CURRICULUM

FOR

HONORS BIOLOGY

GRADES 9 & 10

This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.

ACKNOWLEDGMENTS

Dr. Susan Dube, Program Supervisor of Science and Technology Education

The Board acknowledges the following who contributed to the preparation of this curriculum.

Adrienne Barnes

Dr. Tiffany A. Beer, Director of Curriculum and Instruction

Subject/Course Title:
Honors Biology
Grade: 9 & 10

Date of Board Adoption:
September 21, 2021

RAHWAY PUBLIC SCHOOLS CURRICULUM

Honors Biology – Grades 9 & 10

PACING GUIDE

Unit	Title	Pacing
1	Ecology: Energy & Matter	3 weeks
2	Ecology: Population Ecology	2 weeks
3	Ecology: Communities	2 weeks
4	Ecology: Human Impact & Climate Change	3 weeks
5	Experimental Design	2 weeks
6	Cell Types & Cell Theory	1 week
7	Cellular Energy	3 weeks
8	Cell Transport & Homeostasis	3 weeks
9	Cell Division	3 weeks
10	Nucleic Acids, Protein Synthesis, & Enzymes	3 weeks
11	Genetics – Mendelian & Non-Mendelian	5 weeks
12	Genetic Technology	3 weeks
13	Natural Selection & Evolution	3 weeks
14	Viruses & Bacteria	2 weeks

ACCOMMODATIONS

504 Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Provide extra visual and verbal cues and prompts.
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages).
- Provide study sheets and teacher outlines prior to assessments.
- Quiet corner or room to calm down and relax when anxious.
- Reduction of distractions.
- Permit answers to be dictated.
- Hands-on activities.
- Use of manipulatives.
- Assign preferential seating.
- No penalty for spelling errors or sloppy handwriting.
- Follow a routine/schedule.
- Provide student with rest breaks.
- Use verbal and visual cues regarding directions and staying on task.
- Assist in maintaining agenda book.

IEP Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Differentiate reading levels of texts (e.g., Newsela).
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide extra visual and verbal cues and prompts.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Provide students with additional information to supplement notes.
- Modify questioning techniques and provide a reduced number of questions or items on tests.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Provide study sheets and teacher outlines prior to assessments.
- Use of manipulatives.
- Have students work with partners or in groups for reading, presentations, assignments, and analyses.
- Assign appropriate roles in collaborative work.
- Assign preferential seating.
- Follow a routine/schedule.

Gifted and Talented Accommodations:

- Differentiate reading levels of texts (e.g., Newsela).
- Offer students additional texts with higher lexile levels.
- Provide more challenging and/or more supplemental readings and/or activities to deepen understanding.
- Allow for independent reading, research, and projects.
- Accelerate or compact the curriculum.
- Offer higher-level thinking questions for deeper analysis.
- Offer more rigorous materials/tasks/prompts.
- Increase number and complexity of sources.
- Assign group research and presentations to teach the class.

ELL Accommodations:

- Provide extended time.
- Assign preferential seating.
- Assign peer buddy who the student can work with.
- Check for understanding frequently.
- Provide language feedback often (such as grammar errors, tenses, subject-verb agreements, etc…).
- Have student repeat directions.
- Make vocabulary words available during classwork and exams.
- Use study guides/checklists to organize information.
- Repeat directions.
- Increase one-on-one conferencing.
- Allow student to listen to an audio version of the text.
- Give directions in small, distinct steps.

● Assign/allow for leadership roles during collaborative work and in other learning activities.	● Allow copying from paper/book. ● Give student a copy of the class notes. ● Provide written and oral instructions. ● Differentiate reading levels of texts (e.g., Newsela). ● Shorten assignments. ● Read directions aloud to student. ● Give oral clues or prompts. ● Record or type assignments. ● Adapt worksheets/packets. ● Create alternate assignments. ● Have student enter written assignments in criterion, where they can use the planning maps to help get them started and receive feedback after it is submitted. ● Allow student to resubmit assignments. ● Use small group instruction. ● Simplify language. ● Provide scaffolded vocabulary and vocabulary lists. ● Demonstrate concepts possibly through the use of visuals. ● Use manipulatives. ● Emphasize critical information by highlighting it for the student. ● Use graphic organizers. ● Pre-teach or pre-view vocabulary. ● Provide student with a list of prompts or sentence starters that they can use when completing a written assignment. ● Provide audio versions of the textbooks. ● Highlight textbooks/study guides. ● Use supplementary materials. ● Give assistance in note taking ● Use adapted/modified textbooks. ● Allow use of computer/word processor. ● Allow student to answer orally, give extended time (time-and-a-half). ● Allow tests to be given in a separate location (with the ESL teacher). ● Allow additional time to complete assignments and/or assessments. ● Read question to student to clarify. ● Provide a definition or synonym for words on a test that do not impact the validity of the exam. ● Modify the format of assessments. ● Shorten test length or require only selected test items. ● Create alternative assessments. ● On an exam other than a spelling test, don't take points off for spelling errors.

UNIT OVERVIEW

Content Area: Honors Biology

Unit Title: Ecology – Energy & Matter

Target Course/Grade Level: Grades 9 & 10

Unit Summary: In this unit, students will begin by discussing the differences between biotic and abiotic factors, as well as the characteristics of life. They will investigate the path of energy and matter in an ecosystem by studying the feeding relationships between organisms and the nutrient cycles. Transfer of energy and matter from abiotic and through biotic parts of the ecosystem will be analyzed. Students will calculate energy flow between various organisms in an ecosystem. Students will be use this information to engineer a Biodome in which they will have to create an artificial sustainable ecosystem for a given biome at the end of the Units 1 and 2.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning 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-LS2-3 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 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

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations.
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
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.
9.3.12.AG- ENV.3 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
9.3.12.AG- ENV.4 Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:
RST.9-10.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.9-10.8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.9-10.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
WHST.9-10.1. Write arguments focused on discipline-specific content.
A. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
B. Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

Unit Understandings:
Students will understand that…

- Biology is the organized study of living things and their interactions with their natural and physical environments.
- Biologists have formulated a list of characteristics by which we can recognize living things.
- Autotrophic organisms are primary producers and manufacture carbohydrates using energy from the sun.
- Heterotrophs or consumers obtain energy by eating other organisms, producers and/or consumers.
- Primary consumers are herbivores that consume producers and are considered the second trophic level. Secondary consumers are carnivores that consume primary consumers and are considered the third trophic level, etc. Some consumers act at multiple trophic levels because they are both producers and consumers. These are omnivores.
- Decomposers feed on dead bodies and wastes to release the nutrients these contain into an ecosystem for use by the producers. Decomposers act at every trophic level.

- The total mass of organisms at each trophic level makes up the biomass.
- Every time energy transfers from one organism to another, most of it doesn't go into useful energy but is instead given off as heat. About 10% of the energy remains useful after each transfer. This means that fewer organisms can exist that depend on multiple levels of organisms beneath them, so at the highest trophic levels, there is the least biomass.
- Matter cycles through an ecosystem, while energy moves in one direction.
- Materials such as carbon, nitrogen, phosphorus, and water are cycled within ecosystems.
- Nitrogen and phosphorus from human chemical use can easily end up in water supplies where they have detrimental effects on ecosystems.
- By burning large amounts fossil fuels, humans are disrupting the carbon cycle. There is evidence for rising levels of carbon dioxide in the atmosphere leads to climate change.
- There are seven terrestrial biomes: Tundra, Taiga, Temperate Deciduous Forests, Temperate Rainforests, Tropical Rainforests, Grasslands, and Deserts.
- Climate is the single most important factor that determines the characteristics of a terrestrial biome. As a result of climate, biomes can also be distinguished by the presence of certain plants and animals which have adaptations to live within these regions.

