Willingboro Public Schools

"Where Excellence is the Expectation"

Biology

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From New Jersey Student Learning Standards

Course Sequence/Table of Contents:

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Overview	Content Standards	Core Ideas
Unit 1 **Sustainability** **(Climate Change Law)**	• HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. • HS-ESS3-3. Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity. • HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. • HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. • HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and • biodiversity. • HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and • reproduce. • HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	• Resource availability has guided the development of human society. • 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. • The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. • Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary) • Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. • 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. • Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation,

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Overview	Content Standards	Core Ideas
		and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). ● 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. ● 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. ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. ● 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.

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Overview	Content Standards	Core Ideas
Unit 2 **Ecology: Living on Earth**	• 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-LS2-6. 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-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. • HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. • 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-LS2-6. Evaluate 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.	• 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. • 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. • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.

Overview	Content Standards	Core Ideas
		• 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. • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
Unit 3 **Cell Biology: World Health**	• 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. include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis. • 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.	• 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. • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.
Unit 4 **Genetics: Feeding the World**	• HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. • HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. • HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. • HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	• 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. • 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. • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular

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Overview	Content Standards	Core Ideas
		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. ● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell div ision), thereby creating new genetic combinations and thus more genetic v ariation. 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.
Unit 5 **Evolution: Maintaining Biodiversity**	● HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development. ● 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. Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical	● Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. ● 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. ● 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

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Overview	Content Standards	Core Ideas
	models such as simple distribution graphs and proportional reasoning. Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution. ● 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. Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations. ● HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations. Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading 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. Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.	those organisms that are better able to survive and reproduce in that environment. ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. ● 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. ● 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.
Suggested Open Educational Resources	● National Association of Biology Teachers ● 20 SEL Activities for High School ● HHMI BioInteractive ● The Concord Consortium ● Lab-Aids	

Unit 1: Sustainability

Overview

Literacy in science is of essence for all citizens in our modern society. This biology curriculum will focus on actively engaging students with the world around them. Students should gain in-depth knowledge of the different living organisms and the environments they each live in to better protect, sustain or enhance the natural environment.

Essential Questions	Enduring Understandings
● What do indicators tell us about regions of the world? ● What can indicators reveal about the sustainability challenges facing different countries? ● What steps have communities taken to live in ways that are more sustainable? ● Can the earth's ecosystems sustain our current use of resources? ● How can phosphate and nitrate indicators help identify the contamination problem in Jaffrey Lake? ● How can a sustainability plan be developed for Jaffrey Lake that will balance the interests of all of the stakeholders?	● A community is sustainable if it meets its present needs without compromising the ability of future generations to meet their own needs. ● An indicator is an observation or calculation that shows the presence or state of a condition or trend. ● Certain indicators reveal quality of life and natural resources consumption in a community. ● Sustainability problems of a community might be environmental, economical, or social. ● Sustainability problems have adverse environmental, economical, and social impacts on communities. ● A product's life cycle describes the amounts of resources and energy it takes to make the product, the length of the product's usefulness to the consumer, and how the product is disposed of, recycled, or reclaimed when it is no longer needed. ● Desertification happens when land-use practices cause healthy land to lose nutrients and water-holding capacity. ● Some solutions to sustainability challenges are technologically, economically, and socially viable. ● The earth has a finite amount of resources. ● Each individual has an impact on the ecosystem and that impact can, in many cases, be reduced. ● Concentrations of solutions can be measured in units of parts per million (or parts per billion). ● A small concentration of a contaminant can have a large effect on water quality. ● Human activity can have negative effects on water quality. ● A correlation is a relationship between one event or action and another. ● A causal relationship between two correlated events is when one event (called cause) and another event (called effect) are related by the latter being a direct consequence of the former. In a causal relationship, the cause(s) alone produces the effect. ● Successful decision-making takes into account all stakeholders. ● Trade-offs must be made when seeking viable solutions to sustainability problems.

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	• Sustainability problems have adverse environmental, economical, and social impacts on the community.

Unit 1: Sustainability

Performance Expectations/Core Ideas

- HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- HS-ESS3-3. Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.
- HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and
- biodiversity.
- HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and
- reproduce.
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Core Ideas

- Resource availability has guided the development of human society.
- 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.
- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.
- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.
- 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.
- 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.

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Unit 1: Sustainability

Performance Expectations/Core Ideas

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
- 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.
- 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.
- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
- 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.

Student Learning Objectives

Students will be able to:

- Investigate the use of resources across regions of the world by manipulating indicator data.
- Investigate indicators of four countries and analyze the current sustainability challenges facing those communities.
- Read about two communities that took steps to improve their resource use of energy, water, and land.
- Complete an on-line survey that estimates their ecological footprint and then compares the results with averages for the United States, other countries, and the world.
- Act in the role of scientists testing for contaminants in the lake water of fictitious Jaffrey Lake.
- Propose a master plan for dealing with the contamination of Jaffrey Lake in a way that is satisfactory to the stakeholders in the community.

Integrated Accommodations and Modifications		
Special Education Students	**English Language Learners**	**At Risk**
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered.

• Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	• Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

Gifted and Talented Students	**504 Plan**
• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments

Interdisciplinary Connections	**Computer Science and Design Thinking**
Math • HSS.IC.A.1: Understand statistics as a process for making inferences about population parameters based on a random sample from that population.	**Computer Science and Design Thinking Practices** 1. ☐ Fostering an Inclusive Computing and Design Culture

- HSS.IC.B.5: Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

English Language Arts

Reading

- RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

Writing

- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Speaking and Listening

- SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

2. ☑ Collaborating Around Computing and Design
3. ☐ Recognizing and Defining Computational Problems
4. ☐ Developing and Using Abstractions
5. ☐ Creating Computational Artifacts
6. ☐ Testing and Refining Computational Artifacts
7. ☑ Communicating About Computing and Design

Computer Science and Design Thinking Standards

- 8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
- 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.
- 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.

Core Ideas

- Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information.
- The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data.
- The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities.

Career Readiness, Life Literacies and Key Skills

Career Readiness, Life Literacies and Key Skills Practices

- Act as a responsible and contributing community member and employee.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity, increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 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.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1)
- 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.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

Formative Assessment Plan	Summative Assessment Plan
Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards. Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods: ● Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) ● Exit tickets, rotational activities (stations), quizzes, and small group activities ● Classwork, homework, group work ● Pre-Assessments, teacher's observation, class discussion, and journal	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.* ● **Investigations:** ○ **Our Global Community** ○ **Life in Other Countries** ○ **Ecological Footprint** ● **Case Study: Sustainability** ● **Laboratory: Jaffrey City's Problem** ● **Talk it Over: Jaffrey City's Master Plan**

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• Journal Writing • Daily Verbal Assessments	• **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module tests and quizzes) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Indicator, Sustainability, Resource Use, Product Life Cycle, Land Degradation, Sustainable Practice, Indicator, Ecological Footprint, Evidence, Claims and Reasoning, Eutrophication, Correlation and Causality, Sustainable Decision-Making, Trade-offs, Stakeholders

Resources:

- Climate Change - Climate Change 101 with Bill Nye | National Geographic **(Climate Change)**
- Ocean Plastics - How We Can Keep Plastics Out of Our Ocean | National Geographic **(Climate Change)**
- Conservation - How to save wildlife | Living Planet Report 2020 | WWF**(Climate Change)**
- SciGirls | Dra. Violeta Garcia: Ecologista y Pedagoga / Ecologist and Teacher | PBS LearningMedia **(Diversity, Equity & Inclusion)**

Pacing Guide

Can be found within Lab-Aids.

Unit 2: Ecology: Living on Earth

Overview

Literacy in science is of essence for all citizens in our modern society. This biology curriculum will focus on actively engaging students with the world around them. Students should gain in-depth knowledge of the different living organisms and the environments they each live in to better protect, sustain or enhance the natural environment.

