MIDLAND PARK PUBLIC SCHOOLS
Midland Park, New Jersey
CURRICULUM

Biology

Prepared by:
Raina Dawson

Superintendent of Schools:
Marie C. Cirasella, Ed.D.
Director of Curriculum, Instruction & Assessment:
Melissa Quackenbush

Approved by the Midland Park Board of Education on August 16, 2016

HS Biology Curriculum Overview

High School Biology is taught in five units throughout the school year. The curriculum is a full integration of the practices of science with its ideas and all major biological concepts. Students will learn the idea of science/biology through actually doing science/biology. High School Biology is a laboratory science course in which students investigate the biological concepts and practice scientific skills. Students will investigate Cycles of Matter and Energy Transfer in Ecosystems: How do matter and energy move through ecosystems? And how do organisms interact with the living and nonliving environment. The next disciplinary core idea discussed will be: Ecosystem Dynamics, Functioning and Resilience: What happens to ecosystems when the environment changes?. Structure and Function or How do the structures of organisms enable life's functions? Will be explored by the students in Unit 3. The study of Genetics asks questions about the Variation of Traits: Why do individuals of the same species vary in how they look, function and behave? Evolution is the central theme of all biology and it is the core theme of the course and will be discussed and emphasized throughout all projects!

Aspects of physical science;chemistry and biochemistry; earth & space science; and engineering, technology & applications of science are taught throughout the year. A guided inquiry program, problem-based learning experiences and engineering projects will give students the opportunity to explore topics and concepts though investigations. Participating in this hands-on program helps students:

1. To be prepared for College/Career by emphasizing key skills and practices (NGSS, CCSS, STEM).
2. Become lifelong learners and engaged citizens.

Suggested Course Sequence*:

Unit 1: **Matter and Energy Transformations in Ecosystems and Interdependent Relationships in Ecosystems: 45 days**
Unit 2: **Human Activity and Climate and Biodiversity: 38 days**
Unit 3: **Cell Specialization and Homeostasis: 42 days**
Unit 4: **DNA and Inheritance: 27 days**
Unit 5: **Natural Selection and Evolution: 30 days**

Pre-Requisites: Middle School Science Program

**The number of instructional days is an estimate based on the information available at this time. 1 day equals approximately 48 minutes of seat time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.*

Content Area: Science/ Biology

Unit Title: Matter and Energy Transformations in Ecosystems and Interdependent Relationships in Ecosystems

Grade Level: 9

Unit Summary: In this unit of study, students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration, and they will develop models to communicate these explanations. Students also understand organisms' interactions with each other and their physical environment and how organisms obtain resources. Students utilize the crosscutting concepts of matter and energy and systems, and system models to make sense of ecosystem dynamics. Students are expected to use students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations as they demonstrate their understanding of the disciplinary core ideas.

Students will also formulate answers to the question "how and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?" Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students use mathematical reasoning and models to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter and flow of energy through systems. The crosscutting concepts of scale, proportion, quantity and stability and change are called out as organizing concepts for the disciplinary core ideas. Students are expected to use mathematical reasoning and models to demonstrate proficiency with the disciplinary core ideas.
Interdisciplinary

Connections:
Chemistry, Mathematics, Earth Science, Physics

21st Century Themes and Skills:
CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills.. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

Standards (Content and Technology):

CPI#:	Statement:
HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.]
HS-LS1-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]

HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. *[Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]*
LS2-A	Illustrate how interactions among living systems and with their environment result in the movement of matter and energy.
LS2-A	Graph real or simulated populations and analyze the trends to understand consumption patterns and resource availability, and make predictions as to what will happen to the population in the future.
LS2-A	Provide evidence that the growth of populations are limited by access to resources, and how selective pressures may reduce the number of organisms or eliminate whole populations of organisms.
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. *[Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.*
HS-LS-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. *[Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]*
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. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]
8.1	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
8.2	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
8.2.12.B.2	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.

8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review

Unit Essential Question(s):

- Why are the properties of water important to organisms?
- How do organisms use different types of carbon compounds?
- How do chemicals combine and break apart inside living things?
- How do living and nonliving parts of Earth interact and affect the survival of organisms?
- How do plants and other organisms capture the energy from the sun?
- How do organisms store and obtain energy?

Unit Enduring Understandings:

- Organisms need to obtain and use matter and energy to live and grow.
- The existence of life on earth depends on interactions among organisms and between organisms and their environment.