Unit Essential Questions:

- Why is the study of Biology important?
- How are the characteristics of living things used to distinguish between abiotic and biotic factors?
- What characteristics can be observed in a living organism?
- How is energy flow through ecosystems related to trophic structures? \
- How do materials (carbon, nitrogen, phosphorus, and water) cycle through ecosystems?
- How do organisms affect the cycling of elements and water through biosphere?
- How are humans affecting biogeochemical cycles?
- How and why do biomes differ in biodiversity?

Knowledge and Skills:

Students will know...

- Ecological vocabulary such as heterotroph, autotroph, trophic level, omnivore, decomposer, ecosystem, etc.
- The characteristics of life.
- Difference between abiotic and biotic factors.
- Identify food chains within food webs.
- Label trophic levels within food chains and webs.
- The 10% rule in reference to the flow of energy in an ecosystem.
- The importance of climate on different ecosystems.
- The biogeochemical pathways: water cycle, carbon cycle, nitrogen cycle, and phosphorus cycle.
- Different ways humans can disturb the nutrients cycling in an ecosystem.

Students will be able to...

- Define and provide examples of the ecological vocabulary.
- Use claim, evidence, reasoning to defend when something may or may not be living at longer based on the characteristics of life.
- Relate organisms' adaptations due to abiotic and biotic factors in its environment.
- Create food webs based on evidence.
- Calculate energy flow based on evidence in ecosystems.
- Build nutrients cycles based on evidence.
- Explain how humans impact nutrients cycles.
- Design and explain how to build a sustainable ecosystem based on ecological knowledge.

- Model a sustainable ecosystem.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams as well as:
    - use claim, evidence, reasoning to defend when something may or may not be living at longer based on the characteristics of life.
    - calculate energy flow based on evidence in ecosystems.
    - describe the effects throughout a food chain/web when an organism is removed or added.
    - differentiate between energy and matter flow in an ecosystem.
    - describe the significance of the cycling of nutrients between abiotic and biotic factors throughout an ecosystem
    - analyze and describe the consequence of a shortage or overabundance of a nutrient on the stability of the ecosystem.

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Fortune Telling Fish Investigation
- Is Sammy Alive? Claim, Evidence, Reasoning Activity
- Pond water food web creation and analysis questions
- Building an Energy Pyramid and Rice Demonstration
- Is it Food for Plants?
- Carbon Cycle Activity
- Traveling Nitrogen Passport
- The Phosphorus Cycle Graphic Organizer
- Ecology Gizmos and STEM cases
- Ecology EdPuzzles

RESOURCES

Teacher Resources:

- Textbook: Biology, by Stephen Nowicki. Ch. 1,13 & 15
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, poster paper, fortune telling fish, rice, and various sized beakers, calculators

UNIT OVERVIEW

Content Area: Honors Biology

Unit Title: Ecology – Population Biology

Target Course/Grade Level: 9 & 10

Unit Summary: In this unit, students are introduced to population dynamics in an ecosystem. Dispersal patterms, survivorship, the exponential model and the logistics model of population growth are analyzed through the interpretation of related graphs and charts. The growth of human population over time and its impact on the environment are also studied. Students will investigate how humans can impact the Biodomes they study for their model creation based on known problems that humans are causing to populations or different organisms in these systems.

Approximate Length of Unit: 2 weeks

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in:
(1) increases in the number of individuals of some species,
(2) the emergence of new species over time, and
(3) the extinction of other species.
HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.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.
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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.
9.3.12.AG- ENV.3 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
9.3.12.AG- ENV.4 Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:
NJSLSA.R1. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence

Unit Understandings:
Students will understand that…

- A population is a group of individuals of the same species living in the same place at the same time.

- The size of a population is determined by the number of individuals it contains.
- Populations can distribute themselves into clumped, random, or uniform dispersions.
- Survivorship curves can show how populations naturally grow.
- Four processes determine population growth: birth rates, death rates, immigration, and emigration.
- The exponential model describes perpetual growth at an increasing rate in a population. Birth and death rates are constant, and there is no movement of individuals into or out of the population.
- The logistics model accounts for limiting factors and so growth rate falls and death rate increases as the population increases.
- The carrying capacity is the number of individuals an environment can support for an indefinite amount of time. At carrying capacity, birth and death rates are equal so the population is stabilized.
- Density independent limiting factors kill the same percentage of the population regardless of its size.
- Density dependent limiting factors kill more individuals in a large population than in a small one.
- Small populations are more vulnerable to extinction.
- At first, human population was slow, but once resources were abundant, the population has grown exponentially.
- The development of agriculture, improved hygiene and economic conditions, and better diet, improvements in sanitation and medicine have caused human population growth to accelerate and grow exponentially.
- It is unclear exactly when the human population will reach carrying capacity. Continued technological developments allow the population to continue to grow though the growth rate is dropping.
- Increased human populations cause an increase in pollution and a decrease in biodiversity.

Unit Essential Questions:

- How do organisms within a population interact with and affect each other's populations within an environment?
- What factors impact the growth rates of populations of organisms in an ecosystem?
- What models are used to make predictions about the growth of a population over time?
- How has human population growth changed over time?
- What factors accelerated the growth of the human population?
- How does human population growth impact ecosystems?

Knowledge and Skills:

Students will know...

- Key definitions: survivorship, birth rate, death/mortality rate, life expectancy, carrying capacity, density-independent limiting factor, density dependent limiting factor, emigration, immigration, exponential growth, growth rate, logistic growth.
- How populations grow naturally based on different factors.
- The historical events that have accelerated the growth of human population.
- The negative effects that the human population has on the environment currently and may have in the future

Students will be able to...

- Use evidence to explain how different populations arrange themselves in different ways.
- Analyze survivorship curves.
- Calculate population growth of different species based on evidence.
- Research real ecosystems that have populations impacted by humans.
- Create graphs of populations to determine patterns and trends in population growth over time.

- Predict the future of these populations based on data.
- Investigate the effects of different limiting factors for populations.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams as well as:
    - use evidence to explain how different populations arrange themselves in different ways and describe the effects of limiting factors for these populations.
    - analyze survivorship curves
    - evaluate the effects of tourism on specific ecosystems
    - create various population growth graphs based on data and use the graphs to determine trends and predict future changes.

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Population Dispersion Diagram Identification and Cost/Benefits Analysis
- Graphing and Analysis of Survivorship Curves
- Tourism Problem Graphing Activity and Analysis
- Density Independent/Dependent Limiting Factor Sorting Activity
- Raptor Population Graphing Activity and Analysis
- Ecology Gizmos and STEM cases

RESOURCES

Teacher Resources:

- Textbook: Biology, by Stephen Nowicki. Ch. 14 & 16
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, poster paper – plain and graphing, calculators

UNIT OVERVIEW

Content Area: Honors Biology

Unit Title: Ecology - Communities

Target Course/Grade Level: 9 & 10

Unit Summary: This unit provides an overview of species interactions within a community with particular focus on developing an understanding of a species niche. Predation, competition, mutualism, parasitism and commensalism are described along with the importance of species diversity. The processes of primary and secondary succession within ecosystems are also included. The evolutionary adaptations that occur through natural selection which enable species to survive and function through these biological events are presented.

Approximate Length of Unit: 2 weeks

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.12.AG- ENV.3 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
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9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

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RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
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NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- Each organism in an ecosystem can tolerate a different range of environmental conditions.

- Each species has its role or place in the community known as its niche. The niche includes what the species eats, what eats it, where it lives, and its relationships with other organisms. Two species cannot occupy the exact same niche. If this happens, they will compete until one alters its niche or becomes extinct.
- Ecologists investigate the adaptations an organism possesses and its interactions with other organisms that allow it to exist in its niche.
- Predators have evolved many ways to efficiently find and capture prey. While prey have evolved many ways to defend themselves against predators. They coevolve.
- Parasitism involves one organism feeding on another organism, but does not have to result in the death of the infested.
- Competition may cause competitive exclusion, the extinction of one competitor from a community.
- Competition happens between individuals in a population; intraspecific competition.
- Competition can happen between individuals of different populations; interspecific competition.
- Mutualism is a symbiotic relationship in which both species benefit.
- Commensalism is a symbiotic relationship in which one species benefits and the other is not harmed.
- As a general rule, species diversity is greatest near the equator and decreases as you approach the poles in either hemisphere.
- Larger areas of land or water generally support more species.
- Stability in a community can be disrupted by natural events or human interactions.
- In succession, pioneer species are the initial colonists of a new land or disturbed area. They generally grow fast, reproduce quickly, and disperse their seeds well.
- A climax community is the stable end point of succession.

