Pentucket Regional School District

School: Pentucket Regional High School

Department: Science

Course Title: Biology

<table>
<tr><th colspan="3">Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS
● Students demonstrate that they can use investigations and gather evidence to support explanations of cell function and reproduction.
● They understand the role of proteins as essential to the work of the cell and living systems.
● Students can use models to explain photosynthesis, respiration, and the cycling of matter and flow of energy in living organisms.
● The cellular processes can be used as a model for understanding the hierarchical organization of organisms.
● Students can use mathematical reasoning to demonstrate understanding of fundamental concepts of carrying capacity, factors affecting biodiversity and populations, and the cycling of matter and flow of energy among organisms in an ecosystem.
● Students are able to ask questions, make and defend a claim, and use</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
build from prior learning to explain additional and more complex phenomena related to genetics, the functioning of organisms, and interrelationships between organisms, populations, and the environment.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
● Students will understand that…
● Systems of specialized cells within organisms carry out essential functions of life.
● Any one system in an organism is made up of numerous parts.
● Feedback mechanisms maintain an organism’s internal conditions within certain limits and mediate behaviors.
● In multicellular organisms, the processes of mitosis and differentiation drive an organism’s growth and development.
● Each chromosome pair contains two variants of each gene.
● Offspring that result from sexual reproduction inherit one set of chromosomes from each parent.</td><td>ESSENTIAL QUESTIONS
How do organisms live and grow?
How and why do organisms interact with their environment, and what are the effects of these interactions?
How are characteristics of one generation passed to the next?
How can individuals of the same species and even siblings have different characteristics?
What evidence shows that different species are related?</td></tr>
</table>

concepts of probability to explain the genetic variation in a population. ● Students demonstrate understanding of why individuals of the same species vary in how they look and function. ● Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression. ● Students construct explanations for the processes of natural selection and evolution and communicate how multiple lines of evidence support these explanations. ● Students can evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. ● Students can apply concepts of probability to explain trends in populations as those trends relate to advantageous heritable traits in a specific environment.	● Organisms are constantly breaking down and reorganizing matter. ● The hydrocarbon backbones of sugars produced through photosynthesis are used by organisms to make amino acids and other macromolecules that can be assembled into proteins or DNA. ● During cellular respiration, the bonds of macromolecules and oxygen are broken down to build new products and transfer energy. ● Ecosystems have carrying capacities resulting from biotic and abiotic factors. ● The fundamental tension between resource availability and organism populations affects genetic diversity within populations and biodiversity within ecosystems. ● Photosynthesis captures energy in sunlight and stores it in chemical bonds of matter. Most organisms rely on cellular respiration to release energy in these bonds to power life processes. ● About 90% of available energy is lost from one trophic level to the next, resulting in fewer organisms at higher levels. ● At each link in an ecosystem, elements are combined in different ways and matter and energy are conserved.	

	● Photosynthesis, cellular respiration and decomposition are key components of the global carbon cycle. ● If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex interactions within the ecosystem. The ability of an ecosystem to both resist and recover from change is a measure of its overall health. ● Nearly every cell in an organism contains an identical set of genetic information on DNA but the genes expressed by cells can differ. ● In sexual reproduction, genetic material in chromosomes of DNA is passed from parents to offspring during meiosis and fertilization. ● The variation and distribution of traits in a population depend on genetic and environmental factors. ● Sources of genetic variation include gene shuffling and crossing over during meiosis, recombination of alleles during sexual reproduction, and mutations. ● Mutations can be caused by environmental factors or errors in DNA replication, or from errors that occur during meiosis.	

	● Only mutations that occur in gametes can be passed on to offspring. ● The fossil record and genetic, anatomical, and developmental homologies provide evidence for common descent among organisms. ● Natural selection, including the special cases of sexual selection and coevolution, works together with genetic drift and gene flow (migration) to shape the diversity of organisms on Earth through speciation and extinction. ● Evolution by natural selection occurs when there is competition for resources and variation in traits that lead to differential ability of individuals to survive, reproduce, and pass on genes. ● As the environment changes, so, too, do the traits that confer the strongest advantages.	
	● ***Acquisition***	
	Students will know… ● How organisms live and interact with one another ● How interactions affect other organisms and the environment ● How traits are passed from one generation to another ● How species are related to one another	*Students will be skilled at…* ● developing and using models ● constructing explanations ● engaging in argumentation from evidence ● obtaining, evaluating, and communicating information.
Evidence		
Evaluative Criteria	**Assessment Evidence**	

Content Mastery	MAJOR PERFORMANCE TASK(S): Unit tests Projects
Developing and using models Using evidence and reasoning to support claims Evaluating information	OTHER EVIDENCE OF IMPORTANCE: Model construction Open response writing Lab reports including Graph construction/ Analysis <type here>

Learning Plan

Summary of Key Learning Events, Instruction & Structures for Learning

September:
Scientific Inquiry skills through lab and observation activities.
Claim, evidence, reasoning skills through lab and observation activities.
Basic chemistry skills to frontload for the macromolecule unit.

