of any 2 parents. • New traits may result from new combination of existing gene or from mutations of genes in reproductive cells within a population. More combinations can occur in sexually reproducing species.

Unit Learning Targets
Students will…

- Distinguish between cell growth, division, and differentiation.
- Compare and contrast asexual and sexual reproduction.
- Describe the consequences of random genetic mutations during cell division.
- Distinguish between haploid and diploid cells.
- Contrast cell division in eukaryotes and prokaryotes.
- Describe the stages of the cell cycle.
- Explain how the cell cycle is controlled.
- Explain the steps of mitosis.
- Explain the steps of meiosis.
- Explain how variation is created in meiosis.

Evidence of Learning

Summative Assessment: Unit test

Formative Assessments:

- Quizzes
- Homework
- Labs
- Projects

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Cell size mini-lab • Cancer lab • Meiosis lab • Cell cycle foldable	Weeks 23-26
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate):	

-Google Classroom -Pear Deck -FlipGrid -Kahoot -Kami -Nearpod	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

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•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Honors Biology – Grade 9 Unit 6

Unit Title: Genetics

Unit Summary: All living things contain genetic material. Genetic material must be passed from parent to offspring for life to continue through generations. In this unit, students will discuss the importance of DNA. It carries the encoded instructions for protein synthesis. Mendelian genetics will be used to show how traits are inherited. Environmental and genetic causes of gene mutation will be discussed. Modern genetic technology will be discussed.

Primary Interdisciplinary Connections: Mathematics, Social Studies, Art

Career Readiness, Life Literacies, and Key Skills: Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness, Technology Literacy, Information and Media Literacy

Learning Targets

NJSLS Standards: HS-LS3-1, HS-LS3-2, HS-LS3-3

Computer Science and Design Thinking Standards: 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.1.12.DA.6, 8.2.12.ITH.3, 8.2.12.EC.1, 8.2.12.EC.2, 8.2.12.EC.3

Climate Change Standards: --

ELA Companion Standards: RST.11-12.1, RST.11-12.9, WHST.9-12.1

Content Statements:

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.
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.
3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Big Idea: Organisms contain genetic information that influences their traits, which they pass onto their offspring.

Unit Essential Questions:

- How is genetic information passed through generations?
- What happens during protein synthesis?
- How does DNA replicate itself?
- What is the structure and function of DNA?
- How does a genotype affect the phenotype of a trait?

Unit Enduring Understandings:

- All living organisms have DNA.
- Changes in DNA (mutations) can occur spontaneously, during DNA replication, or due to the environment.
- Inserting, deleting, or substituting DNA segments can alter the genetic code.
- Genes can be passed down through generation that are helpful, harmful or have little to no effect on the future success of the offspring in

• What are the different patterns of inheritance? • How has new genetic technology been incorporated into modern society?	its environment. • There are predictable patterns of inheritance. The variation that exists in a species is related to its mode of reproduction. • New technology is continually being developed to further the understanding of genetics.

Unit Learning Targets
Students will…

- DNA contains information that determines the sequence of amino acids added to a growing protein.
- Summarize the experiments that led to the discovery of DNA and inherited material.
- Identify the structure of DNA.
- Summarize the process of DNA replication.
- View how random alterations the genetic code may help, harm, or have no effect on an organism.
- Predict the possible offspring of a genetic cross.
- Predict the probability of inheriting a trait or disorder.
- Contrast the autosome and sex chromosomes.
- Compare the difference inheritance patterns.
- Analyze pedigrees to determine how genetic traits and disorders are inherited.
- Discuss new genetic technology uses and its possible ethical and social issues.

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
▪Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

Analyzing and Interpreting Data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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. (HS-LS3-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
▪ Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2)

Disciplinary Core Ideas

LS1.A: Structure and Function

▪All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)*

LS3.A: Inheritance of Traits

▪Each chromosome consists of a single very long DNA molecule, and each gene on the chromosomes 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. (HS-LS3-1)

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. (HS-LS3-2)
- 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. (HS-LS3-2), (HS-LS3-3)

Crosscutting Concepts

Cause and Effect

▪Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.(HS-LS3-1), (HS-LS3-2)

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).(HS-LS3-3)

Connections to Nature of Science

Science is a Human Endeavor

▪Technological advances have influenced the progress of science and science has influenced advances in technology.(HS-LS3-3)

▪Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

Evidence of Learning

Summative Assessment: Unit test, projects

Formative Assessments:

- Mini-labs
- Quizzes
- Homework

- Labs

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• DNA extraction lab • Transcription / translation lab • Make a baby / probability lab • Pedigree project • Genetic disorder research project • Punnett square design and analysis	Weeks 27-34
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate): -Google Classroom -Pear Deck -FlipGrid -Kahoot -Kami -Nearpod	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

Examples of Strategies and Practices that Support Students with Disabilities:
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• Use of assisted technology
• Use of prompts
• Modification of content and student products
• Testing accommodations
• Authentic assessments

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• Adjusting the pace of lessons
• Curriculum compacting
• Inquiry-based instruction
• Independent study
• Higher-order thinking skills
• Interest-based content
• Student-driven instruction

• Real-world problems and scenarios

Examples of Strategies and Practices that Support English Language Learners:
• Pre-teaching of vocabulary and concepts
• Visual learning, including graphic organizers
• Use of cognates to increase comprehension
• Teacher modeling
• Pairing students with beginning English language skills with students who have more advanced English language skills
• Scaffolding
•Word walls
•Sentence frames
•Think-pair-share
•Cooperative learning groups

Honors Biology – Grade 9 Unit 7

Unit Title: Evolution	
Unit Summary: Evolution takes place when new species arise from pre-existing species. In this unit, students will learn the main points behind natural selection as well as the impact it has on the environment. Various mechanisms of evolution will be explained. The process by which natural selection eliminated unfavorable traits and gives rise to adaptations will be illustrated.	
Primary Interdisciplinary Connections: Mathematics and Social Studies	
Career Readiness, Life Literacies, and Key Skills: Creativity and Innovation, Critical Thinking and Problem-solving, Global and Cultural Awareness, Technology Literacy, Information and Media Literacy	
Learning Targets	
NJSLS Standards: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5	
Computer Science and Design Thinking Standards: 8.1.12.DA.1, 8.1.12.DA.2, 8.1.12.DA.5, 8.1.12.DA.6, 8.2.12.ITH.3, 8.2.12.ETW.1, 8.2.12.ETW.4, 8.2.12.EC.2, 8.2.12.EC.3	
Climate Change Standards: HS-ESS3-1, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6	
ELA Companion Standards: RST.11-12.1, RST.11-12.8, WHST.9-12.5, WHST.9-12.9, SL.11-12.4	
Content Statements:	
1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
2	Construct an explanation based on evidence that the process of evolution primarily results from 4 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.
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.
4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
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.
6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
Big Idea: Genetic differences between organisms of the same kind are the basis on which evolution is founded on. It provides advantages for surviving and reproducing in different environments.	

Unit Essential Questions:	**Unit Enduring Understandings:**
• How do organisms of the same species different from one another? • How does variation help some organisms survive and reproduce? • How cane cell within a multicellular organism be different in structure and function, if they all came from the same original cell? • How are natural selection and species adaptions related? • What are the major points of Darwin's theory of natural selection?	• The diversity of life is the results of ongoing evolutionary change. All species have evolved from ancient common ancestors. • An estimate of how closely related species are is based on scientific evidence. • Adaptations can help, harm, or have little to no effect on an offspring's success in its environment. These changes can be passed to offspring. • Differences between organisms of the same species can provide advantages for surviving and reproducing in different environments, which can lead to dramatic changed in a population over time. • The fossil record, natural selection, and common descent provide a scientific explanation for the history of life on Earth.

Unit Learning Targets
Students will…

- Estimate how closely related species are based on scientific evidence.
- Explain the different categories of evidence that support the theory of evolution.
- Summarize the results of experiments that led to the disproval of spontaneous generation.
- List the characteristics that describe the first forms of life on Earth.
- Explain the theory of endosymbiosis.
- Explain how modern cells have evolved.
- Relate the concepts of adaptation and fitness to the theory of natural selection.

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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. (HS-LS4-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- 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. (HS-LS4-2), (HS-LS4-4)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science.

- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- 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). (HS-LS4-1)

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity

- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

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. (HS-LS4-2), (HS-LS4-3)
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

LS4.C: Adaptation

- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)
- 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. (HS-LS4-3), (HS-LS4-4)
- Adaptation also means that the distribution of traits in a population can change when conditions

change. (HS-LS4-3)

- 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. (HS-LS4-5), (HS-LS4-6)
- 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. (HS-LS4-5)

LS4.D: Biodiversity and Humans

- 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. (HS-LS4-6) *(Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.)*

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary to HS-LS4-6)*
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary to HS-LS4-6)*

Crosscutting Concepts

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-1), (HS-LS4-3)

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2), (HS-LS4-4), (HS-LS4-5), (HS-LS4-6)

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. (HS-LS4-1), (HS-LS4-4)

Connections to Nature of Science

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

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-LS4-1)

Evidence of Learning

Summative Assessment: Unit test

Formative Assessments:

- Quizzes
- Homework
- Labs
- Projects

Lesson Plans

Activities/Interdisciplinary Connections	*Timeframe*
• Adaptation lab • Natural selection simulation • Video excerpts	Weeks 35-38
Teacher Resources	*Teacher Note*
• Textbook • PowerPoint / google slides presentation • Technology Tools (add/delete as appropriate): -Google Classroom -Pear Deck -FlipGrid -Kahoot -Kami	

Differentiating Instruction: Students with Disabilities, English Language Learners, and Gifted & Talented Students

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