Unit Essential Questions:

- How can one organism's niche be related to and/or impacted by other organisms?
- How do species interact in their environments?
- How can humans impact species interactions within an ecosystem?
- What role do species interactions play in the species diversity of an ecosystem?
- How do species interactions impact the process of succession and the development of a climax community?

Knowledge and Skills:

Students will know...

- Key definitions: commensalism, competition, competitive exclusion, interspecific competition, intraspecific competition, host, mimicry, mutualism, parasite, parasitism, predator, prey, symbiosis, species diversity, species richness, stability, climax community, primary succession, secondary succession, pioneer species.
- How organisms can interact in communities.
- An example for each of the three types of symbiosis.
- A relationship exists between species diversity and the stability of an ecosystem.
- Specific examples of direct relationships between species.

Students will be able to...

- Describe a habitat vs. a niche.
- Explain the different types of symbiosis.
- Identify different types of succession.
- Analyze a predator/prey graph.
- Explain how populations have evolved certain adaptations based on the community they live in based on interactions with different species.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section.

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Prey/predator simulation model/activity
- Symbiosis Analysis Activity
- Habitat vs Niche Analysis Activity
- Succession CLOZE Activity
- Ecology Gizmos
- Ecology EdPuzzles

RESOURCES

Teacher Resources:

- Textbook: Biology, by Stephen Nowicki. Ch. 14
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, poster paper – plain and graphing

UNIT OVERVIEW

Content Area: Honors Biology

Unit Title: Ecology – Human Impact and Climate Change

Target Course/Grade Level: 9 and 10

Unit Summary: In this unit, students examine how humans affect the environment by studying ozone depletion, acid rain, chemical pollution, depletion of resources, habitat destruction, and invasive species. The major focal point of the unit will be to develop a better understanding of the greenhouse effect, global warming and climate change. In regards to climate change, students will delve into the causes of the issue, analyze real time data for sea level rise, ocean acidification, and short- and long-term trends in CO2 concentration in the atmosphere. Tying the changes in these trends to human activities from the industrial revolution to present day and the multitude of compounded effects across the planet is a critical outcome of student learning.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.12.AG- ENV.3 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
9.3.12.AG- ENV.4 Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations.
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
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.

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NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
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WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- Human population growth has caused major changes to ecosystems throughout the planet.
- Over a short period of time, humans have affected global climate systems, including altering the composition of the atmosphere by decreasing ozone levels and increasing carbon dioxide levels.

- Industrial chemicals called CFCs have destroyed part of the ozone layer. A treaty banning the further use of CFCs has been signed and improvements in the ozone layer have been recorded since its inception.
- From the results of various computer models, sea levels, and ice core sampling, scientists have concluded that increased carbon dioxide levels have resulted in warmer surface temperatures on the Earth. Scientists expect temperatures to continue to rise as fossil fuel use and carbon dioxide levels in the atmosphere increase.
- Humans can take actions to reduce their carbon dioxide emissions.
- Alternative energy sources exist and should be invested in.
- Biodiversity refers to the variety of life in a given area.
- Habitat destruction is a leading cause of threatened and endangered plant and animal species.
- Conservation biology is concerned with identifying and maintaining areas that are relatively undisturbed while restoration biology focuses on repairing the damage done to ecosystems. Both are particularly concerned with areas referred to as "hot zones" where unique species are located and may be threatened or endangered.
- Reintroduction programs are helping to save some threatened and endangered species.
- Acid rain has damaged many aspects of different ecosystems.
- Invasive species are organisms brought to different locations of the world where they have no natural predators and thrive. This happens either naturally or by human action.
- These invasive species intrude on native species niches and lower biodiversity.

Unit Essential Questions:

- How is human population growth impacting ecosystems?
- How are the greenhouse effect, global warming, and climate change related?
- How can humans reduce their carbon dioxide emissions in the atmosphere?
- What actions can humans take to counteract climate change?
- What methods can be successful in conserving and/or restoring ecosystems?

Knowledge and Skills:

Students will know...

- Key definitions: chlorofluorocarbons, environmental science, biodiversity, ecotourism, genetic diversity, conservation biology, restoration biology, habitat degradation, habitat fragmentation
- How humans have impacted the composition of the Earth's atmosphere.
- That increased levels of carbon dioxide increase temperature and lead to global warming and climate change.
- The variety of data sources scientists collect and analyze to determine changes in global carbon dioxide and temperature levels over short and long periods of time.
- Alternative energy sources exist and can be used to reduce carbon dioxide emissions in the atmosphere.
- How acid rain is impacting ecosystems.
- Characteristics of invasive species.
- The importance of biodiversity to the sustainability of an ecosystem.

Students will be able to...

- Explain the importance of the ozone layer and how humans have impacted it negatively and positively.
- Graph carbon dioxide levels over the last 10 years and analyze the data for common trends.
- Analyze the impacts of acid rain through given data as well as collected data from an experiment they conduct.
- Analyze the efficacy of alternative energy solutions.

- Explain how certain invasive species have impacted native species populations and changed the diversity of ecosystems.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:
    - explain the importance of the ozone layer and the impact that humans have had on the ozone layer.
    - Use real time data from a geological website to describe the changes in carbon dioxide levels and sea level over time and how this impacts the climate of the planet.
    - explain how certain invasive species have impacted native species populations and changed the diversity of ecosystems.
    - Use self-generated data from a lab conducted in class to describe the effects of acid rain on seed germination.

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Ozone Layer Comic Book Activity
- Carbon Dioxide Level Graphing Activity
- Google Forms Climate Change Data Sources Analysis Jigsaw Activity
- Cane Toad Video and Analysis Questions
- Acid Rain and Seed Germination Laboratory
- Biomagnification Activity

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 16
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, graph paper, Cane Toad video, vinegar, bean seeds, beads, paper towels, sandwich bags, pipettes, permanent markers, gloves

UNIT OVERVIEW

Content Area: Honors Biology

Unit Title: Experimental Design

Target Course/Grade Level: 9 and 10

Unit Summary: Students will the basic principles of the scientific process employed by scientists when developing answers to scientific questions and solving problems. Student will learn how biologists conduct scientific investigations in the lab and in the field by researching and analyzing biological experiments. Student will complete the unit by designing an experiment to investigate an ecological problem on their own.

Approximate Length of Unit: 2 weeks

LEARNING TARGETS

NJ Student Learning 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-LS2-3 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-LS2-6 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.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.12.AG- ENV.3 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
9.3.12.AG- ENV.4 Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
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.
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audience.
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
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NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
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WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- Biologists use controlled experiments to obtain data that may or may not support a hypothesis.
- Biologists conduct investigations to increase knowledge about the natural world. Scientific results can help to solve real world problems.
- Scientific processes are used by biologists to answer questions or solve problems. Scientific processes include observing, asking questions, forming hypotheses, experimenting, collecting and evaluating data, forming conclusions, publishing results, engaging in argument, and forming theories.
- Scientific knowledge is a special kind of knowledge based on the collection of evidence. All scientific knowledge changes in light of new technologies and evidence gathered over time.

- Biologists do their work in laboratories and in the field. They collect both quantitative and qualitative data from their observations, experiments, and investigations.
- Scientists continuously revise predictions and explanations to account more completely for available evidence.
- Scientific models and understandings of fundamental concepts and principles are continuously refined as new evidence is considered.
- Communication is very important in science because scientists build on the work of others.

Unit Essential Questions:

- How do scientists use scientific processes to answer questions and solve problems?
- How do scientists collect data and develop theories and models about how nature works?

Knowledge and Skills:

Students will know...

- Various scientific processes such as observation, asking questions, collecting data, doing research, analysis, and drawing conclusions.
- Laboratory safety procedures.
- Science is an ever-changing body of knowledge as new discoveries are made and knowledge is attained.

Students will be able to...

- Identify key terms in experiments such as hypothesis, constants, control group, experimental group, dependent variable, and independent variable.
- Write a testable hypothesis.
- Design and conduct an experiment based on an ecological problem.
- Collect and analyze data.
- Represent data in chart and graph form.

EVIDENCE OF LEARNING

- Engage in argumentation using data from experiments.
- Explain how data from an experiment can have implications in the real world.

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:
  - write a testable hypothesis
  - analyze the experimental design of an investigation
  - draw conclusions based on given experimental results
  - argue with evidence using the CER protocol

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Acid Rain and Seed Germination Experiment – Design & Conduct Investigation
- Asking Questions & Writing Hypotheses: Burning Tea Bag Activity

- Independent vs Dependent Variable Identification Activities
- Control Group vs. Experimental Group Identification Activities

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 1
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, graph paper, vinegar, bean seeds, beads, paper towels, sandwich bags, pipettes, permanent markers, gloves

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Cell Types & Cell Theory

Target Course/Grade Level: 9 and 10

Unit Summary: Students will know the difference between prokaryotic and eukaryotic cells and be able to explain the parts of the cell theory. Cells are the foundation for all life forms. Birth, growth, development, death and all life functions begin as a cellular process. This unit introduces basic cell structure and function.

Approximate Length of Unit: 1 week

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.12.AG- ENV.4 Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
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NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- There is a relationship between the structure of inorganic and organic molecules to their function in cellular structure and metabolism.
- The cell is the basic unit of structure and function in all organisms.
- Cells have and do evolve over time.
- Living things are: made up of cells, reproduce, grow and develop, respond to stimuli, use materials and energy, evolve, and adapt to their environment.
- The cell theory states that all living things are composed of cells, cells are the basic unit of structure and function in living things, and that new cells are produced by existing cells.
- The levels of organization in multicellular organisms are individual cells, tissues, organs, and organ system.
- Multicellular organisms exhibit the characteristics of division of labor, interdependence and specialization.
- Cells in multicellular organisms develop in different ways to perform particular functions within the organism.

Unit Essential Questions:

- How do the similarities and differences in prokaryotic and eukaryotic cells provide evidence of their evolutionary relationships?
- How does compartmentalization organize a cell's functions?
- How has our understanding of cells changed over time?
- What scientific studies contributed to the cell theory?

Knowledge and Skills:

Students will know...

- Key definitions: magnification, resolution, cell theory, cell membrane, cytoplasm, cytoskeleton, ribosome, prokaryote, cell wall, flagellum, eukaryote, nucleus, organelle, compound microscope, electron microscope.
- Parts of a microscope and how each part works.
- How to properly care for and use a microscope.
- The cell theory and the scientists who contributed to it.

Students will be able to...

- Use a compound microscope to identify different parts in bacteria, animal, and plant cells.
- Compare prokaryotic and eukaryotic cells.
- Describe the evolution of prokaryotic and eukaryotic cells.
- Develop an analogy to describe prokaryotic and eukaryotic cell.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:
    - Complete a practical microscope use assessment

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Is it Made of Cells?
- Prokaryotic and Eukaryotic Characteristics Chart Activity
- Prokaryotic and Eukaryotic Cell Venn Diagram
- Parts of a microscope diagram
- Laboratory: Onion, Elodea, and Cheek Cells

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 3
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, microscopes, gloves, toothpicks, slides, cover slips, onion, Elodea, cell models

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Cellular Energy

Target Course/Grade Level: 9 and 10

Unit Summary: In this unit, students will develop an understanding of energy processes on the cellular level. The biochemistry related to photosynthesis, aerobic respiration, and anaerobic respiration will be described in detail. Students will learn that ATP is the energy currency of the cell and how ATP is made and used throughout the cell. The structure and function of the chloroplast and mitochondria will be explored and students will relate the structure to the roles of these organelles in the biochemical processes. Finally, students will understand the similarities and differences in the processes as well as how the processes differ in prokaryotic verses eukaryotic cells and in different organisms.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
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.
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such as climate change.
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NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…
- All cells need chemical energy.
- All chemical energy in organisms is initially captured by plants from the sun.
- All matter in organisms is initially captured by plants.
- The overall process of photosynthesis produces sugars that store chemical energy.
- Photosynthesis requires a series of complex chemical reactions that take place in the chloroplast of a cell.
- The overall process of aerobic respiration converts sugar to ATP using oxygen in 2 main stages which take place in the mitochondria of the cell.
- Anaerobic respiration allows for the production of a small amount of ATP without the use of oxygen.
- The processes for attaining cellular energy differ between different types of cells and organisms.

Unit Essential Questions:
- Why do cells need energy?

- How do cells attain energy?
- What is the role of ATP in cells?
- What are the reactants and products of photosynthesis, aerobic respiration and anaerobic respiration?
- How does the structure of the chloroplast and mitochondria allow for the biochemical processes within each to occur?
- How are the processes of photosynthesis and aerobic respiration similar? How do they differ?
- How are the processes of aerobic and anaerobic respiration similar? How are they different?
- How do energy processes compare and contrast in prokaryotic and eukaryotic cells and between different organisms?

Knowledge and Skills:

Students will know...

- Key definitions: ATP, ADP, chemosynthesis, photosynthesis, chlorophyll, thylakoid, light dependent reactions, light independent reactions, photosystem, electron transport chain, ATP synthase, Calvin Cycle, cellular respiration, aerobic, anaerobic, glycolysis, Krebs Cycle, fermentation, lactic acid
- The chemical energy used for most cell processes is carried in ATP.
- Organisms break down carbon-based molecules (usually glucose and other carbohydrates) to make ATP.
- There are a few types of organisms that do not need sunlight and/or photosynthesis to produce ATP. They use a process called chemosynthesis instead.
- Photosynthetic organisms are producers.
- Photosynthesis in plant cells occurs in the chloroplast.
- The light dependent stage of photosynthesis captures energy from the sun and converts it to chemical energy in the bonds of ATP and NADPH.
- The light independent reactions uses the chemical energy stored in ATP and NADPH from the first stage to make sugars.
- Cellular respiration makes ATP by breaking down sugars.
- Glycolysis occurs in all cells and is needed for all cellular respiration processes.
- Aerobic respiration uses oxygen to make large amounts of ATP.
- The Krebs Cycle is the first major stage of aerobic respiration and produces ATP, NADH, and $FADH_2$.
- The electron transport chain is the second major part of aerobic respiration and uses NADH and $FADH_2$ from the Krebs Cycle to produce large amounts of ATP.
- Anaerobic respiration produces NAD^+ which allows glycolysis to continue to make small amounts of ATP.
- Fermentation is important in the production of many human made products.

Students will be able to...