October:
Explore the relationship between the elements carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur and the larger macromolecules through diagrams, charts, and lab activities.

November:
Explore cell structure and function using models and analogies. Frontloading for photosynthesis, cellular respiration, cell cycle and genetics.
Construct a model for cell transport and explore homeostasis using models and lab activities.

December:
Explore photosynthesis using models
Explore cellular respiration using models and lab activities.
Compare and contrast viruses and bacteria related to size, living/non-living designation, mode of reproduction and key features.

January:
Use a model to demonstrate how carbon is cycled through the biosphere and atmosphere.
Construct an explanation for the importance of the Cell Cycle using models.

February:

Develop and use a model to show how traits are passed from parent to child and how gametes are formed during Meiosis.
Construct an explanation of how genetic variation can exist by exploring Mendel's principles and crossing over.
Calculate Genetic probability using punnett squares and pedigrees.

March:
Explore DNA structure/mutations using models and lab activities.
Explore Transcription using models and diagrams.
Explore Translation using models and diagrams.

April:
Examine evidence from fossils, DNA, and geographic distribution to construct an explanation for evolution.
Construct an explanation of Darwin's theory of natural selection based on data and lab activities.
Analyze data sets to determine the impacts of biotic and abiotic factors on ecosystems.

May:
Construct a model to show the transfer of energy between trophic levels.
Explore ecosystem health related to biodiversity and human impact.
Construct a model of human body systems including nutrient and gas exchange.

Priority Standards	HS-LS1-1. Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life. HS-LS1-2. Develop and use a model to illustrate the key functions of animal body systems, including (a) food digestion, nutrient uptake, and transport through the body; (b) exchange of oxygen and carbon dioxide; (c) removal of wastes; and (d) regulation of body processes. HS-LS1-3. Provide evidence that homeostasis maintains internal body conditions through both bodywide feedback mechanisms and small-scale cellular processes. HS-LS1-4. Construct an explanation using evidence for why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including (a) cell growth and DNA replication, (b) separation of chromosomes (mitosis), and (c) separation of cell contents.

	HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of sugars and other carbohydrates. HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules. HS-LS1-7. Use a model to illustrate that aerobic cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new bonds form, resulting in new compounds and a net transfer of energy. HS-LS2-1. Analyze data sets to support explanations that biotic and abiotic factors affect ecosystem carrying capacity. HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem. HS-LS2-4. Use a mathematical model to describe the transfer of energy from one trophic level to another. Explain how the inefficiency of energy transfer between trophic levels affects the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight or inorganic compounds from the environment. HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere. HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience. HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health. HS-LS3-1. Develop and use a model to show how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction. HS-LS3-2. Make and defend a claim based on evidence that genetic variations (alleles) may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during meiosis, (b) mutations that occur during replication, and/or (c) mutations caused by environmental factors. Recognize that mutations that occur in gametes can be passed to offspring.

	HS-LS3-3. Apply concepts of probability to represent possible genotype and phenotype combinations in offspring caused by different types of Mendelian inheritance patterns. HS-LS3-4(MA). Use scientific information to illustrate that many traits of individuals, and the presence of specific alleles in a population, are due to interactions of genetic factors and environmental factors. HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence, including molecular, anatomical, and developmental similarities inherited from a common ancestor (homologies), seen through fossils and laboratory and field observations. HS-LS4-2. Construct an explanation based on evidence that Darwin's theory of evolution by natural selection occurs in a population when the following conditions are met: (a) more offspring are produced than can be supported by the environment, (b) there is heritable variation among individuals, and (c) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others. HS-LS4-4. Research and communicate information about key features of viruses and bacteria to explain their ability to adapt and reproduce in a wide variety of environments. HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population of a given species, the emergence of new species over generations, or the extinction of other species due to the processes of genetic drift, gene flow, mutation, and natural selection.
Core Content Resources/Texts	Miller and Levine Biology Textbook and accompanying online resources
Supporting Resources	Various online materials; HHMI, Biology Corner

HS & MS Course Information			
Core Class: yes	***Elective Class:*** no	***HS Credits:***	***Advanced Level Class:*** no
Pathways Class: <enter which pathway(s)>			***Grades Eligible: 9-12***

Pathways Next Class: Chemistry		
Prerequisite Course: 8th Grade Science		