Essential Questions	Enduring Understandings
• How does change affect ecosystems? • How quickly can a population grow? How does the size of a population change through time? • How do the characteristics of a biome determine the types of organisms found there? • How do certain characteristics increase the likelihood that a nonnative species becomes an invasive species? • How can the overuse of an ecosystem service be prevented? • How do plankton populations affect the sustainability of a fishery? • How can we use food webs to predict the short and long term effects of particular events on the ecosystem?	• Ecosystems involve interactions between communities of living things and those living things with their physical environment. • Ecological changes can stress ecosystems in many ways. When the ecosystem is able to recover from or accommodate stress it is demonstrating resiliency. • Biodiversity is related to the number of species in an ecosystem. • Increasing biodiversity (e.g., by adding an invasive species) does not necessarily increase the sustainability of an ecosystem. • Reducing biodiversity, especially reducing native species, can make an ecosystem less sustainable. • Populations grow at varying rates, depending on conditions. • Some species are better suited to certain environmental conditions than others. • Some conditions can lead to exponential population growth for certain species.

• How does human activity affect the movement of carbon through the carbon cycle and nitrogen through the nitrogen cycle? • How do carbon and oxygen cycle through the environment? • How do various factors affect the rate of cellular respiration? • How does changing one variable affect photosynthesis and cellular respiration in plants? • How does the rate of cellular respiration affect the oxygen levels available in an aquatic ecosystem? • How do organisms gain or lose from their interactions with each other? • How do changing variables alter population growth rates and ecosystem carrying capacities? • How can the environmental harm from salmon farming be minimized? • How does information about relationships among organisms help to determine the sustainability of a species and an ecosystem? • What determines if an ecosystem can recover from a major event? • How can case studies guide what should be done with the Avril Gulf tuna fishery? • Which fishery management strategy is the best choice for the sustainability of the Avril Gulf tuna fishery?	• Population growth is limited by the resources available. • Ecosystems have a carrying capacity based on the current resources available, which determines how large a population the ecosystem can support. • A biome is a region with characteristic climate, geography, and ecological communities of plants and animals. • The world can be grouped into a number of distinct • Because biomes are a human construct, there is not perfect agreement on the number and types of biomes found on earth. Tis unit includes the following biomes: tropical rain forest, desert, savanna, chaparral, temperate grass-land, taiga, temperate deciduous forest, and tundra. • The abiotic (nonliving) factors in an environment include light, temperature, precipitation, soil, rocks, and minerals. • The biotic factors in an environment are related to living things and include organisms, their interactions, and their waste. • Some traits are useful in helping an organism survive in a habitat. If the conditions in an environment change sufficiently, or if the organism moves to an entirely different environment, the trait(s) may no longer be useful and the organism will not be as well suited to the conditions. • Native species are those that are naturally found in an ecosystem. Since it is impossible for humans to know exactly which species are “natural” to an environment, it is generally considered that a species is native if it is thought to have existed in an environment for thousands of years. • An introduced species is one that has been brought into an environment in which it does not naturally occur. Such species are also referred to as nonnative, exotic, or nonindigenous. • Not all introduced species succeed in a new environment. If one can easily acclimate to the new environment, it is more likely to become established. • If a nonnative species causes harm to the environment, the economy, or human health, it is considered invasive. • If a nonnative species displaces a native species from its habitat, it is considered invasive. • Ecosystem services are the natural resources and processes that humans rely on for survival. • There are many types of ecosystem services, some of which provide direct benefits and some of which provide indirect benefits. • Societies can prevent diminishment of common resources with appropriate regulations and enforcement. • Limits, such as fishing limits, must be monitored to ensure they are set at appropriate levels. • Scientists create models to compare a theoretical situation to an actual situation.

	• Ecological biodiversity is the number of species found in a given ecosystem or area. • Biodiversity allows for a variety of habitats to be filled within an ecosystem. • Microscopic organisms, such as some plankton, form the basis for large food webs. • Fishery productivity can be linked to plankton productivity. • Producers form the bases of food webs, and when consumed, provide energy for consumers. • Food is as an energy source. • There are many varieties of consumers. Some are herbivores and eat only producers; some are carnivores and eat only other consumers; some are omnivores and eat both; and some are decomposers and eat only dead and • decaying organic matter. • A food web is a diagram that shows energy flow through an ecosystem. • An energy pyramid is a diagram that shows how much energy is available for each level of organism (producers, consumers, etc.). • Consumers are placed at certain levels according to what they consume. Primary consumers eat producers, secondary consumers eat primary consumers, and tertiary consumers eat secondary consumers. • Ecosystems depend on a diversity of organisms to function. • Removal of one or more species from a food web can cause an ecosystem to collapse. • Some events that disturb an ecosystem have only a short-term effect, while others are long lasting. • The carbon cycle is one of several biogeochemical cycles that move elements through multiple reservoirs, allowing the elements to be used repeatedly by living organisms. • Reservoirs in the carbon cycle include rocks and soils, the ocean and other bodies of water, producers, consumers, the atmosphere, and fossil fuels. • The total amount of carbon in the carbon cycle is fixed; it is neither created nor destroyed. • The amount of carbon in each reservoir fluctuates. • The carbon in different reservoirs is in different chemical forms, such as carbon dioxide or glucose. • Human activities, such as the burning of fossil fuels, have a major impact on the movement of carbon between reservoirs by releasing previously immobile forms of carbon. • Photosynthesis is a cellular process through which organisms capture light energy from the sun and use it to generate and store energy. • Cellular respiration releases stored energy in glucose, allowing the organism to function.

	• Light is required for photosynthesis to occur, although parts of photosynthesis can happen in the absence of light. • Photosynthesis happens in the chloroplasts, which contain chlorophyll. • Only producers can perform photosynthesis. • Cellular respiration happens in the mitochondria and cytoplasm of cells. • Many organisms, including plants and plankton, perform oxygen-dependent cellular respiration. • Photosynthesis takes in light energy, carbon dioxide, and water, producing glucose and oxygen. • Cellular respiration takes in oxygen and glucose and produces carbon dioxide and water. Adenosine triphosphate (ATP) is also produced from cellular respiration. • The substances produced and consumed in photosynthesis and cellular respiration are complementary. • Some experimental designs require a control and experimental setup. • Designing an experiment requires a clear, reproducible • procedure. • Designing an experiment requires choosing an experimental variable that can be manipulated independently of the other variables. • Cellular respiration occurs in plants as well as other organisms. • Cellular respiration occurs at different rates under different conditions. • Plants can perform cellular respiration independently of photosynthesis. • The stages of photosynthesis that produce oxygen happen in the presence of light. • Plants and other producers perform cellular respiration and, therefore, produce carbon dioxide. • Different variables, such as temperature, and amount of light, affect the rate of photosynthesis and cellular respiration. • Chemical indicators show chemical changes in a substance, such as when water becomes more acidic due to the addition of carbon dioxide. • Chemical indicators allow us to infer that a cellular process, such as photosynthesis, is occurring. • Greater nutrient availability in aquatic environments can cause an increase in phytoplankton. • A large increase in nutrient availability that stimulates plant growth is called eutrophication. • Dramatic increases in phytoplankton make more organic matter available for decomposer bacteria, thus increasing the amount of bacteria. • Increases in bacteria deplete surrounding waters of oxygen, causing other organisms in the ecosystem to migrate or die.

	• Dead zones are created where there is a lack of organisms as a result of eutrophication. • Aquatic environments depend on a balance of photosynthesis and cellular respiration to prevent dead zones. • Dead zones have a significant impact on surrounding ecosystems and ecosystem services. • Experiments require a control and experimental setup. • Scientific models are created to represent actual phenomena. • Organisms frequently have close ecological relationships, known as symbiotic relationships. • The four main categories of symbiotic relationships are: parasitism, commensalism, amensalism, and mutualism. • In parasitism one species benefits, and the other is harmed. • In commensalism one species benefits, and the other is not harmed and does not benefit. • In amensalism one species is harmed and the other species is not harmed and does not benefit. • In mutualism both species benefit. • Population growth rate is the rate of change in a population over specified intervals of time. • Population growth rate is affected by a number of factors, some of which constantly fluctuate. • Factors that affect population growth rate include birth rate, death rate, disease, predators, food availability, and human activities. • A positive growth rate indicates that the population is getting larger, while a negative growth rate indicates the population is getting smaller. • The trend of a growth rate can be altered if the factors influencing it change. • Sustained negative growth rates will eventually lead to population extinction. • Populations with a positive growth rate eventually reach a carrying capacity, at which point the ecosystem cannot support a larger population. • Aquaculture is the practice of growing fsh and other aquatic species for human consumption. • Some species are better suited to aquaculture than others. • Many types of aquaculture are employed around the world. • Aquaculture often harms the surrounding ecosystem. • The damage by aquaculture to the surrounding ecosystem can be mitigated in several ways. • Relationships between species in an ecosystem are interdependent. • Changes in the population of a species within an ecosystem affect other species in that ecosystem. • Removing a species from an ecosystem can have unintended consequences.

	• Some fisheries have significantly damaged associated ecosystems. • Changes in the population dynamics of an ecosystem can be a factor in an invasive species becoming established within that ecosystem. • Sustainable management of ecosystem services depends on continual input from scientists and other experts. • Natural and human-caused events ofen disturb ecosystems. • Ecosystem disturbance varies in degree, from minor disruption to catastrophe. • If the disturbance is discrete, ecosystems can sometimes recover through ecological succession. • Primary succession occurs in areas devoid of input (e.g., soil and organisms). • Secondary succession occurs in disturbed areas where some input remains. • Ecosystem resilience refers to an ecosystem's ability to return to its previous state after a disturbance. It often depends on the biodiversity remaining within and living around a disturbed area. • Not all ecosystems are resilient enough to recover from a disturbance. • Some ecosystems are naturally resistant to certain invasive species. This can help prevent invasive species from becoming established in those ecosystems. • Historical case studies provide information that can be helpful in decision-making. • There are numerous approaches to fisheries management. • Aquaculture and marine reserves are two strategies for protecting fisheries in decline. • Successful fishery-management strategies must be tailored to each situation. • Marine reserves and aquaculture are two fishery-management strategies, each of which involves certain environmental, social, and economic consequences. • Analyses of indicators inform resource-management decisions. • Indicators from a variety of data types over extended periods of time provide more information than a limited set of indicators from a short period.

Unit 2: Ecology: Living on Earth

Content Standards

- 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-LS2-6. 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-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- 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.

Unit 2: Ecology: Living on Earth

Content Standards

- HS-LS2-6. Evaluate 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.

Core Ideas

- 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.
- 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.
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
- 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.
- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.

Student Learning Objectives

Students will be able to:

- Investigate case studies of ecosystem changes and the impacts on organisms.
- Monitor and analyze the growth of a population of duckweed plants for an eight-week period.
- Investigate characteristics of biomes and types of organisms in biomes.
- Investigate characteristics that make it likely for a species to become an invasive and examine case studies of invasive species introductions.
- Investigate how fishing limits impact the sustainability of a fishery.
- Investigate how fishing limits impact the sustainability of a fishery.
- Explore the relationships that exist among organisms in a kelp forest and use a food web they construct to predict the impact of different events on the kelp forest ecosystem.
- Model the movement of carbon through the natural cycle of matter, and compares this to the impact of human activities on the movement of carbon through its cycle of matter.

- Determine the cycle of photosynthesis and cellular respiration by organizing a series of statements into a sequence.
- Investigate cellular respiration in beans. Students develop their own variable and test conditions.
- Observe underwater plants in various conditions to determine if plants respire and photosynthesize. Students will develop their own variable and test conditions.
- Use yeast to model population dynamic, cellular respiration & eutrophication.
- Use descriptions of inter-species interactions to determine different symbiotic relationships.
- Investigate the effect of birth rate and carrying capacity on the growth rate of a population.
- Examine the effect of a salmon farm on wild salmon population growth.
- Examine graphs of different populations effected by fisheries and try to determine what the whole ecosystem effect has been.
- Read about primary and secondary succession and how that is affected by ecosystem resiliency.
- Analyze case studies and predict how fishery management strategies might impact the sustainability of Bayside and the Purple-spotted Flatfish fishery.
- Analyze indicator data to determine the impact of a fishery management strategy on the sustainability of Bayside and the Purple-spotted Flatfish fishery.

Integrated Accommodations and Modifications		
Special Education Students	**English Language Learners**	**At Risk**
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time
Gifted and Talented Students		**504 Plan**

• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments
Interdisciplinary Connections	**Computer Science and Design Thinking**
Math • HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling. **English Language Arts** Reading • RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing • WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	**Computer Science and Design Thinking Practices** 1. ☐ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. ☐ Recognizing and Defining Computational Problems 4. ☐ Developing and Using Abstractions 5. ☐ Creating Computational Artifacts 6. ☐ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** • 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. **Core Ideas**

	• Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. • Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.

Career Readiness, Life Literacies and Key Skills

Career Readiness, Life Literacies and Key Skills Practices

- Act as a responsible and contributing community members and employee
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 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.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan

Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards.
 	
Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods:
	Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.
	
	• **Investigations:**
	  ○ **Biomes**
	  ○ **Invasive Species**
	  ○ **Producers and Consumers**

• Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) • Exit tickets, rotational activities (stations), quizzes, and small group activities • Classwork, homework, group work • Pre-Assessments, teacher's observation, class discussion, and journal • Journal Writing • Daily Verbal Assessments	○ **Energy Flow Through an Ecosystem** ○ **Cycles of Matter** ○ **The Photosynthesis and Cellular Respiration Shuffle** ○ **Too Much Life** ○ **Symbiotic Relationships** ○ **Investigating Population Growth Rates** ○ **Ecosystems Out of Balance** ○ **Making Sustainable Fishery Decisions** • **Modeling:** ○ **The Tragedy of the Commons** ○ **Changes Due to Population Growth** • **Laboratory:** ○ **A Population of Duckweed** ○ **Respiring Beans** ○ **Respiration and Photosynthesis in Plants** • **Talk it Over:** ○ **Ecosystems and Change** ○ **Fishery Case Studies** • **Reading:** ○ **Ecosystems Change and Resiliency** • **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module tests and quizzes) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Photosynthesis, Cellular Respiration, Population Dynamics, Eutrophication, Symbiosis, Parasitism, Mutualism, Commensalism, Populations, Population Growth Rates, Birth Rates, Carrying Capacity, Population Dynamics, Inter-species Relationships, Human Impact, Succession, Ecosystem Resilience, Food Web

Resources:

- Invasive Species - Invasive Species 101 | National GeographicDivers Fight the Invasive Lionfish | National Geographic
- Tragedy of the Commons -What is the tragedy of the commons? - Nicholas Amendolare
- Succession - Why certain naturally occurring wildfires are necessary - Jim Schulz

Pacing Guide

Can be found within LabAids.

Unit 3: Cell Biology: World Health

Overview

Literacy in science is of essence for all citizens in our modern society. This biology curriculum will focus on actively engaging students with the world around them. Students should gain in-depth knowledge of the different living organisms and the environments they each live in to better protect, sustain or enhance the natural environment.

Essential Questions	Enduring Understandings
• What do health indicators show about world health and sustainability? • How do observations of cells help doctors and scientists diagnose and study diseases? • What are the similarities and differences in cells from various living organisms? • What are the functions of the structures in cells? • What are the specialized structures and functions of cells? • What are the fundamental structures and functions of cells? • What structures and characteristics help the cell membrane perform its functions? • What factors determine whether substance moves across a model of the cell membrane? • How do the structures of the cell membrane help it function? • What are the functions of proteins in cells and viruses? • How do pH and temperature affect the function of the enzyme lactase? • How do photosynthesis and cellular respiration meet the energy needs of all organisms? • What happens during each phase of the cell cycle,and how are the phases regulated? • How do stem cells produce specialized cells? • What are the current scientific understandings and social debates about stem cell research? • How does HIV take overacell's structures and organelles during infection and use them to reproduce? • What are the benefits, drawbacks,and trade-offs of some disease interventions? • How should funding be allocated to address sustainability problems related to world health?	• Diseases are classified as infectious or noninfectious. • Infectious diseases are transmitted from person to person either directly or by vectors. Noninfectious diseases cannot be transmitted and are instead due to such factors as aging, the environment, behavior, or genetics. • Less-developed countries tend to have a greater proportion of deaths from infectious diseases than do more-developed countries. • The challenges of dealing with diseases affect progress toward sustainable development, by which existing communities improve their means of meeting their needs without endangering future generations' abilities to meet their needs. These needs include receiving appropriate medical care and living a full life span. • Some human diseases are caused by abnormalities that develop within the body's cells, while others are caused by microbes. • Some diseases, including sickle cell disease and malaria, are diagnosed by viewing blood samples from the affected individual through a light microscope. • Every organism is made of one or more cells. • Cells have particular structures that perform specific functions. • Every cell is surrounded by a membrane, which separates it from the outside environment. • Some plant cells contain chloroplasts. • A plant cell has a cell wall. • Cells have particular structures that underlie their functions, including a cell membrane and a cytoplasm that contain a mixture of thousands of different molecules. • All of the molecules in a cell form a variety of specialized structures and organelles, to perform such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and storage of genetic material. • Plant cells contain chloroplasts, the site of photosynthesis.