Unit Learning Targets/Objectives:

Students will

- Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
- Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions
- Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms
- Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon
- Among the biosphere, atmosphere, hydrosphere and geosphere.

Formative Assessments:

Quizzes, homework, classwork, tests, Laboratory assignments, PBL's, Engineering Projects;

Summative/Benchmark Assessments:

Test, PBLs and Engineering Projects

Materials:

Textbook, online resources (The American Biology Teacher, HHMI Publications, Science Times etc.)

Leaf Photosynthesis NetLogo Model

Surviving Winter in the Dust Bowl (Food Chains and Trophic Levels)

https://engage.intel.com/docs/DOC-51219

www.pearsonsuccessnet.com

www.discoverystreaming.com

www.tryengineering.org

www.teachengineering.org

Modifications:

Special Education Students/at risk students/gifted students: •

- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Lesson Name/ Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Changes in the Bay or Energy Flow in Ecosystems	**Students will construct and revise explanations based on evidence for the flow of energy**	4
Cycles of Matter	**Students will construct and revise explanations based on evidence for the cycling of matter**	4
The Process that feeds the world	**Students will develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon.**	12
Disappearing mussels (PBL)	**Sw design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity**	2
A Plague of Rabbits or how populations grow	**Students will use mathematical representations to support explanations that affect carrying capacity of ecosystems**	6
The wolf effect or ecosystems	**Sw evaluate the evidence for the role of group behavior on individual and**	5

and communities	**species' chances to survive and reproduce**	
What is ecological succession?	**Sw evaluate claims, evidence and reasoning that changing conditions may result in a new ecosystem**	4
Biomes in Action	**Sw design biome presentations and create newspaper/magazine pages to inform the public about threads to the biomes**	8 (PBL)

Teacher Notes:

Additional Resources
Click links below to access additional resources used to design this unit:

Content Area: Biology

Unit Title: Human Activity and Climate and Biodiversity

Grade Level: 9

Unit Summary:

In this unit of study, students examine factors that have influenced the distribution and development of human society; these factors include climate, natural resource availability, and natural disasters. Students use *computational representations* to analyze how earth systems and their relationships are being modified by human activity. Students also develop an understanding of how human activities affect natural resources and of the interdependence between humans and Earth's systems, which affect the availability of natural resources. Students will apply their engineering capabilities to reduce human impacts on earth systems and improve social and environmental cost–benefit ratios. The crosscutting concepts of *cause and effect, systems and systems models, stability and change*, and *the influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for the disciplinary core ideas. Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate understanding of the disciplinary core ideas.

The students will use *mathematical models to* provide support for the conceptual understanding of systems and students' ability to *design, evaluate, and refine solutions* for reducing the impact of human activities on the environment and maintaining biodiversity. Students create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity. Crosscutting concepts of *systems and system models* play a central role in students' understanding of science and engineering practices and core ideas of ecosystems. Mathematical models also provide support for students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.

Interdisciplinary Connections: Chemistry, Mathematics, Earth Science, Physics

21st Century Themes and Skills:

CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills.. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

Standards (Content and Technology):

CPI#:	Statement:
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. *[Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]*
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. *[Clarification Statement:*

	Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. *[Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]*
HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]
HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. *[Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]*
HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

8.1	**Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**
8.1.12.A.2	**Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.**
8.1.12.A.3	**Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.**
8.1.12.A.5	**Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.**
8.2	**Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.**
8.2.12.B.1	**Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.**
8.2.12.B.2	**Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.**
8.2.12.B.4	**Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.**
• **8.2.12.D.1**	**Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review**

Unit Learning Targets/Objectives:

Students will

- **Investigate how human activities that can affect the biosphere.**
- **Investigate how human activities affect soil/land, water and air resources.**
- **Identify current threads to biodiversity.**
- **Investigate and describe how biodiversity can be preserved.**
- **Identify the role of ecologists in a sustainable future.**
- **Analyze and evaluate data and scientific publications.**
- **Create a controlled experiment to solve a real world problem.**
- **Design an Algae Farm to solve a real world global problem.**
- **Apply all their knowledge/skills to unfamiliar questions/problems**

Formative Assessments:
Quizzes, homework, classwork, tests, Laboratory assignments, PBL's, Engineering Projects;