- Observe the process of photosynthesis.
- Predict the effect of limiting light on the photosynthetic process and the consumption of carbon dioxide and production of oxygen in a plant.
- Plan and conduct an experiment to record and analyze data related to the rate of aerobic respiration under varying conditions.
- Analyze the results of an experiment where yeast cells undergo fermentation at varying rates.
- Calculate and compare rates.
- Distinguish between aerobic and anaerobic respiration.
- Evaluate evidence for the evolution of chloroplasts and mitochondria.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section.
    - CER Protocol for the Evidence of Photosynthesis Lab
    - CER Protocol for the Aerobic Respiration Lab

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Giant Sequoia Tree Formative Assessment Probe
- Evidence of Photosynthesis Lab
- Chloroplast and Mitochondria Diagramming
- Drawing Photosynthesis Activity
- Aerobic Respiration Presentation
- Aerobic Respiration Energy Carrying Molecules Tally Chart
- Aerobic Respiration Lab
- Anaerobic Respiration Presentation
- Fermentation Lab
- Photosynthesis and Aerobic Respiration Venn Diagram
- Comparing Photosynthesis, Aerobic Respiration, and Fermentation Chart

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 4
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, elodea, aluminum foil, test tubes, test tube racks, test tube stoppers, lamps, light bulbs, BTB solution, straws, stop watches, graph paper (poster and regular sized), chart paper, construction paper, colored pencils,

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Cellular Transport & Maintenance of Homeostasis

Target Course/Grade Level: 9 and 10

Unit Summary: Students are introduced to the variety of ways that cells regulate the movement of materials across the cell membrane and thereby maintain homeostasis despite changes in their environmental surroundings. This is expanded to maintenance of homeostasis throughout the body through cellular communication pathways. Students will also explore the theory of endosymbiosis and relate this to the evolution and structure of mitochondria and chloroplasts.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:
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.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
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.
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WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that…

- Cells are enclosed in a semi permeable membrane that regulates their interactions with their surroundings and other cells, including the transport of molecules into, out of, and between the cell.
- Cellular function is maintained through the regulation of cellular processes in response to changes in internal and external conditions.
- All molecules within the plasma membrane have a certain structure related to their function.
- The cell membrane is non-polar.
- Passive transport moves a substance with the concentration gradient and requires no energy from the cell.
- Osmosis is the diffusion of water through a selectively permeable membrane.
- Cells are affected by hypertonic and hypotonic solutions.
- Active transport moves materials against the concentration gradient and requires energy to overcome the opposition to the concentration gradient.
- Cell size is limited largely by the diffusion rate of materials into and out of the cell, the amount of DNA available to produce proteins to maintain the metabolic function of the cell, and the surface area-to-volume ratio of the cell.
- The theory of endosymbiosis is supported by evidence related to the function of the plasma membrane and structure of different organelles within the cell.

Unit Essential Questions:

- What cellular mechanisms allow substances to cross membranes?
- How does the polarity of the membrane affect the transport of materials in and out of the cell?
- What are the effects on a cell placed in hypotonic, hypertonic and isotonic solutions? Why do these reactions occur?
- What limits the size of a cell?
- What evidence supports the endosymbiosis theory?

Knowledge and Skills:

Students will know...

- Key Definitions: active transport, passive transport, endocytosis, exocytosis, facilitated diffusion, hypertonic solution, hypotonic solution, isotonic solution, osmosis, concentration gradient, equilibrium, turgor pressure, plasmolysis, carrier proteins.
- The difference between passive transport processes such as diffusion, facilitated diffusion, and osmosis and active transport processes such as endocytosis and exocytosis.
- Why cell transport is vital to the survival of a cell.
- How the polarity of the cell membrane affects cell transport.
- What might happen to a cell if cell transport fails to occur accurately and efficiently.
- How homeostasis is established through the processes of cell transport.
- Why cells need to be small in order to successfully complete all metabolic processes and survive.

Students will be able to...

- Observe the process of diffusion and determine the environmental factors that affect the rate of diffusion through several demonstrations.
- Predict the effect of a hypotonic, hypertonic, or isotonic solution on a cell.
- Analyze the results of an experiment where cells are placed in hypotonic and hypertonic solutions.
- Distinguish between endocytosis and exocytosis.
- Evaluate evidence dealing with the endosymbiosis theory.
- Calculate and compare cell surface to volume ratios.
- Predict the transport of molecules across the membrane based on polarity and size.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:
  - calculate cell surface to volume ratios.
- Plasma Membrane Models
- Osmosis in an Egg Lab Report
- Structure of the Cell Membrane Quiz

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Plasma Membrane and Cell Transport Modeling Activities and Analysis Questions

- Dialysis Tubing Cell Transport Demonstration and Analysis Questions
- Osmosis Beaker Problems
- Cell Membrane and Cell Transport Webquest
- Osmosis in an Egg Lab
- Endosymbiosis Theory Evidence Reading Activity
- Cell Surface Area to Volume Ratio Lab and Activities

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 3
- EdPuzzle
- Explore Learning - Gizmos

Equipment Needed:

- Chromebooks, eggs, vinegar, corn syrup, distilled water, transport modeling/craft materials, potatoes, agar, iodine, phenolphthalein, beakers, balances, chart paper

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Cell Division – Mitosis & Meiosis

Target Course/Grade Level: 9 and 10

Unit Summary: Students will understand how somatic and sex cells reproduce through the process of mitosis and meiosis. They will differentiate between the two processes and understand how the differing chromosomal events affect the genetic make-up of the cells at the end of each process. Students will know that cancer results from a malfunction of the mitotic process and be able to describe the specific failure in the cell cycle. Students will describe chromosomal abnormalities that occur when the meiotic process fails.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:
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.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.3.HL- BRD.1 Summarize the goals of biotechnology research and development within legal and ethical protocols
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
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WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that…

- Cellular function is maintained through the regulation of cellular processes in response to changes in internal and external conditions.
- Somatic cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.
- The life cycle of a cell is divided into two general periods. A period of active growth and metabolism, known as interphase, and a period that leads to cell division known as mitosis.
- Mitosis is divided into four phases: prophase, metaphase, anaphase, and telophase.
- Cancer is caused by genetic and environmental factors that change the genes that control the cell cycle.
- Mutations in somatic (body) cells affect only the individual and may result in cancer.
- Mutations in gametes (sex cells) will impact the offspring and may affect the evolution of a species.
- In meiosis, one diploid (2n) cell produces four haploid (n) gametes, providing a way for offspring to have the same number of chromosomes as their parents when two haploid cells unite during fertilization.
- Crossing over allows for the exchange of genetic information between homologous chromosomes and occurs during Prophase I of meiosis. This process leads to genetic diversity in gametes and offspring.

- Random assortment and crossing over during meiosis provide for genetic variation among the members of a species. These variations play a role in the evolution of a species.
- The outcome of meiosis may vary due to a failure in the appropriate separation of chromosomes known as non-disjunction, which can create disorders.
- Nondisjunction may result in an abnormal number of chromosomes. Abnormal numbers of autosomes are usually lethal. Down Syndrome is an example of a genetic disease caused by nondisjunction.
- A karyotype can identify unusual numbers of chromosomes in an individual.

Unit Essential Questions:

- How do somatic cells divide to produce daughter cells that have the same genetic material as the original cell?
- How are the events of the cell cycle of a normal cell different from the events that occur to create a cancerous cell?
- How are the processes of mitosis and meiosis similar? How are they different?
- How is genetic information passed from one generation to the next during sexual reproduction?
- How does the processes of meiosis and fertilization maintain a constant number of chromosomes in a given species?
- How does meiosis lead to genetic variation in species?
- How do errors in meiosis lead to genetic abnormalities?
- What enzymes control the processes of the cell cycle, mitosis, and meiosis?

Knowledge and Skills:

Students will know...

- Key Definitions: anaphase, cell cycle, centriole, centromere, chromatin, chromosome, cytokinesis, interphase, metaphase, mitosis, prophase, sister chromatid, spindle fibers, telophase, cancer, gene, pollination, trait, zygote, crossing over, diploid, haploid, egg, sperm, genetic recombination, homologous chromosomes, meiosis, nondisjunction, asexual reproduction, sexual reproduction, fertilization, gamete.
- The events and checkpoints of the cell cycle and its importance.
- Why cells may become cancerous and how cancerous cells go through the cell cycle differently than healthy cells.
- The stages and major events of meiosis I and II.
- How failures in meiosis can lead to genetic abnormalities.
- The processes of the cell cycle, mitosis, and meiosis are controlled by enzymes.

Students will be able to...

- Discuss the importance of checkpoints in the mitotic cycle.
- Distinguish between the process of cellular growth (cell division) and development (cell differentiation).
- Identify stages of the cell cycle, mitosis, and meiosis through modeling activities.
- Demonstrate the significance of DNA replication to the cell cycle in both prokaryotes and eukaryotes.
- Compare and contrast the organization of DNA in prokaryotic and eukaryotic cells.
- Distinguish between the events of a normal cell cycle and the abnormal events that result in cancer.
- Manipulate a model to demonstrate the events that occur in the various stages of meiosis including crossing over, separation of chromosomes, and nondisjunction.
- Analyze how meiosis and fertilization maintain a constant number of chromosomes within a given species.

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:
  - Accurately model and explain the stages of the cell cycle, mitosis, meiosis, and nondisjunction.

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Identifying the Stages of Mitosis in an Onion Root Tip Laboratory
- Introduction to Mitotic Cells Internet Activity (http://bio.rutgers.edu/~gb101/lab2_mitosis/index2.html)
- Cell Cycle Foldable
- Mitosis Webquest
- Meiosis Webquest
- Cell Cycle Models- Students develop and explain their own models of the cell cycle.
- Rutgers Decoding Cancer Lesson & revisions to models to display cancer
- Stem Cell Article Jigsaw Project
- Diagrams Comparing Mitosis and Meiosis
- Modeling Meiosis and Nondisjunction Activity
- Mitosis and Meiosis Google Slides Sorting Activities

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 5
- EdPuzzle
- Explore Learning – Gizmos

Equipment Needed:

- Chromebooks, beads, pipe cleaners, craft materials for modeling, construction paper, chart paper, microscopes, onion root tip slides

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Nucleic Acids, Protein Synthesis, & Enzymes

Target Course/Grade Level: 9 and 10

Unit Summary: In this unit, the structure of DNA is described and modeled by the students. The controversy surrounding the discovery of the structure of DNA is explained, noting the key scientists involved in the research. The process of DNA replication and the enzymes involved are presented, explained, and modeled by the students. Transcription and translation are also explained, diagrammed, and modeled by the students. The structure and function of the organelles involved in these processes are introduced to the students. The different types of point and frameshift genetic mutations and their potential effects are modeled and described.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning 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.
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.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
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WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- DNA is the genetic material of all organisms. It is found in the nucleus of eukaryotic cells and floating in the cytoplasm of a prokaryotic cell.
- DNA is a type of nucleic acid and is composed of four kinds of nucleotides. Each nucleotide consists of a sugar, phosphate, and a nitrogen base. The sugar present in DNA is deoxyribose. The nitrogen bases present in DNA are adenine, thymine, cytosine, and guanine.
- A DNA molecule is shaped like a double helix which means it resembles a twisted ladder. It consists of two strands of nucleotides with sugars and phosphates making up the backbone of the molecule. These

parts are found towards the outside of the molecule. The nitrogen bases are bonded together according to base pairing rules on the inside of the molecule.

- The nucleotides in DNA follow a base pairing rule. Guanine always pairs with cytosine and adenine always pairs with thymine. Because of this, DNA can replicate itself with great accuracy.
- The central dogma describes the process of protein synthesis as "DNA to RNA to Protein to Trait."
- Genes are small sections of a chromosome made up of DNA.
- Most sequences of three base pairs in the DNA of a gene code for a single amino acid in a protein.
- Messenger RNA is made during the process of transcription. DNA is used as a template to code for the order of nucleotides in an mRNA molecule. This process takes place in the nucleus of eukaryotic cells and the cytoplasm of a prokaryotic cell.
- Translation is the process in which an mRNA molecule is used as a template to code for the order of amino acids in a protein. This process takes place in a ribosome in both prokaryotic and eukaryotic cells.
- A mutation is a change in the nucleotide base sequence of DNA.
- Mutations can be harmful, beneficial, or inconsequential depending on the change.
- Mutations can affect one gene or an entire chromosome.
- Mutations in somatic cells have the potential to cause cancer.
- Mutations in sex cells affect future generations by producing offspring with new characteristics.
- Enzymes are a type of protein made by the coding instructions in DNA.
- Enzymes are catalysts for reactions that happen within organisms.
- Enzymes have a specific shape that relates to their function.
- Enzyme function can be affected by environmental factors such as temperature, pH, salinity, and the concentration of substrate.
- Enzymes can become denatured in environments that are outside their optimal conditions to function.
- Enzymes control the processes of DNA replication, transcription, and translation.

Unit Essential Questions:

- How does the structure of DNA enable it to make a copy of itself accurately?
- What is the controversy surrounding the discovery of DNA?
- How does a change in DNA in a somatic cell affect an organism?
- How can a change in DNA in a sex cell affect the offspring of an organism?
- How is a sequence of nucleotides in DNA transcribed and translated to synthesize a protein?
- What organelles are involved in the process of protein synthesis?
- What enzymes control the processes of DNA replication and protein synthesis?
- How does enzyme shape affect its function?
- How are enzymes affected by environmental changes?
- How does enzyme function impact organisms?

Knowledge and Skills:

Students will know...

- Key definitions: DNA replication, double helix, nitrogen bases, codon, anticodon, mRNA, tRNA, rRNA, transcription, translation, gene, chromosomal mutation, frameshift mutation, mutagen, mutation, point mutation, somatic cells, enzyme, substrate, product, denaturing agent, active site.
- The contributions of Alfred Hershey, Martha Chase, James D. Watson, Francis Crick, Erwin Chargaff, and Rosalind Franklin in the discovery and understanding of the structure of DNA.
- The shape and parts of a DNA molecule.
- The shape and parts of an RNA molecule.
- The base pairing rules for a molecule of DNA.
- How DNA codes for different proteins in organisms, especially enzymes.
- The impact different environmental factors have on enzyme function.

- As enzymes shape is critical to its function.
- A change in the shape of an enzyme is known as denaturing.

Students will be able to...

- Create a model of a DNA molecule and demonstrate how it replicates.
- Relate the concept of genes to the sequences of nucleotides in DNA.
- Sequence the steps involved in protein synthesis: both transcription and translation.
- Describe basic differences between protein synthesis in prokaryotes and eukaryotes.
- Compare and contrast the effects of different kinds of mutations on cells and organisms.
- Describe the central dogma.
- Model enzyme function and explain what causes enzymes to denature.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* above.

- Enzyme Lab Report

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- DNA Extraction Lab
- DNA Modeling Activity
- Transcription & Translation Coloring Activity
- Human Face Traits Gene to Trait Activity
- Mutation Coding Activity
- Enzyme Close Reading Activity
- Enzyme Modeling Activity

RESOURCES

- Catalase Lab Experiment

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 8
- EdPuzzle
- Explore Learning – Gizmos

Equipment Needed:

- Chromebooks, strawberries, peas, chicken liver, salt, shampoo, beakers, coffee filters, sandwich bags, isopropyl alcohol, test tubes, hot plates, colored pencils, craft materials, hydrogen peroxide

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Genetics – Mendelian and Non-Mendelian

Target Course/Grade Level: 9 and 10

Unit Summary: This unit introduces genetics through the presentation of Gregor Mendel's classic work. The focus is the probability of producing offspring with certain traits based on the parents genotypes and/or phenotypes. Students will also examine non-Mendelian inheritance patterns and the principles of human genetics. These inheritance patterns include codominance, incomplete dominance, blood type, sex-linked traits, and polygenic traits. Students will learn to read and analyze a pedigree.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:
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.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations.
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for

accomplishing a specified task.
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
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.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:
NJSLSA.R1. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- Genes are located on chromosomes and exist in alternate forms called alleles.
- Cells have matching pairs of homologous chromosomes called autosomes that code for all the traits of an organism except sex.
- Sex chromosomes contain genes that determine the sex of an individual as well as containing genes for other non-sex related traits.
- Mendel formulated the Law of Segregation to explain the masking of a recessive trait in the F1 generation and its reappearance in the F2 generation when parents who were pure for the each of the traits were crossbred.
- Mendel formulated the Law of Independent Assortment to explain that two traits are inherited independently as long as they are on separate chromosomes.
- Events in genetics are governed by the laws of probability. A Punnett Square is a tool that can be used to determine the probability of a certain genotype and/or phenotype being inherited by an individual.
- All genes on the same chromosome are linked and are inherited together. It is chromosomes rather than the individual genes that are assorted independently.