	• The genetic information stored in DNA directs the synthesis of the thousands of proteins the cell needs. • Bacterial cells have neither a nucleus nor other membrane-bound organelles. • Cells have particular structures that enable their functions, including a cell membrane and a cytoplasm that contains a mixture of thousands of different molecules. • All of the molecules in a cell form a variety of specialized structures and organelles that perform such cell functions as energy production, transport of molecules, waste disposal, synthesis of new molecules, and storage of genetic material. • Every cell is surrounded by a membrane that separates it from the outside environment. • All cells maintain homeostasis, a range of internal conditions that allows the cell to live and function. • All cells have cytoplasm. Within the cytoplasm of eukaryotic cells is a cytoskeleton that provides support and structure for the cell. • Nearly all cells contain genetic information. In eukaryotes, the genetic information is stored in the nucleus. • Multicellular organisms have specialized cells with an arrangement of structures that accomplishes a specialized function. • The cytoplasm of all cells (and the nucleus of eukaryotes) is the site of the reactions of metabolism. • Every cell is surrounded by a membrane that serves as a barrier between the cell and its environment. • The cell membrane is made mainly of phospholipids and proteins. • The membrane is a fluid structure that gives the cell flexibility and strength. • Models help us understand cellular processes that are difficult to observe in living cells, but they have limitations. • Diffusion is the movement of a substance from an area of higher concentration to an area of lower concentration. • Some substances can diffuse across cell membranes. The diffusion of a liquid, such as water, across a membrane is called osmosis. • The cell membrane is selectively permeable, meaning that only certain substances can move into or out of the cell. • In an experiment a control provides a standard of comparison for judging experimental effects. • Models help us understand cellular processes that are difficult to observe in living cells, but models have limitations. • Some substances diffuse freely across the cell membrane, while others enter through protein channels in a process called facilitated diffusion.

	• Some substances are transported into the cell against, or up, a concentration gradient by transport proteins. This process requires the cell to expend energy and is called active transport. • The genetic information stored in DNA directs the synthesis of the thousands of proteins the cell needs. • Proteins are often classified according to their functions. • Enzymes are a large group of proteins that act as biological catalysts to speed up the chemical reactions in cells. • Enzymes' structures and functions are affected by such factors as temperature and pH. • The energy for life is derived primarily from the sun. • The structure and organization of cells and internal cell parts are essential for the cell to transform and release energy needed for cellular functions. • Plants capture energy by absorbing light and using it to form chemical bonds between the atoms of carbon-containing molecules. • The chemical bonds of food molecules store energy. • Energy is released when the bonds of food molecules are rearranged in the reactions of cellular respiration to form new compounds. • Cells temporarily store the energy released by cellular respiration in adenosine triphosphate (ATP) molecules. • Cell functions are regulated to control and coordinate cell growth and division. • The cell cycle is the complete sequence of phases from the end of one cell division to the end of the next. • When normal cell regulation is disrupted, serious consequences, such as cancer, result. • Some types of cells, including blood and skin cells, divide more often than other types, such as liver and nerve cells. • Stem cells can produce a variety of specialized cells. • The process by which stem cells produce specialized descendent cells is called differentiation. • An embryonic stem cell has the potential to produce any type of specialized cells, while stem cells from developed organisms can produce a limited set of specialized cell types. • To support life cells need thousands of proteins, each with a specialized function. • Receptor proteins and enzymes play key roles in viral infections. • Cellular organelles, structures, and enzymes make the proteins required by cells. • The HIV virus is not a cell and cannot reproduce on its own. • When HIV infects a cell, it uses the host's cell organelles and proteins to make more HIV viruses.

	• Abnormal body cells and microbes cause diseases. • Disease interventions are actions taken to prevent or treat diseases. • Less-developed countries tend to have a higher proportion of deaths from infectious diseases than do more-developed countries.

Unit 3: Cell Biology: World Health

Content Standards

- 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. include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.
- 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.

Core Ideas

- 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.
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

Student Learning Objectives

Students will be able to:

- Look at world health data and examine factors of sustainability tied to disease
- Observe normal red blood cells, sickled red blood cells, and blood infected with Plasmodium in order to determine the cause of two patients' symptoms. Students begin to think about cell structure and function.
- Prepare a drawing of a cell as a formative assessment and write their ideas about cells. Then they examine using a light microscope the similarities and differences in various types of living cells and fixed cells.
- Learn about common cells structures and functions.
- Investigate the different numbers and types of organelles required for specialized plant and animal cells.
- Read about the history of the development of the cell principle, and cell structures and functions.
- Investigate several models of the cell membrane in order to observe properties of the cell membrane.
- Investigate the properties of the cell membrane and osmosis and diffusion by using dialysis tubing models using water, glucose, starch and iodine.

- Read about the cell membrane's functions and the fluid mosaic model.
- Research one type of protein and present the information to the class in order to learn the diverse functions of proteins in cells.
- Design an experiment to test the effects of pH and temperature on the function of an enzyme.
- Complete a computer simulation of the processes of photosynthesis and cellular respiration and then complete a reading about the two processes.
- Investigate the cell cycle including mitosis and cytokinesis
- Use a set of colored chips to investigate the steps in which embryonic stem cells become specialized cells.
- Discuss a set of questions surrounding the stem cell research debate, and examine why it is not useful for addressing infectious diseases.
- Investigate how HIV uses the endomembrane system during infection of a human cell.
- Summarize the disease mechanism for six diseases, examine various interventions for the six diseases and their trade-offs.
- Write a world health proposal to address the problems of disease and vote on which to fund when funding is limited.

Integrated Accommodations and Modifications

Special Education Students	English Language Learners	At Risk
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

Gifted and Talented Students	504 Plan
• Utilize advanced, accelerated, or compacted content	• Pair visual prompts with verbal presentations

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• Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments
Interdisciplinary Connections	**Computer Science and Design Thinking**
Math • HSF-BF.A.1: Write a function that describes a relationship between two quantities. • HSS.IC.A.1: Understand statistics as a process for making inferences about population parameters based on a random sample from that population. • HSS.IC.B.5: Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. **English Language Arts** Reading • RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing • WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and	**Computer Science and Design Thinking Practices** 1. □ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. □ Recognizing and Defining Computational Problems 4. □ Developing and Using Abstractions 5. □ Creating Computational Artifacts 6. □ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** • 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. • 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources. • 8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. • 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. **Core Ideas** • The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities.

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limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. ● WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. Speaking and Listening ● SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	● Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information. ● The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data.

Career Readiness, Life Literacies and Key Skills

Career Readiness, Life Literacies and Key Skills Practices

- Act as a responsible and contributing community members and employee
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 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.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1)
- 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.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan

Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards.

Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods:

- Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy)
- Exit tickets, rotational activities (stations), quizzes, and small group activities
- Classwork, homework, group work
- Pre-Assessments, teacher's observation, class discussion, and journal
- Journal Writing
- Daily Verbal Assessments

Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.

- **Investigations:**
  - **What Do Cells Do?**
  - **What Do Specialized Cells Do?**
  - **The Cell Cycle**
  - **Stem Cell Differentiation**
  - **HIV/AIDS Infection And Cell Organelles**
- **Laboratory:**
  - **Cells and Disease**
  - **What is a Cell?**
  - **The Cell Membrane and Diffusion**
  - **Investigating Enzyme Function**
- **Talk it Over:**
  - **World Health and Sustainability**
  - **Stem Cell Research**
  - **Disease Interventions**
  - **World Health Proposal**
- **Reading:**
  - **Cell Structure and Function**
  - **Cell Membrane and Diffusion**
  - **Photosynthesis and Cellular Respiration**
- **Modeling: A Model Membrane**
- **Research Project and Presentations: Functions of Protein in Cells**
- **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module tests and quizzes) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Indicators, Sustainability, Microbes, Abnormal Cells and Diseases, Cell Structure and Function, Cell Differentiation, Cell Principle, Cell Membrane, Diffusion, Osmosis, Passive Transport, Active Transport, Proteins, Enzymes, Chloroplasts, Mitochondria, Light and Dark Reactions, Calvin Cycle, Glycolysis, Electron Transport Chain, Anaerobic Fermentation, Cell Cycle, Mitosis, Cytokinesis, Stem Cells, Virus Infection, Abnormal Cells, Disease, Disease Intervention, Sustainable Development,

Resources:
• Cells Alive - 3D imagery of cells - CELLS alive! • Virtual Diffusion Lab - Cell Homeostasis Virtual Lab - Activity • Cancer Movement - How does cancer spread through the body? - Ivan Seah Yu Jun • Careers: Developmental Stem Cell Biology Graduate Student **(Amistad Law)** • Study uses stem cells from umbilical cords to fight rare heart defect **(Disabilities Awareness)** • Untold Story Celebrating Pride: Alan Hart - Science ATL **(LGBTQ+)** • The Discovery the Germs Cause Disease- Tuberculosis in America
Pacing Guide
Can be found within LabAids.

Unit 4: Genetics: Feeding the World

Overview

Literacy in science is of essence for all citizens in our modern society. This biology curriculum will focus on actively engaging students with the world around them. Students should gain in-depth knowledge of the different living organisms and the environments they each live in to better protect, sustain or enhance the natural environment.

Essential Questions	Enduring Understandings
• Should your country allow farmers to grow genetically modified corn? • How do scientists genetically modify an organism? • If a genetically modified cell undergoes mitosis, how likely is it that the daughter cells will contain the inserted gene? • How can information about the genetic makeup of plants help farmers breed plants for desirable traits? • What can we inferaboutgenesand traits based on heredity patterns? • How do scientists predict the results of crossing corn for two kernel characteristics: color and texture? • What trade-offs are involved in selective breeding desirable strain of rice? • What information can geneticists obtain by analyzing a pedigree? • How is DNA isolated from an organism? • What is the molecular structure of DNA? • How has genomics contributed to our understanding of heredity? • How does DNA replicate? • How do chromosomes divide during the formation of egg and sperm cells? • How do genes and chromosomes behave during meiosisand sexual reproduction? • What are the benefits and trade-offs of using genetically modified organisms? • How does a cell make proteins with the information from DNA?	• Genetically modified organisms are created through the insertion of particular genes, usually from other species, into the genetic material or through the deletion of particular genes. • Many crops have been genetically modified to carry specific desirable traits, such as pest or disease resistance, drought tolerance, and higher nutritional value. • The production and use of a genetically modified organism might have unintended consequences for humans and ecosystems. • Basic concepts and principles of science and technology contribute to evidence-based debate about the economics, policies, politics, and ethics of various science- and technology-related innovations. • Cells store DNA to guide their functions. The genetic information stored in DNA directs the synthesis of the thousands of proteins the cell needs. • Scientists alter small pieces of DNA called plasmids to transfer desired genes into bacteria. • Through selective breeding and genetic modification of organisms, people can significantly transform the genetic makeup of a population. • Asexual reproduction produces genetically identical offspring from a single parent. • Genes are organized in larger structures called chromosomes.

• How does the same set of genes direct the activities of 220 human cell types? • Which samples contain genetically modified corn? • What are the benefits and trade-offs of genetically modifying crops to contain edible vaccines? • Should the government Panel on Genetic Modification approve the planting of genetically modified soybeans?	• Mitosis is the process by which replicated chromosomes divide and, following cytokinesis, form two identical daughter cells. • Cells contain two copies of each gene. These copies are called alleles. In organisms that reproduce sexually, one allele of each type of gene is inherited from each parent. • Punnett squares are models of the transmission of alleles from one generation to the next. • A Punnett square demonstrates the possible phenotypic and genotypic results of a cross and how likely it is that each genotype and phenotype will occur from that cross. • Studying and observing the results of sexual reproduction of a model organism provide information about the behavior of genes and the relationship between genotype and phenotype. • Selective breeding influences the phenotypes and genotypes of offspring. • Heredity is the passage of genetic traits from one generation to the next. • Gregor Mendel (1822–1884) was a monk, teacher, and scientist, who studied the relationship between heredity and traits, mainly by experimenting with pea plants. • According to the laws of simple dominance, dominant traits will appear in the phenotype of an organism, while recessive traits are masked by the presence of a dominant trait. • Genes are sequences of DNA that encode for a particular trait. • Dominance is not always complete. Incomplete dominance refers to two traits that result in a third, intermediate trait, while codominance refers to the full expression of both traits in a heterozygote. • Some traits are determined by one gene, and others are determined by multiple genes. • In all organisms, genes carry the instructions for specifying the characteristics of the organism. • Cells contain two copies of each gene. These copies are called alleles. • Breeding generations of model organisms, such as corn, provides extensive information about the behavior of genes and the relationship between genotype and phenotype. • Selective breeding develops organisms with desirable traits. • Punnett squares predict the phenotypes and genotypes of a cross between two parents for two traits that are not linked. • According to the laws of simple dominance, dominant traits will appear in the phenotype of an organism, while recessive traits are masked by the presence of a dominant trait. • From pedigrees scientists can infer the genetic mechanism of inheritance of single-gene traits.

	• DNA is the genetic material in all cells. • DNA is isolated from cells by breaking the cells and adding chemicals that precipitate the DNA. • DNA is a macromolecule composed of nucleotide subunits. • DNA is composed of two complementary strands, each made of a sequence of nucleotides. • Each strand of DNA has a sugar–phosphate backbone and a sequence of nitrogenous bases. Two strands of DNA together form a double helix. • Genomics is the study of the entire genetic makeup of an organism. This field has expanded rapidly over the past four decades. • The Human Genome Project successfully cataloged the human genome. The information generated by the project has allowed scientists to explore the role of genes in human diseases and healing and new approaches to finding cures. • Genomics has the potential to contribute to solving sustainability problems related to biodiversity, alternative energy, and human and animal health. • In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a molecule formed from a sequence of nucleotide • subunits. • The nucleotide subunits found in DNA are adenine, guanine, cytosine, and thymine, represented as A, G, C, and T. • The chemical and structural properties of DNA are the basis for how the genetic information that determines heredity is both encoded in genes (as a string of molecular “bases”) and replicated by means of a semiconservative template mechanism. • Most of the cells in an organism are diploid: they contain two copies (a pair) of each kind of chromosome. • Gametes are formed through meiosis, which creates four haploid sex cells, each containing only one copy of each kind of chromosome. • Gametes—sperm in males and eggs in females—contain half the number of chromosomes found in the somatic cells of the same organism. • Fertilization occurs when a sperm and egg unite in sexual reproduction. This produces an offspring with two copies of each chromosome, one from the maternal parent and one from the paternal parent. • A karyotype is an image of the stained chromosomes of a cell. • The independent segregation of chromosomes during meiosis is the basis for traits that exhibit independent assortment. • As a result of independent segregation and crossing over during meiosis, one individual produces an almost limitless variety of gametes. • Abnormalities in chromosome number from errors occurring in gamete production often result in loss of viability or abnormal development of affected offspring.

	• Genetically modified organisms are those in which a gene or genes from another organism have been inserted into or deleted from their genetic material. • Genetic modification has been used to develop organisms with specific desirable traits, such as pest or disease resistance, drought tolerance, or enhanced nutritional qualities. • The production and use of genetically modified organisms might have unintended consequences for humans and ecosystems. • Basic concepts and principles of science and technology contribute to evidence-based debate about the economics, policies, politics, and ethics of various science- and technology-related innovations. • Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, whereas others have a variety of effects. • The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "bases") and replicated by means of a template. • The expression of specific genes regulates cell differentiation and cell functions. • Somatic cells in an individual organism have the same genome, but selectively express the genes for production of characteristic proteins. • The proteins a cell produces determine that cell's phenotype. • In all organisms, the instructions for specifying the characteristics of the organism are in the genes. • Understanding DNA makes it possible for scientists to manipulate genes and thereby create new combinations of traits and new varieties of organisms. DNA electrophoresis separates DNA based on size. • DNA electrophoresis is a method of using known samples and markers to match DNA. • Understanding DNA makes it possible for scientists to manipulate genes to create new combinations of traits and new varieties of organisms. • The key steps in the creation of a genetically modified organism are: identification of a desirable gene; isolation of the gene; preparation of a DNA construct that contains the desired gene and a selectable marker; delivery of the desired gene into the target organism; and raising the transformed organisms using a selective medium to verify that the gene has been inserted into the target organism. • DNA constructs are inserted into organisms in several ways, including shooting them in with a gene gun, bacterial transformation, or delivering them via a virus.

	• Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science- and technology-related issues. • Human activities have a major effect on other species. • Understanding the relationship between the structure and function of DNA, chromosomes, and genes makes it possible for scientists to manipulate genes and thereby create new combinations of traits and new varieties of organisms. • The farming of genetically modified plants or animals poses risks and benefits, and making decisions about them requires trade-offs. • Individuals and society must decide on proposals involving new research and the introduction of new technologies into the environment. Decisions require assessment of alternatives, risks, costs, and benefits, and consider- • ation of who benefits and who does not, who pays and who gains, and what risks are and who or what bears them.

Unit 4: Genetics: Feeding the World

Content Standards

Performance Expectations

- HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
- HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Core Ideas

- 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.
- 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.
- 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.

Unit 4: Genetics: Feeding the World

Content Standards

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell div ision), 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.

Student Learning Objectives

Students will be able to:

- Consider the use of Genetically Modified Organisms by looking at it from the perspective of a country trying to decide if they should grow Bt corn.
- Investigate the conditions necessary for genetically modified bacteria to express an inserted gene.
- View online computer animations and construct a narrated sketch of the phases of meiosis. Students show how an gene inserted into a genetically modified organism can be passed on to a daughter cell through the process of asexual reproduction.
- Observe the phenotypes of several ears of corn and use their observations and Punnett squares to determine the genotypes of the parents used to produce the resulting corn ears.
- Read about basic genetics concepts as they relate to the heredity of traits.
- Use Punnett squares to predict the outcome of a cross between corn plants for two traits. Students create a plan to determine the genotype of a parent based on observing the results of crosses for two traits.
- Use Allele Cards to apply their knowledge of genetics to the breeding of a desirable strain of rice.
- Trace traits in pedigrees to determine their mechanism of inheritance.
- Compare DNA isolated from spinach to DNA from various other samples to investigate the universal structure of DNA.
- Work with several different representations and a model of DNA to learn about its molecular structure.
- Read about the history of genomics and how the science is developing.
- Use online simulation & DNA model to gather evidence to support one of three hypothesis of DNA replication conservative, semi-conservative, or dispersive-- in a historical exploration of the DNA replication experiments conducted by Meselson and Stahl.
- View computer simulations to investigate how chromosomes divide during meiosis. Students use their understanding of meiosis to explore the question, “What is the chance an inserted gene will be passed onto a daughter cell through the process of sexual reproduction?”
- Read about the passing of chromosomes from the parents to offspring during the process of sexual and asexual reproduction.
- Produce informational posters that highlight the development of and issues related to a genetically modified organism. Information gained through a poster session is used to develop criteria to evaluate GM organisms that will be used in the final activity.
- Work through the stages of protein synthesis. Then they work through a model to show the steps involved at each stage.
- Explore gene expression combinations and explore the impact of gene expression and repression on cell phenotype.
- Run and interpret a DNA electrophoresis gel to determine which corn samples contain genetically modified corn.
- Read about the engineering of plants that are genetically modified to produce proteins that induce a vaccine response in humans.
- Use information gathered from different research studies to determine if they want to use a genetically modified crop to help solve a sustainability challenge.

Integrated Accommodations and Modifications

Special Education Students	English Language Learners	At Risk
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment • Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

Gifted and Talented Students	504 Plan
• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments

Interdisciplinary Connections	Computer Science and Design Thinking
English/Language Arts Reading ● RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing ● WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. ● WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. ● WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. ● WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. ● WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. Speaking and Listening ● SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.	**Computer Science and Design Thinking Practices** 1. □ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. □ Recognizing and Defining Computational Problems 4. □ Developing and Using Abstractions 5. □ Creating Computational Artifacts 6. □ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** ● 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. ● 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. ● 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. ● 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources. **Core Ideas** ● Individuals select digital tools and design automated processes to collect, transform, generalize, simplify, and present large data sets in different ways to influence how other people interpret and understand the underlying information. ● Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information. ● The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data. ● The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities.
Career Readiness, Life Literacies and Key Skills	

Career Readiness, Life Literacies and Key Skills Practices

- Act as a responsible and contributing community members and employee
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 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.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1)
- 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.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
- 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2)
- 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan
Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards.	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.*

Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods: ● Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy) ● Exit tickets, rotational activities (stations), quizzes, and small group activities ● Classwork, homework, group work ● Pre-Assessments, teacher's observation, class discussion, and journal ● Journal Writing ● Daily Verbal Assessments	● **Investigations:** ○ **A Genetically Modified Solution** ○ **Breeding Corn** ○ **Interpreting Pedigrees** ○ **DNA Replication** ○ **Cell Differentiation and Gene Expression** ● **Laboratory:** ○ **Creating Genetically Modified Bacteria** ○ **DNA Isolation** ○ **Which Corn is Genetically Modified?** ● **Modeling:** ○ **Mitosis and Asexual Reproduction** ○ **Breeding Corn for Two Traits** ○ **Breeding Better Rice** ○ **Modeling DNA Structure** ○ **Meiosis and Sexual Reproduction** ○ **Protein Synthesis: Transcription and Translation** ● **Reading:** ○ **Genes and Traits** ○ **Genomics** ○ **Genes and Chromosomes** ○ **Biopharming Edible Vaccines** ● **Talk it Over: Are GMO's the Solution?** ● **Project: Evaluating Genetically Modified Organisms** ● **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module tests and quizzes) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Genetic Modification, Trade-offs, E-coli, Plasmid, Bacterial Transformation, Gene Expression, Chromosome, Mitosis, Asexual Reproduction, Genotype, Phenotype, Ratios, Crosses, Punnett Squares, Sex Cells, genotype, Phenotype, Crosses, Mendel, Alleles, Inheritance of Traits, Simple Dominance, Incomplete Dominance, Codominance, Dihybrid, Law of Independent Assortment, Simple Dominance, Patterns of Inheritance, Selective Breeding, Traits, Pedigrees, Sex-linked Traits, Co-Dominance, DNA, Isolation, Cell Lysis, DNA, Nucleotide, Sugar-phosphate backbone, Genomics, Human Genome Project, DNA, Semi-Conservative Replication, Chromosomes, Meiosis, Crossing Over, Gametes, Sexual

Reproduction, Genes, Chromosomes, Karyotypes, Crossing Over, GMO, Transcription, Translation, Protein Syntheis, Mutations, Gene Expression, Gene Repression, Electrophoresis, Gene Expression, Selectable Markers, Research Proposals

Resources:
• Mutations and DNA damage - What happens when your DNA is damaged? - Monica Menesini **(Disabilities Awareness)** • Selective Breeding - Meet the Super Cow | National Geographic • Snurfle Meiosis Interactive - Snurfle Meiosis and Genetics (HTML5) • Tibetans get high-altitude edge from extinct Denisovans' genes **(Diversity, Equity and Inclusion)** • Nazi Medical Experiments | Holocaust Encyclopedia **(Holocaust Law)** • Black geneticists **(Amistad Law)** • Lesson: From Theory to Classroom: Eugenics and Education | Facing History **(Holocaust Law)**
Pacing Guide
Can be found within LabAids.

Unit 5: Evolution: Maintaining Biodiversity

Overview

Literacy in science is of essence for all citizens in our modern society. This biology curriculum will focus on actively engaging students with the world around them. Students should gain in-depth knowledge of the different living organisms and the environments they each live in to better protect, sustain or enhance the natural environment.

Essential Questions	Enduring Understandings
• How are the biodiversity of an ecosystem and the sustainability of human communities related? • How do humans alter the biodiversity of groups of taxa? • What are the key events of geologic time? • How did Darwin build on his and others' work to develop his ideas about natural selection and evolution? • How does fossil evidence determine the relationships of whale ancestors and their descendants? • How do scientists interpret evidence in the fossil record? • How do you test a tree hypothesis for a group of taxa? • How do biologists study the evolutionary relationships of hominids? • How does evidence about phylogenetic relationships assist evolutionary biologists and conservationists in making sustainable conservation decisions? • How do new species separate from existing species? • How does natural selection lead to speciation?	• Biodiversity encompasses variability between and within ecosystems, between species, and within a species' gene pool as evidenced by genetic diversity. Biodiversity is closely linked to sustainability. • Ecosystem services are the benefits that people obtain from ecosystems, including natural resources and pro cesses that humans rely on for survival. Examples of ecosystem services include income generation; soil protection; materials derived for food, medicine, and shelter; water purification; carbon removal; and pollution control. • Protected areas are sections of land and sea especially dedicated to the maintenance of biological diversity and of natural and associated cultural resources. They are usually managed by government agencies or nonprofit organizations. • Sustainability is the ability to meet the needs of the present without endangering the ability of future generations to meet their own needs. The three underlying pillars of sustainability are the environment, the economy, and society.

• How did a change in the environment lead to genetic changes in populations of the rock pocket mouse? • How do evolutionary processes lead to changes in biodiversity? • What scientific evidence and reasoning supports ideas about evolution? • Which of four areas should receive priority for conservation?	• Such human activities as acquisition of resources, urban growth, and waste disposal accelerate rates of natural change. • Three levels of biodiversity are ecosystem diversity, species diversity, and genetic diversity. • Human activities often cause biodiversity to increase or decrease. • The geologic timeline reflects the vast time scale since earth originated. • Earth was formed approximately 4.5 billion years ago. • Life began on earth approximately 4.3 billion years ago. • Multicellular life originated relatively recently in geologic time, approximately 640 million years ago. • Most key events in the evolution of life occurred in relatively recent geologic time. • Natural selection is a key part of the evolution of diverse taxa from common ancestors. • Darwin developed the theory of evolution by natural selection by putting together his own observations and ideas with the findings and ideas of other naturalists, geologists, and an economist. • Scientific theories are based on natural and physical phenomena. • Scientific theories are well established and highly reliable explanations. • Scientists usually build on earlier knowledge and are influenced by other experts and their society and culture. • Occasionally, a scientific advance has important long-lasting effects on science and society because of its explanation of natural phenomena. The theory of biological evolution by natural selection is an example of such an advance. • Species are related by descent from common ancestors. • The theory of natural selection is a scientific explanation for the fossil record of ancient life forms. • Stratigraphy is based on the idea that older rock strata are found beneath strata that were formed more recently. • Fossils in lower strata are generally older than fossils found in upper strata. • Scientific theories are well established and highly reliable explanations. Hypotheses are tentative and testable statements that eventually might be supported or refuted by observational evidence. • From fossils scientists have developed and tested hypotheses for how major taxa, such as tetrapods, evolved. • In the absence of transitional fossils, scientists focus on transitional features in fossils—key features that demonstrate the evolutionary changes that resulted in macroevolution. • The millions of species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors.

	• Modern biological classifications show how taxa are related based on similarities that reflect their genealogical relationships. • Shared derived characters as evidence of common ancestry determine where to place taxa on a tree. • Scientific hypotheses are tentative-and-testable statements that are either supported or not supported by observational evidence. • Morphological evidence, such as forelimb structure and function, combined with other evidence leads scientists to hypothesize the evolutionary relationships of taxa on a tree. • Scientific explanations must adhere to criteria such as the application of appropriate evidence, consistently logical reasoning, and basis in accepted historical and current scientific knowledge. • The theory of natural selection and its evolutionary consequences provides a scientific explanation for the fossil record of ancient life forms and the striking molecular similarities found among diverse species of living organisms. • Scientists apply fossil and molecular data to develop hypotheses for how major taxa, such as the hominids (African apes and humans), evolved. • Evolutionary biologists and paleontologists focus on transitional features in fossils—those key features that demonstrate the evolutionary changes that resulted in macroevolution. • Scientific explanations must adhere to such criteria as the application of appropriate evidence, consistently logical reasoning, and basis in accepted historical and current knowledge. • The millions of species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors. • Modern biological classifications show how taxa are related based on similarities in their genealogical lineages. • Phylogenetic diversity demonstrates the relationships of lineages to one another through time. • Phylogenetic diversity provides information for people to make sustainable conservation decisions. • Sustainability is closely linked to biodiversity. • Species evolve over time. The millions of species that live on the earth today are related by descent from common ancestors. • Taxa are classified in a hierarchy of groups and subgroups based on genealogical relationships. • The broad patterns of behavior exhibited by animals have evolved by natural selection as a result of reproductive success. • Scientists have found that the original definition of species as groups of organisms with similar morphology does not reflect underlying evolutionary processes.

	• The biological species concept defines a species as a population of individuals that actually or can potentially interbreed in nature to produce fertile offspring. • Scientific explanations must adhere to criteria such as the application of appropriate evidence, consistently logical reasoning, and basis in accepted historical and current scientific knowledge. • Adaptive radiation is the relatively rapid evolution from a common ancestor of multiple species that occupy newly available environments. • Natural selection and reproductive isolation lead to speciation in new environments. • For natural selection to occur in a population there must be heritable variation among individuals, competition for resources needed for survival, and differential survival and reproduction. • Extinction occurs when the environment changes. Less diverse populations have fewer variations that might enhance survival in new environments and are at greater risk of extinction. • Natural selection acts on existing genetic variability in a population. • Genetic variation occurs naturally in a population due to mutation and recombination of genetic material. • Genes store genetic information that interacts with environmental factors to determine the traits, or phenotypes, of organisms. • Environmental changes may lead to natural selection of traits that were previously rare, but enhance fitness in the new environment. • Over many generations the gene for a selected trait becomes increasingly common in the population. • Species evolve over generations. The millions of different species that live on earth today are related by descent from common ancestors. • The biodiversity at any time in earth's history depends on both the evolution of new taxa and the extinction of existing taxa. • The four causes of microevolution are mutation, natural selection, genetic drift, and gene flow. • Adaptations are inherited characteristics that improve the survival and reproduction of an organism and are the result of natural selection. • Adaptive characters include physical traits, behaviors, biochemical processes, or any other traits that enhance fitness and evolve through natural selection. • Microevolution is evolution on a small scale and results in changes in the proportion of genes in a population. • Macroevolution is any change that occurs at or above the species level and is shaped by both speciation and extinction. Macroevolution leads to the large-scale patterns of biodiversity on earth. • Evolutionary processes lead to the biodiversity of life, all of which is related by common ancestry from the earliest life. Evolution is the process by which traits

	favorable to living in a particular environment are selected for and passed on to offspring. ● There is a large body of physical, molecular, and fossil evidence to support the natural selection theory of evolution. ● Natural selection is not random. Natural genetic variation is the result of mutation and recombination in the individuals that make up a population. Based on environmental conditions, favorable traits enhance fitness and are passed on during reproduction. As more individuals inherit the favorable trait(s), the population changes. ● Adaptations are the result of natural selection and do not occur over the lifetime of individuals. ● Genetic data suggest that humans and apes share an evolutionary ancestor. Chimpanzees and humans share a more recent ancestor than either does with gorillas. ● All scientific knowledge is subject to change as new evidence becomes available. ● Scientific explanations must adhere to such criteria as application of appropriate evidence, consistently logical reasoning, and basis in accepted historical and current scientific knowledge. ● Science is a social enterprise, but alone it only indicates what can happen, not what should happen. The latter involves human decisions about the use of knowledge. ● Human activities can cause biodiversity to increase or decrease. Such human activities as acquisition of resources, urban growth, and waste disposal accelerate rates of natural change in organisms and ecosystems. ● The millions of different species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors. ● Evolutionary trees show evolutionary ancestry. ● Biodiversity is measured on phylogenetic, species, and genetic levels.

Unit 5: Evolution: Maintaining Biodiversity

Content Standards

Performance Expectations

- HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.
- 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. Emphasis is on using evidence to explain the influence each of the

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Unit 5: Evolution: Maintaining Biodiversity

Content Standards

four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning. Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.

- 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. Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.
- HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations. Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading 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. Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.

Core Ideas

- Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.
- 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.
- 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.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.
- 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.
- 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.