Summative/Benchmark Assessments:
Test, PBLs and Engineering Projects
Materials:
Textbook, online resources (The American Biology Teacher, HHMI Publications, Science Times etc.)
www.pearsonsuccessnet.com
www.discoverystreaming.com
www.tryengineering.org
www.teachengineering.org

Modifications:
Special Education Students/at risk students/gifted students:

- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Moving the Moai	**Sw solve the mystery how the Rapa Nui moved the stones**	6
Case Study: Global	**Sw create an explanation based on evidence to show how human activity**	4

Climate Change	**influences earth's atmosphere**	
Case Study: Atmospheric Ozone	**Sw use a computer simulation to investigate the ozone layer**	4
Case Study: North Atlantic Fisheries	**Sw use data to describe the problem of overfishing**	4
Global Climate Change: Algae to the rescue	**Sw design the model of an algae farm to reduce the carbon dioxide output**	15 (engineering project)
Ecological Footprint	**Sw use a computer simulation to calculate their ecological footprint and test solutions**	2
What is acid rain?	**Sw assess the effects of acid rain.**	3 (Laboratory activity)

Teacher Notes:

Additional Resources
Click links below to access additional resources used to design this unit:

Content Area: Biology

Unit Title: Cell Specialization and Homeostasis

Grade Level: 9

Unit Summary:

Students formulate an answer to the question "How do the structures of organisms enable life's functions?" Students investigate explanations for the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. The crosscutting concepts of structure and function, matter and energy, and systems and system models are called out as organizing concepts for the disciplinary core ideas. Students use critical reading, modeling, and conducting investigations. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas

Interdisciplinary Connections: Chemistry, Mathematics, Earth Science, Physics

21st Century Themes and Skills: Themes and Skills: CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills.. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

Standards (Content and Technology):

CPI#:	Statement:
8.1	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
8.2	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
8.2.12.B.2	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.

8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review
LS1. A	Explain the connection between the sequence and the subcomponents of a biomolecule and its properties. [Clarification Statement: Emphasis is on the general structural properties that define molecules. Examples include r-groups of amino acids, protein shapes, the nucleotide monomers of DNA and RNA, hydrophilic and hydrophobic regions.] [Assessment Boundary: Assessment does not include identification or the molecular sequence and structure of specific molecules] Create representations that explain how genetic information flows from a sequence of nucleotides in a gene to a sequence of amino acids in a protein. Construct models that explain the movement of molecules across membranes with membrane structure and function. [Clarification Statement: Emphasis is on the structure of cell membranes, which results in selective permeability; the movement of molecules across them via osmosis, diffusion and active transport maintains dynamic homeostasis.] Provide examples and explain how organisms use feedback systems to maintain their internal environments.
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. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. *[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]*
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]

Unit Essential Question(s):	Unit Enduring Understandings:
• Why is it important to study cells? • What are the basic chemical principles that affect living things? • What is the matter in organisms made of? • How do organisms use different types of carbon compounds? • How do chemicals combine and break apart inside living things? • How does a cell transport materials across a cell membrane and maintain homeostasis? • How does a cell produce a new cell? • How does a cell control the process of cell division?	• Structure and function: the structures of organisms enable life's functions. • The processes that occur at the cellular level provide the energy and basic structure organisms need to survive. • How does a single undifferentiated cell lead to a complex multicellular organism?

Unit Learning Targets/Objectives:

Students will

- **Distinguish between prokaryotes and eukaryotes**
- **Identify and describe the structure and function of all major cell organelles**
- **Distinguish between passive and active transport**
- **Explain how unicellular and multicellular organisms maintain homeostasis**
- **Describe the role of ATP in cellular activities**
- **Compare sexual and asexual reproduction**
- **Investigate the main phases of the cell-cycle**
- **Explain how life can be studied at different levels**
- **Discuss the unique properties of water**
- **Describe the structures and functions of each of the four groups of macromolecules**
- **Identify the role of DNA in heredity and its chemical components**
- **Explore DNA replication**
- **Summarize protein synthesis**

Formative Assessments:

Quizzes, homework, classwork, tests, Laboratory assignments, PBL's, Engineering Projects;

Summative/Benchmark Assessments:

Test, PBLs and Engineering Projects

Materials:

Textbook, online resources (The American Biology Teacher, HHMI Publications, Science Times etc.)

www.pearsonsuccessnet.com
www.discoverystreaming.com
www.tryengineering.org
www.teachengineering.org

Modifications:

Special Education Students/at risk students/gifted students:

- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
Harnessing the fear of water	**Sw develop models to explain hydrophobicity**	4 PBL/Engineering Project
Healthy Schools	**Sw create a public announcement to improve the eating habits at school**	10 PBL
The ghostly fish	**Sw solve a real world problem**	5Mystery
Maxed out muscles	**Sw create a fitness plans that explain the causes of muscle fatigue**	3 PBL
Death by ...water?	**Sw explain how a marathon runner can experience death by drinking water**	2 Mystery
What is homeostasis?	**Sw explain how cells and organisms maintain homeostasis**	4
DNA-structure and function	**Sw create a model to explain the structure of DNA**	4
The Cell Cycle	**Sw create a model of the cell cycle and demonstrate the importance of cellular division**	5 Video/Cartoon project
RNA and Protein synthesis	**Sw model the process of protein synthesis**	5 Video/Cartoon project

Teacher Notes:

Additional Resources
Click links below to access additional resources used to design this unit:

Content Area: Biology

Unit Title: DNA and Inheritance

Grade Level: 9

Unit Summary:

Students analyze data develop models to make sense of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next. Students determine why individuals of the same species vary in how they look, function, and behave. Students develop *conceptual models* of the role of DNA in the unity of life on Earth and *use statistical models* to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science are described. Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions. The crosscutting concepts of *structure and function*, *patterns*, and *cause and effect* are used as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas. Interdisciplinary.

Connections: Chemistry, Mathematics, Earth Science, Physics

21st Century Themes and Skills:

CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills.. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

Standards (Content and Technology):

CPI#:	Statement:
8.1	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
8.2	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
8.2.12.B.2	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial

	revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.D.1	**Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review**
LS1.B **LS3.B**	**Explain how the process of meiosis results in the passage of traits from parent to offspring, and how that results in increased genetic diversity necessary for evolution. [Clarification Statement: The emphasis is on how meiosis results in genetic diversity, not the rote memorization of the steps of meiosis.]** **Create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced.**
HS-LS1-4	**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]**
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. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]**
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. *[Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]***

Unit Essential Question(s):	**Unit Enduring Understandings:**
• **How does cellular information pass from one generation to another?** • **How can interactions between alleles, genes and the environment affect an organism's traits?** • **Why do populations show genetic variation?** • **How do cells copy their DNA?** • **What happens if a cell's DNA changes?** •	• **DNA enables an organism to transmit heredity and along with the environment, determines an organism's characteristics.** • **Variation of traits: individuals of the same species vary in how they look, function and behave because of gene shuffling during sexual reproduction, mutations and lateral gene transfer.**

Unit Learning Targets/Objectives:

Students will

- **Create punnett squares and apply principles of probability**
- **Explain the relationship between genes and the environment**
- **Summarize the events of meiosis**
- **Compare and contrast mitosis and meiosis**
- **Identify the role of DNA in heredity and review its chemical components**
- **Explore DNA-Replication and Gene expression**
- **Define mutations and describe the different types of mutations**
- **Explore the effects mutations can have on genes and phenotypes**
- **Relate gene regulation to development in multicellular organisms**

- **Explain how small changes in the DNA cause genetic disorders**
- **Investigate applications and impacts of genetic engineering**

Formative Assessments:
Quizzes, homework, classwork, tests, Laboratory assignments, PBL's, Engineering Projects;

Summative/Benchmark Assessments:
Test, PBLs and Engineering Projects
Materials:
Textbook, online resources (The American Biology Teacher, HHMI Publications, Science Times etc.)

www.pearsonsuccessnet.com
www.discoverystreaming.com
www.tryengineering.org
www.teachengineering.org

Modifications:
Special Education Students/at risk students/gifted students:

- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
How does DNA-replic	**Sw create and explain a model of DNA-Replication**	2

ation work?		
Green Parakeets	**Sw solve a genetics problem**	5
Other Patterns of Inheritance	**Sw describe other patterns of inheritance and use the laws of probability**	4
Genetic variation	**Sw defend the claim that genetic variation results from meiosis**	5 video/cartoon/prezi presentations
	Sw defend the claim that genetic variation results from mutations caused by environmental factors/mistakes	5
Genetic Engineering	**Sw create a transgenic organism to solve a real word problem**	2 PBL/Engineering Project
Food Fight	**Sw create a visual summary of their position concerning GM foods**	4 (PBL)