- Some alleles can be expressed through incomplete dominance or co-dominance. This makes additional phenotypic outcomes possible.
- There may be multiple alleles for one trait.
- Some traits are polygenic; meaning there are multiple genes in different locations and/or on different chromosomes controlling that trait.
- The majority of human traits are controlled by multiple allele or polygenic inheritance. The inheritance patterns of these traits are highly variable.
- A pedigree is a family tree of inheritance.
- Most human genetic disorders are inherited as rare recessive alleles, but a few are inherited as dominant alleles.
- Sex-linked traits are determined by the inheritance of sex chromosomes. X-linked traits are usually passed from carrier females to their male offspring.
- Nondisjunction may result in an abnormal number of chromosomes. Abnormal numbers of autosomes are usually lethal. Downs Syndrome is an example of a genetic disease caused by nondisjunction.
- A karyotype can identify unusual numbers of chromosomes in an individual.

Unit Essential Questions:

- What laws resulted from Gregor Mendel's research and experiments with garden pea plants?
- How is a Punnett Square used to predict the possible outcomes for offspring of a genetic cross?
- How are Mendel's laws of heredity related to the events of meiosis?
- How can a pedigree be used to determine the likelihood that a trait is being carried and/or may be inherited by an individual?
- How do traits expressed through incomplete dominance or codominance inheritance patterns affect the outcome of a phenotype in an individual?
- What role does multiple allelic and polygenic inheritance play in the diversity of human genotypes and phenotypes?
- Why are X-linked, sex-linked traits more likely to result in female offspring being carriers while male offspring are affected?
- Why are X-linked, sex-linked traits likely to be passed from mothers to their sons?
- Why are Y-linked, sex linked traits passed from fathers to sons only?
- How can a karyotype be interpreted to detect chromosomal abnormalities?

Knowledge and Skills:

Students will know...

- Key definitions: allele, dominant, recessive, genetics, genotype, phenotype, heredity, heterozygous, homozygous, hybrid, law of independent assortment, law of segregation, trait, monohybrid cross, dihybrid cross, P generation, F1 generation, F2 generation, heredity, genetics, testcross, carrier, zygote, fetus, pedigree, autosome, codominant alleles, incomplete dominance, multiple alleles, polygenic inheritance, sex chromosome, sex-linked traits, karyotype
- How to calculate probability of a specific trait in the offspring based on parental genotypes.
- Common human genetic disorders that are caused by the inheritance of recessive alleles.
- Common codominant, multiple allelic, sex-linked, and polygenic traits in humans and other organisms.

Students will be able to...

- Relate Mendel's two laws to the results he obtained in his experiments with garden peas.
- Analyze Punnett Squares for monohybrid and dihybrid crosses to determine the probability of certain genotypes and/or phenotypes being inherited by an individual.
- Relate Mendel's two laws of heredity to the events of meiosis.
- Model inheritance patterns through diagrams.

- Interpret a pedigree.
- Determine and make predictions for genotypes and phenotypes of individuals based on a pedigree.
- Distinguish between alleles for incomplete dominance and co-dominance.
- Analyze the pattern of inheritance for human blood type, a multiple allelic trait.
- Analyze the pattern of inheritance for sex-linked traits.
- Distinguish between conditions that result from extra autosomal or sex chromosomes.
- Analyze a karyotype for chromosomal abnormalities

EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:
    - model inheritance patterns through Punnett squares and pedigrees.
    - analyze Punnett Squares for monohybrid and dihybrid crosses to determine the probability of certain genotypes and/or phenotypes being inherited by an individual.
    - distinguish between alleles for incomplete dominance and co-dominance.
    - analyze Punnett Squares to determine the pattern of inheritance for human blood type and sex-linked traits.

- EOC Biology 2010 Operational Performance Task Tom Ato's New Crop

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Monohybrid Cross Problems Packet
- Guinea Pig Breeding Problems
- Probability Penny Lab
- Dihybrid Crosses and Mendel's Laws of Inheritance Problems Packet
- Incomplete Dominance and Codominance Practice Problems
- Sex-linked Trait Problems Packet
- Pedigree Problems Packets
- Modeling a Pedigree Activities

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 6 & 7
- EdPuzzle
- Explore Learning – Gizmos

Equipment Needed:

- Chromebooks, pennies, calculators

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Genetic Technology

Target Course/Grade Level: 9 and 10

Unit Summary: This unit describes artificial selection/breeding, advances in DNA technology, and the significance of the Human Genome Project. This unit includes activities that help build student understanding of the use of restriction enzymes, cloning, PCR, Gel Electrophoresis/DNA Fingerprinting, bacterial transformation and the production of human proteins (esp insulin), and CRISPR technology.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning 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.
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.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.3.HL- BRD.1 Summarize the goals of biotechnology research and development within legal and ethical protocols.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.

9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations.
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
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.

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NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- Plant and animal breeders selectively breed organisms with a desirable trait which increases the frequency of a desired allele in a population. This is referred to as artificial selection.
- Scientists have developed methods to move genes from one species into another.
- Transgenic organisms can make the genetic products of other organisms using the foreign DNA.
- Bacteria, plants, and animals can be genetically engineered to be of increased use to humans.
- Gene cloning can be done by through gene splicing into bacteria or through a polymerase chain reaction (PCR).
- Many species of animals have been cloned. The first cloned mammal was a sheep.
- The Human Genome Project has sequenced the chromosomal DNA of the human genome.
- Gel Electrophoresis and DNA fingerprinting is used to identify individuals.
- Gene therapy technology can be used to treat genetic disorders.

- CRISPR technology is at the forefront of biotechnological engineering at present. It has greater implications for helping treat genetic disorders and disease than any other previous biotechnological advances.

Unit Essential Questions:

- How can selective breeding and artificial selection affect the gene pool of a species?
- How can a gene be removed from one species and inserted into the genome of another?
- How are proteins produced from foreign DNA inserted into a transgenic organism?
- Why was/is the polymerase chain reaction an important laboratory technique used in the advancement of genetic engineering?
- How might the Human Genome Project be used to cure genetic disorders through gene therapy?
- How is gel electrophoresis used to create a DNA fingerprint that can identify a single individual and his or her kin?
- What is CRISPR technology and how can it be used to advance the medical field?
- What are some of the major bioethical issues related to genetic technology?

Knowledge and Skills:

Students will know...

- Key definitions: inbreeding, clone, genetic engineering, plasmid, recombinant DNA, restriction enzymes, transgenic organism, vector, gene therapy, human genome, DNA fingerprinting, gel electrophoresis, polymerase chain reaction, CRISPR.
- The steps used to engineer transgenic organisms.
- The steps of gel electrophoresis and how it is used to make a DNA fingerprint.
- The steps of PCR and how it is used in bioengineering and medicine (esp relevant to COVID testing).
- The steps involved in the use of CRISPR technology.
- The applications and benefits of genetic engineering.
- The ethical and moral concerns surrounding genetic engineering.

Students will be able to...

- Evaluate the importance of plant and animal breeding to humans.
- Analyze how completely mapping and sequencing the human genome will advance the human race.
- Describe how recombinant DNA is formed and used in medical engineering.
- Describe how PCR is used in genetic/medical engineering.
- Describe how gel electrophoresis is used in genetic/medical engineering.

EVIDENCE OF LEARNING

- Analyze a DNA fingerprint to identify an individual and/or their family members.
- Describe how CRISPR is used in genetic/medical engineering.

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section.
    - Recombinant DNA Modeling Activity

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Biotechnology Presentation
- Biotechnology Close Reading Activity
- Artificial Selection Laboratory Activity
- HHMI PCR Activity
- HHMI Bacterial Transformation Activity
- Recombinant DNA Modeling Activity
- DNA Fingerprinting Activities
- CRISPR Close Reading Activity – Genome: Unlocking Life's Code - https://unlockinglifescode.org/crispr-teaching-tools
- Genes in Space MiniPCR Lab – grant must be applied for annually.

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 9
- Biotechnology Gizmos
- Biotechnology EdPuzzles

Equipment Needed:

- Chromebooks, Genes in Space MiniPCR Machines – When applied for through the grant.,

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Natural Selection & Evolution

Target Course/Grade Level: 9 and 10

Unit Summary: This unit introduces Darwin's theory of evolution by natural selection. The role of natural selection in the evolution of new species is presented. Students will compare and contrast the work of Jean-Baptiste Lamarck with Darwin's. Students will discuss Charles Darwin's original evidence for natural selection as well as learn about the evidence related to modern advancements in genetic technology and understanding.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction other species.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
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.
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NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:
Students will understand that…

- There are many theories, both past and present, which have explained how organisms change over time.
- The basic idea of theoretical biological evolution is that species that are present on Earth currently developed from earlier, distinctly different species.
- After many years of experimentation and observation, Charles Darwin proposed the idea that species originated through natural selection.
- Natural selection is a mechanism of genetic change in populations.
- In a specific environment, individuals with certain traits are more likely to survive, reproduce, and pass these traits on to their offspring.
- Evolution has been observed in the lab and in the field.
- Much of the evidence for evolution comes from studies of fossils, embryology, physiology, and biochemistry.

- There are many patterns of evolution in nature. These patterns support the idea that natural selection is an important mechanism of evolution.
- Biologists use similarities in body structures, breeding behavior, geographical distribution, chromosomes, and biochemistry to determine evolutionary relationships.
- Cladograms and phylogenic trees can be used to describe and study evolutionary relationships.

Unit Essential Questions:

- How does evolution occur through natural selection?
- Why is natural selection and heredity integral in the process of evolution?
- What are some of the ways scientists study evolutionary relationships among organisms?
- How does fossil, physiological, embryological, and biochemical evidence support Darwin's theory of evolution by natural selection?
- How can changes in populations lead to speciation and macroevolution?
- How can the theory of evolution through natural selection be used to explain the way in which a particular organism came to have its current physical appearance and biochemistry?
- How do the major body plans of plants and animals exhibit evolutionary patterns?
- How are cladograms and phylogenic trees constructed?
- How are cladograms and phylogenic tress describe evolutionary relationships?
- How have human activities impacted the evolution of organisms?

Knowledge and Skills:

Students will know...

- Key definitions: analogous structures, artificial selection, camouflage, embryo, homologous structure, mimicry, natural selection, vestigial structure, allelic frequency, convergent evolution, divergent evolution, speciation, cladistics, cladogram, Archaea, Eubacteria, fungi, phylogeny, protists.
- The four major categories of evidence for evolution.
- How natural selection leads to physical and chemical changes in organisms.
- The difference between a cladogram and a phylogenic tree.
- How human activities have altered the evolution of various species and even caused the extinction of organisms.

Students will be able to...

- Analyze how structural and physiological adaptations of organisms relate to natural selection.
- Summarize the effects of different types of natural selection on gene pools.
- Summarize the role of natural selection in convergent and divergent evolution.
- Interpret a phylogenetic tree.
- Construct and interpret a cladogram based on DNA evidence.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:

- construct a cladogram based on DNA evidence.

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Is it fitter? Formative Assessment Probe
- Evidence for Evolution Dry Lab
- GIZMO: Peppered Moth Simulation
- Anolis Lizards Activity
- Habitat Change Formative Assessment Probe
- "How the Cricket Lost Its Song" Activity
- Survival of the Sneakiest Comic and Analysis Questions

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 10 & 12
- EdPuzzle
- Explore Learning – Gizmos

Equipment Needed:

- Chromebooks, construction paper, hole punch, calculators

UNIT OVERVIEW

Area: Honors Biology

Unit Title: Viruses & Bacteria

Target Course/Grade Level: 9 and 10

Unit Summary: This unit introduces students to the forms and characteristics of viruses. Students will understand and be able to provide evidence as to why viruses are not alive. Students will learn the structures, ecology, and the importance of bacteria in the living world. Students will be able to differentiate between viruses and bacteria. Students will also gain understanding of natural selection and bacterial antibiotic resistance.

Approximate Length of Unit: 2 weeks

LEARNING TARGETS

NJ Student Learning Standards:
HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Interdisciplinary Connections and Standards:
Career Readiness, Life Literacies, and Key Skills:
9.3.ST- SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
9.3.ST- SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations.
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
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.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:

NJSLSA.R1. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.1. 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.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that…

- Pathogens are defined as disease causing agents that can enter the human body and multiply to create infection.
- Bacteria are pathogens that produce disease in one or two general ways.
- Some bacteria damage cells by breaking down the cell for food, while other release toxins (poisons) that travel throughout the body interfering with normal biological activities.
- Like bacteria, viruses produce disease by disrupting the body's normal equilibrium.
- Once a virus is inside a host cell, two different processes may occur.
- The virus may attack the host by producing a lytic or lysogenic infection.
- Antibiotics are compounds that kill bacteria without harming human cells.
- Antibiotics have no effect on viruses.
- Antiviral drugs have been developed to fight certain viral diseases.
- Antiviral drugs inhibit the ability of viruses to invade and multiply in living cells.
- Viral spread is controlled through prevention by vaccination.
- Through natural selection bacteria can become antibiotic resistant.

Unit Essential Questions:

- How do pathogens multiply and cause disease in the human body?
- How do bacteria cause disease?
- How do pathogens disrupt human homeostasis?
- How do viruses replicate?
- What are the lytic and lysogenic cycles of viruses?
- How do antivirals work to destroy viruses?
- How do vaccines work in preventing viral infections and spread?
- What are some major human bacterial and viral diseases that are of historical significance?
- How can bacteria become resistant to antibiotics?
- How do humans use bacteria and viruses to their benefit?

Knowledge and Skills:

Students will know...

- Key definitions: bacteriophage, capsid, host cell, lysogenic cycle, lytic cycle, pathogen, retrovirus, viroid, virus, binary fission, chemosynthesis, conjugation, endospore, nitrogen fixation, obligate aerobe, obligate anaerobe, toxin
- The three shapes of bacteria.
- Major diseases caused by bacteria and viruses.
- How to determine if a disease is bacterial or viral.
- Bacteria are pathogens that reproduce disease in one or two general ways.
- How antibiotics can recognize a specific bacterium and stop its reproduction.
- Basic viral structure.
- Viruses produce diseases by disrupting cell metabolism.
- Vaccines can prevent viral infection and spread.
- Humans use bacteria and viruses in beneficial ways in the medical field, food industry, and in chemical production.

Students will be able to...

- Describe basic bacterial structure.
- Describe binary fission.
- Describe basic viral structure.
- Model how different viruses form.
- Model how viruses reproduce and evolve.
- Describe the important roles bacteria play in organisms and in the environment.
- Use evidence to determine if a disease is bacterial or viral.
- Describe specific examples of human use of bacteria and viruses to their benefit in the medical, chemical, and food industries.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- **End of Unit Assessment**: This assessment will include multiple choice and open-ended questions that require students to draw and analyze graphs and diagrams related to the content described in the *Unit Understandings* section as well as:

    - Analyze evidence to determine if a disease is bacterial or viral.

- Antibacterial and Non-Antibacterial Cleansers and Bacterial Growth Laboratory Report

Learning Activities:
What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Antibacterial and Non-Antibacterial Cleansers and Bacterial Growth Laboratory (teacher may decide to do this lab at the start of the school year or during the evolution unit)
- Comparing Bacteria and Viruses Venn Diagrams
- Bacteria vs. Viruses Presentation
- Viral Reproduction Presentation
- Viral Structure, Reproduction, and Evolution Modeling Activity

RESOURCES

Teacher Resources:

- **Textbook:** Biology, by Stephen Nowicki. Ch. 18
- EdPuzzle
- Explore Learning – Gizmos

Equipment Needed:

- Chromebooks, Virus Model Supplies: Styrofoam cups, colored push pins, seamstress pins, construction paper, pipe cleaners, plastic wrap, paper plates, rubber bands.