Student Learning Objectives

Students will be able to:

- Play a game in which they manage one ecosystem on an island to learn about how biodiversity and sustainability are connected.
- Read scenarios that describe various human activities that affect the diversity of ecosystems, species, and populations.
- Convert geologic time to the scale of a football field and place key events along the timeline.
- Read about Charles Darwin and how his ideas were emerging from others' and led to the theory of evolution by natural selection.
- Examine illustrations of whale fossils and stratigraphic representations to trace the evolution of whales.
- Read about how scientists interpret evidence from the fossil record, including the use of stratigraphy and radiometric dating to determine the age of fossils.
- Use a matrix of shared derived characters to create an evolutionary tree for a group of vertebrates, and use additional evidence to support a tree hypothesis.
- Examine fossil and molecular data to hypothesize the evolutionary relationships between apes, and extinct and modern humans.
- Read about Madagascar and investigate an evolutionary tree of lemurs in order to rank four areas on the island for conservation priority.
- Use the biological species concept as one piece of information about where new species are in the process of separation from existing species. Students also investigate the factors that lead to reproductive isolation of species.
- Work with a computer simulation to investigate the processes of adaptive radiation and extinction.
- Use a model to investigate changes in gene frequency in a population of mice after an environmental change occurs.
- Read about the concepts of microevolution, adaptation, speciation, macroevolution, and extinction.
- Reexamine the thinking they have done in the unit about the statements describing scientific concepts related to evolution.
- Read about four forest areas being considered for conservation on a fictitious island, and use phylogenetic data and other evidence to make their recommendation.

Integrated Accommodations and Modifications		
Special Education Students	**English Language Learners**	**At Risk**
• Utilize modifications & accommodations delineated in the student's IEP • Provide additional manipulatives to support instruction • Allow for alternative strategies to solve algorithms or tasks • Provide the steps needed to complete the task • Model frequently • Provide repetition and practice. • Use visuals to demonstrate/model the processes • Restate, reread, and clarify directions/questions • Ask students to restate information, directions, and assignments. • Provide copy of class notes • Distribute study guide for classroom tests. • Provide preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Provide regular parent/ school communication • Allow extended time to complete assignment	WIDA Can Do Descriptors https://wida.wisc.edu/teach/can-do/descriptors • Modify Assignments • Use testing and portfolio assessment • Utilize Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary) • Repeat, rephrase, paraphrase key concepts and directions • Allow for extended time for assignment completion as needed • Highlight key vocabulary • Define essential vocabulary in context • Use graphic organizers, visuals, manipulatives and other concrete materials • Use gestures, facial expressions and body language • Read aloud • Build on what students already know and prior experience	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Provide preferential seating to be mutually determined by the student and teacher • Allow the use of a computer to complete assignments. • Establish expectations for correct spelling on assignments • Provide extra textbooks for home. • Provide Peer Support • Increase one on one time

• Establish procedures for accommodations / modifications for assessments • Allow student to take/complete tests in an alternate setting as needed		

Gifted and Talented Students	504 Plan
• Utilize advanced, accelerated, or compacted content • Provide assignments that emphasize higher- level thinking skills. • Allow for individual student interest • Gear assignments to development in areas of affect, creativity, cognition, and research skills • Allow for a variety in types of resources • Provide problem-based assignments with planned scope and sequence • Utilize inquiry-based instruction • Adjust the pace of lessons • Utilize Choice Boards • Provide Problem-Based Learning • Establish flexible Grouping	• Pair visual prompts with verbal presentations • Ask students to restate information, directions, and assignments. • Provide repetition and and practice • Model skills / techniques to be mastered. • Provide extended time to complete class work • Provide copy of class notes • Break long assignments into smaller parts • Assist student in setting short term goals • Allow for preferential seating to be mutually determined by the student and teacher • Provide extra textbooks for home. • Model and reinforce organizational systems (i.e. color-coding) • Write out homework assignments, check student's recording of assignments

Interdisciplinary Connections	Computer Science and Design Thinking
English/Language Arts Reading • RST.9-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. Writing • WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • WHST.9-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience;	**Computer Science and Design Thinking Practices** 1. □ Fostering an Inclusive Computing and Design Culture 2. ☑ Collaborating Around Computing and Design 3. □ Recognizing and Defining Computational Problems 4. □ Developing and Using Abstractions 5. □ Creating Computational Artifacts 6. □ Testing and Refining Computational Artifacts 7. ☑ Communicating About Computing and Design **Computer Science and Design Thinking Standards** • 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. • 8.1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process. • 8.1.12.IC.1: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.

integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Speaking and Listening
- SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

- 8.1.12.IC.3: Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.
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Core Ideas
- Individuals select digital tools and design automated processes to collect, transform, generalize, simplify, and present large data sets in different ways to influence how other people interpret and understand the underlying information.
- Large data sets can be transformed, generalized, simplified, and presented in different ways to influence how individuals interpret and understand the underlying information.
- The accuracy of predictions or inferences made from a computer model is affected by the amount, quality, and diversity of data.
- The design and use of computing technologies and artifacts can positively or negatively affect equitable access to information and opportunities.

Career Readiness, Life Literacies and Key Skills

Career Readiness, Life Literacies and Key Skills Practices
- Act as a responsible and contributing community members and employee
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Use technology to enhance productivity increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

- 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.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1)
- 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.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
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- 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2)
- 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

SEL Competencies

- **Self - Awareness**
- **Self - Management**
- **Social Awareness**
- **Responsible Decision Making**
- **Relationship Skills**

District/School Formative Assessment Plan	District/School Summative Assessment Plan

Formative assessment informs instruction and is ongoing throughout a unit to determine how students are progressing against the standards.
 	
Teachers are encouraged to incorporate Formative Assessments into all lessons. During instruction, teachers will collect ongoing information on students' mastery of content through a variety of methods:
 	
• Questioning: using Socratic method, probing questions, a hierarchical system in complexity (Bloom's Taxonomy)
• Exit tickets, rotational activities (stations), quizzes, and small group activities
• Classwork, homework, group work
• Pre-Assessments, teacher's observation, class discussion, and journal
• Journal Writing
• Daily Verbal Assessments
	Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.
	
	• **Investigations:**
	  ○ **Using Fossil Evidence to Investigate Whale Evolution**
	  ○ **The Phylogeny of Vertebrates**
	  ○ **Studying Hominids**
	  ○ **Studying Lineages for Conservation**
	  ○ **What is a Species?**
	• **Talk it Over:**
	  ○ **Biodiversity and Sustainability**
	  ○ **Human Activities and Biodiversity**
	  ○ **Ideas About Evolution**
	  ○ **Conservation of an Island Biodiversity Hotspot**
	• **Modeling**
	  ○ **Geologic Time**
	  ○ **Natural Selection**
	  ○ **The Genetic Basis of Adaptation**
	• **Reading:**
	  ○ **Darwin and the Development of Theory**
	  ○ **Evidence from the Fossil Record**
	  ○ **The Processes and Outcomes of Evolution**

	• **Other Summative Assessments:** Teachers are encouraged to design and their own assessments (topic/module tests and quizzes) individually and/or with their department or grade-level partners, as per Uniform Grading Profile.

Targeted Academic Vocabulary

Biodiversity, Sustainability, Human Impact, Geological Time, Deep Time, Natural Selection, Evolution, Sexual Selection, Artficial Selection, Fossil Record, Scientific Argumentation, Stratigraphy, Strata, Radiometric Dating, Evidence, Macroevolution, Transitional Forms, Common Ancestry, Evolutionary Trees, Human Evolution, Fossils, Species, Speciation, Reproductive Isolation, Geographic Isolation, Adaptive Radiation, Adaptation, Species, Microevolution, Adaptation, Homologous, Analogous, and Vestigial Structures, Protected Area, Phylogeny

Resources:

- Natural Selection -Darwin and Natural Selection: Crash Course History of Science #22
- Exploring Galapagos - Galapagos | Exploring Oceans
- Fossil Record - Whale Evolution - Evolution Primer #3 How Do We Know Evolution Happens
- Human Evolution - Human Origins 101 | National Geographic
- Mass Extinctions - The 6 Craziest Extinctions Ever
- Convergent Evolution - Convergent Evolution | Dolphins and Ichthyosaurs
- Biodiversity - Why is biodiversity so important? - Kim Preshoff **(Climate Change)**
- Are Endangered Species Worth Saving?**(Climate Change)**
- Climate and Human Evolution (available in Spanish) **(Climate Change/Diversity, Equity & Inclusion)**

Pacing Guide

Can be found within LabAids.