Teacher Notes:

Additional Resources
Click links below to access additional resources used to design this unit:

Content Area: Biology

Unit Title: Natural Selection and Evolution

Grade Level: 9

Unit Summary:

Students constructing explanations and designing solutions, analyzing and interpreting data, and engaging in argument from evidence investigate to make sense of the relationship between the environment and natural selection. Students also develop an understanding of the factors causing natural selection of species over time. They also demonstrate and understandings of how multiple lines of evidence contribute to the strength of scientific theories of natural selection. The crosscutting concepts of patterns and cause and effect serve as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions. The crosscutting concepts of patterns and cause and effect support the development of a deeper understanding.
Interdisciplinary

Connections: Chemistry, Mathematics, Earth Science, Physics

21st Century Themes and Skills:
CRP1. Act as a responsible and contributing citizen and employee. CRP2. Apply appropriate academic and technical skills.. CRP4. Communicate clearly and effectively and with reason. CRP5. Consider the environmental, social and economic impacts of decisions. CRP6. Demonstrate creativity and innovation. CRP7. Employ valid and reliable research strategies. CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership and effective management. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence.

Standards (Content and Technology):

CPI#:	Statement:
8.1	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
8.2	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global

	society, and the environment.
8.2.12.B.1 8.2.12.B.2 8.2.12.B.4	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review. Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product. Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review
LS4.A LS4.C	Examine a group of related organisms using a phylogenic tree or cladogram in order to (1) identify shared characteristics, (2) make inferences about the evolutionary history of the group, and (3) identify character data that could extend or improve the phylogenetic tree. Make predictions about the effects of natural selection on the genetic makeup of a population over time.
HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]
HS-LS4-2	Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.]
HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]
HS-LS4-3	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. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]
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. [Clarification Statement: Emphasis is on determining

	cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]
HS-LS2-8	**Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]**

Unit Essential Question(s):

- **What is natural selection?**
- **What is Darwin's theory of evolution by natural selection**
- **What are the main lines of scientific evidence that support the theory of evolution?**
- **How can populations evolve to form new species?**
- **How do genes make evolution possible?**
- **What causes a population's gene pool to change?**
- **How do new species form?**
- **How do evolutionary relationships affect the way scientists classify organisms?**

Unit Enduring Understandings:

- **The diversity of life is the result of ongoing evolutionary change. Species alive today have evolved from ancient common ancestors.**
- **Genetic variation among organisms affects their survival and reproduction.**
- **Over multiple generations species become better adapted to their environment.**
-

Unit Learning Targets/Objectives:

Students will

- **Describe the conditions under which natural selection occurs.**
- **Explain the principle of common descent.**
- **Investigate evidence of evolution.**
- **Define evolution in genetic terms.**
- **Analyze the types of isolation that can lead to the formation of a new species.**
- **Investigate the use of DNA sequences in classification**
- **Explain what the tree of life represents.**

Formative Assessments:

Quizzes, homework, classwork, tests, Laboratory assignments, PBL's, Engineering Projects;

Summative/Benchmark Assessments:

Test, PBLs and Engineering Projects

Materials:

Textbook, online resources (The American Biology Teacher, HHMI Publications, Science Times etc.)

www.pearsonsuccessnet.com
www.discoverystreaming.com
www.tryengineering.org
www.teachengineering.org

Modifications:

Special Education Students/at risk students/gifted students:

- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

Lesson Name/Topic	Lesson Objective(s)	Time frame (day(s) to complete)
The Alpine Chipmunk's Genetic Decline	**Sw construct a scientific argument**	4 (PBL)
What is natural selection?	**Sw simulate natural selection**	5
Lost Worlds	**Sw construct an organism and its habitat based on evidence**	4
Evidence of Evolution	**Sw investigate evidence of evolution**	5
Such varied Honeycreepers	**Sw solve a mystery**	5
Evolution of Populations	**Sw evaluate the evolution of populations**	10

Should Antibiotics be restricted?	**Sw analyze viewpoints and form an opinion based on evidence**	2
Epidemic	**Sw solve a mystery**	1
What are cladograms ?	**Sw create cladograms**	2
Building the Tree of life	**Sw analyze the tree of life**	2
Grin and Bear it	**Sw solve a mystery**	1

Teacher Notes:

Additional Resources
Click links below to access additional resources used to design this unit: