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| **AP Biology** | **Curriculum Map** **Evolution**http://www.jeffersontownship.org/Portals/0/Images/Logos/hornet.jpg |
| Textbook Resources:**Chapters 21-26** | Month(s):**April** | Time Frame:**15 days (11/4 block)** | Assessment:**Reading Quizzes****Unit Test** |
| **Learning Targets** | **Support Text** | **Podcasts** |
| **EK 1.A.1: Natural selection is a major mechanism of evolution.** |
| 1. According to Darwin’s theory of natural selection, competition for limited resources results in differential survival. Individuals with more favorable phenotypes are more likely to survive and produce more offspring, thus passing traits to subsequent generations.
 | **Descent with Modification by Natural Selection**Chapter 22.2 (p.455-460) | [Natural Selection](http://www.bozemanscience.com/001-natural-selection)[Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection) |
| 1. Evolutionary fitness is measured by reproductive success.
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| 1. Genetic variation and mutation play roles in natural selection. A diverse gene pool is important for the survival of a species in a changing environment.
 | **Genetic Variation**Chapter 23.1 (p.469-473) |
| 1. Environments can be more or less stable or fluctuating, and this affects evolutionary rate and direction; different genetic variations can be selected in each generation.
 | **Descent with Modification by Natural Selection**Chapter 22.2 (p.455-460) |
| 1. An adaptation is a genetic variation that is favored by selection and is manifested as a trait that provides an advantage to an organism in a particular environment.
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| 1. In addition to natural selection, chance and random events can influence the evolutionary process, especially for small populations.
 | **Genetic Drift & Gene Flow**Chapter 23.3 (p.476-480) | [Genetic Drift](http://www.bozemanscience.com/003-genetic-drift) |
| 1. Conditions for a population or an allele to be in Hardy-Weinberg equilibrium are: (1) a large population size, (2) absence of migration, (3) no net mutations, (4) random mating and (5) absence of selection. These conditions are seldom met.
 | **Hardy-Weinberg Equilibrium**Chapter 23.2 (p.473-476) | [Solving Hardy-Weinberg Problems](http://www.bozemanscience.com/solving-hardy-weinberg-problems)[Population Modeling](http://www.bozemanscience.com/population-modeling) |
| 1. Mathematical approaches are used to calculate changes in allele frequency, providing evidence for the occurrence of evolution in a population.
	* + - Application of Hardy-Weinberg equilibrium equation
			- Graphical analysis of allele frequencies in a population
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| **EK 1.A.2: Natural selection acts on phenotypic variations in populations.** |
| 1. Environments change and act as selective mechanism on populations.
	* + - Flowering time in relation to global climate change
 | **Global Climate Change**Chapter 52 (p.1149) | [Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection) |
| 1. Phenotypic variations are not directed by the environment but occur through random changes in the DNA and through new gene combinations.
 | **Heterozygote Advantage**Chapter 23.4 (p.484) |
| 1. Some phenotypic variations significantly increase or decrease fitness of the organism and the population.
	* + - Sickle cell anemia
			- Beak depth in Galapagos finches
 |
| 1. Humans impact variation in other species.
	* + - Artificial selection
			- Overuse of antibiotics
 | **Artificial Selection**Chapter 22.2 (p.458-459)**Drug-Resistant Bacteria**Chapter 22.3 (p.461-462) |
| **EK 1.A.3: Evolutionary change is also driven by random processes.** |
| 1. Genetic drift is a nonselective process occurring in small populations.
 | **Genetic Drift & Gene Flow**Chapter 23.3 (p.476-480) | [Genetic Drift](http://www.bozemanscience.com/003-genetic-drift) |
| 1. Reduction of genetic variation within a given population can increase the differences between populations of the same species.
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| **EK 1.A.4: Biological evolution is supported by scientific evidence from many disciplines, including mathematics.** |
| 1. Scientific evidence of biological evolution uses information from geographical, geological, physical, chemical and mathematical applications.
 | **Support for Evolution**Chapter 22.3 (p.460-467)**Inferring Phylogeny from Morphological & Molecular Data**Chapter 26.2 (p.540-542)**Homeobox Genes**Chapter 21.6 (p.445-447)**Phylogeny & Shared Characters**Chapter 26.3 (p.542-548) | [Scientific Evidence for Evolution](http://www.bozemanscience.com/004-evidence-for-evolution)[Phylogenetics](http://www.bozemanscience.com/006-phylogenetics)[Comparing DNA Sequences](http://www.bozemanscience.com/comparing-dna-sequences)[Population Modeling](http://www.bozemanscience.com/population-modeling) |
| 1. Molecular, morphological and genetic information of existing and extinct organisms add to our understanding of evolution.
	1. Fossils can be dated by a variety of methods that provide evidence for evolution. These include the age of the rocks where a fossil is found, the rate of decay of isotopes including carbon-14, the relationships within phylogenetic trees, and the mathematical calculations that take into account information from chemical properties and/or geographical data.
	2. Morphological homologies represent features shared by common ancestry. Vestigial structures are remnants of functional structures, which can be compared to fossils and provide evidence for evolution.
	3. Biochemical and genetic similarities, in particular DNA nucleotide and protein sequences, provide evidence for evolution and ancestry.
	4. Mathematical models and simulations can be used to illustrate and support evolutionary concepts.
		* + Analysis of sequence data sets & phylogenetic trees
			+ Construction of phylogenetic trees based on sequence data
 |
| **EK 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.** |
| 1. Structural and functional evidence supports the relatedness of all domains.
2. DNA and RNA are carriers of genetic information through transcription, translation and replication.
3. Major features of the genetic code are shared by all modern living systems.
4. Metabolic pathways are conserved across all currently recognized domains.
 | **Central Dogma & the Genetic Code**Chapter 17.1 (p.328-331)**Evolutionary Significance of Glycolysis**Chapter 9.5 (p.179) | [Essential Characteristics of Life](http://www.bozemanscience.com/005-essential-characteristics-of-life) |
| 1. Structural evidence supports the relatedness of all eukaryotes.
	* + - Cytoskeleton (a network of structural proteins that facilitate cell movement, transport, morphological integrity and organelle transport)
* Membrane-bound organelles (mitochondria and chloroplasts)
* Endomembrane systems
 | **Cytoskeleton Structure**Chapter 6.1 (p.113)**Endosymbiont Theory**Chapter 6.5 (p.109-110)Chapter 25.3 (p.516-517)**Endomembrane System**Chapter 6.4 (p.104-106) | [Endosymbiosis](http://www.bozemanscience.com/endosymbiosis/) |
| **EK 1.B.2: Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.** |
| 1. Phylogenetic trees and cladograms can represent traits that are either derived or lost due to evolution.
	* + - Number of heart chambers in animals
			- Absence of legs in some sea mammals
 | **Phylogeny & Evolutionary Relationships**Chapter 26.1 (p.536-540)**Evolutionary Variation in Circulation**Chapter 42 (p.898-902)**Inferring Phylogeny from Morphological & Molecular Data**Chapter 26.2 (p.540-542)**Phylogeny & Shared Characters**Chapter 26.3 (p.542-548)**Revising Phylogenies**Chapter 26.6 (p.551-553) | [Phylogenetics](http://www.bozemanscience.com/006-phylogenetics)[Comparing DNA Sequences](http://www.bozemanscience.com/comparing-dna-sequences) |
| 1. Phylogenetic trees and cladograms illustrate speciation that has occurred, in that relatedness of any two groups on the tree is shown by how recently two groups had a common ancestor.
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| 1. Phylogenetic trees and cladograms can be constructed from morphological similarities of living or fossil species, and from DNA and protein sequence similarities, by employing computer programs that have sophisticated ways of measuring and representing relatedness among organisms.
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| 1. Phylogenetic trees and cladograms are dynamic (i.e., phylogenetic trees and cladograms are constantly being revised), based on the biological data used, new mathematical and computational ideas, and current and emerging knowledge.
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| **EK 1.C.1: Speciation and extinction have occurred throughout the Earth’s history.** |
| 1. Speciation rates can vary, especially when adaptive radiation occurs when new habitats become available.
 | **Patterns of Speciation**Chapter 24.4 (p.501-504)**Speciation and Extinction Rates**Chapter 25.4 (p.519-524) | [Speciation](http://www.bozemanscience.com/speciation)[Speciation and Extinction](http://www.bozemanscience.com/007-speciation-and-extinction) |
| 1. Species extinction rates are rapid at times of ecological stress.
* Five major extinctions
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| **EK 1.C.2: Speciation may occur when two populations become reproductively isolated from each other.** |
| 1. Speciation results in diversity of life forms. Species can be physically separated by a geographic barrier such as an ocean or a mountain range, or various pre-and post-zygotic mechanisms can maintain reproductive isolation and prevent gene flow.
 | **Reproductive Isolation**Chapter 24.1 (p.488-492)Chapter 24.2 (p.493-498) | [Speciation](http://www.bozemanscience.com/speciation)[Speciation and Extinction](http://www.bozemanscience.com/007-speciation-and-extinction) |
| 1. New species arise from reproductive isolation over time, which can involve scales of hundreds of thousands or even millions of years, or speciation can occur rapidly through mechanisms such as polyploidy in plants.
 | **Patterns of Speciation**Chapter 24.4 (p.501-504) |
| **EK 1.C.3: Populations of organisms continue to evolve.** |
| 1. Scientific evidence supports the idea that evolution has occurred in all species.
 | **Key Events in Life’s History**Chapter 25.3 (p.514-519)**Changes in Regulation of Developmental Genes**Chapter 25.5 (p.525-529)**Evolution is Not Goal Oriented**Chapter 25.6 (p.529-531) | [Abiogenesis](http://www.bozemanscience.com/010-abiogenesis)[The Origin of Life: Scientific Evidence](http://www.bozemanscience.com/011-the-origin-of-life-scientific-evidence) |
| 1. Scientific evidence supports the idea that evolution continues to occur.
* Antibiotic resistance in bacteria
* Observations of phenotypic change in a population
	+ Grant’s observations of Darwin’s finches in the Galapagos
 | **Drug-Resistant Bacteria**Chapter 22.3 (p.461-462) | [Evolution Continues](http://www.bozemanscience.com/evolution-continues) |
| **EK 3.C.1: Changes in genotype can result in changes in phenotype.** |
| 1. Changes in genotype may affect phenotypes that are subject to natural selection. Genetic changes that enhance survival and reproduction can be selected by environmental conditions.
2. Selection results in evolutionary change.
* Antibiotic resistance
* Sickle cell and heterozygote advantage
 | **Drug-Resistant Bacteria**Chapter 22.3 (p.461-462)**Heterozygote Advantage**Chapter 23.4 (p.484) | [Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection) |
| **EK 2.D.2: Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.** |
| 1. Continuity of homeostatic mechanisms reflects common ancestry, while changes may occur in response to different environmental conditions.
 | **Feedback Control**Chapter 40.2 (p.860-862) | [Homeostasis Review](http://www.bozemanscience.com/ap-homeostasis-review)[Thermoregulation](http://www.bozemanscience.com/thermoregulation/?rq=metabolism)[Homeostatic Evolution](http://www.bozemanscience.com/021-homeostatic-evolution) |
| 1. Organisms have various mechanisms for obtaining nutrients and eliminating wastes.
* Respiratory systems of aquatic and terrestrial animals
* Nitrogenous waste production and elimination in aquatic and terrestrial animals
 | **Respiratory Systems**Chapter 42.5 (p.915-920)**Adaptations for Eliminating Nitrogenous Wastes**Chapter (p.967-968) |
| 1. Homeostatic control systems in species of microbes, plants and animals support common ancestry.
* Excretory systems in flatworms, earthworms and vertebrates
* Osmoregulation in bacteria, fish and protists
* Circulatory system in fish, amphibians and mammals
* Thermoregulation in aquatic and terrestrial animals (countercurrent exchange mechanisms)
 | **Osmoregulation**Chapter 44.1 (p.953-956)**Excretory Systems**Chapter 44.3 (p.960-963)**Organization of Vertebrate Circulatory Systems**Chapter 42.1 (p.899-901)**Thermoregulation**Chapter 40.3 (p.862-868) |
| **EK 1.D.2: Scientific evidence from many different disciplines supports models of the origin of life.** |
| 1. Geological evidence provides support for models of the origin of life on Earth.
	1. The Earth formed approximately 4.6 billion years ago (bya), and the environment was too hostile for life until 3.9 bya, while the earliest fossil evidence for life dates to 3.5 bya. Taken together, this evidence provides a plausible range of dates when the origin of life could have occurred.
	2. Chemical experiments have shown that it is possible to form complex organic molecules from inorganic molecules in the absence of life.
 | **Conditions on Early Earth** Chapter 25.1 (p.507-510)**Miller-Urey Experiment**Chapter 4.1 (p.59)Figure 4.2 (p.59) | [Abiogenesis](http://www.bozemanscience.com/010-abiogenesis)[The Origin of Life: Scientific Evidence](http://www.bozemanscience.com/011-the-origin-of-life-scientific-evidence) |
| **EK 2.E.3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.** |
| 1. Responses to information and communication of information are vital to natural selection.
	1. In phototropism in plants, changes in the light source lead to differential growth, resulting in maximum exposure of leaves to light for photosynthesis.
	2. In photoperiodism in plants, changes in the length of night regulate flowering and preparation for winter.
	3. Cooperative behavior within or between populations contributes to the survival of the populations.
	4. Availability of resources leading to fruiting body formation in fungi and certain types of bacteria
 | **Phototrophism & Auxin**Chapter 39.2 (p.824-829)**Circadian Rhythm & Photoperiodism**Chapter 36.4 (p.777-778)Chapter 39.3 (p.835-841)**Altruism**Chapter 51.4 (p.1137)**Quorum Sensing**Chapter 11.1 (p.206-207) | [Response to External Environments](http://www.bozemanscience.com/019-response-to-external-envirnoments)[Behavior and Natural Selection](http://www.bozemanscience.com/026-behavior-and-natural-selection)[Mechanisms of Timing and Control](http://www.bozemanscience.com/025-mechanisms-of-timing-and-control)[Evolutionary Significance of Cell Communication](http://www.bozemanscience.com/036-evolutinary-significance-of-cell-communication/?rq=quorum%20sensing) |
| **EK 4.C.1:** Variation in molecular units provides cells with a wider range of functions. |
| 1. Multiple copies of alleles or genes (gene duplication) may provide new phenotypes.
2. A heterozygote may be a more advantageous genotype than a homozygote under particular conditions, since with two different alleles, the organism has two forms of proteins that may provide functional resilience in response to environmental stresses.
3. Gene duplication creates a situation in which one copy of the gene maintains its original function, while the duplicate may evolve a new function.
* Antifreeze gene/protein
 | **Heterozygote Advantage**Chapter 23.4 (p.484)**Cold Stress**Chapter 39.4 (844-845) | [Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection)[Cellular Variation](https://www.youtube.com/watch?v=q3dM-JzNs50&feature=youtu.be) |
| **EK 4.C.2:** Environmental factors influence the expression of the genotype in an organism. |
| 1. An organism’s adaptation to the local environment reflects a flexible response of its genome.
* Darker fur in cooler regions of the body in certain mammal species
* Alterations in timing of flowering due to climate changes
 | **Global Climate Change**Chapter 52 (p.1149) | [Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection) |
| **EK 4.C.3:** The level of variation in a population affects population dynamics. |
| 1. Population ability to respond to changes in the environment is affected by genetic diversity. Species and populations with little genetic diversity are at risk for extinction.
* Prairie chickens
 | **Greater Prairie Chicken**Chapter 23.3 (p.478-479) | [Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection) |
| 1. Genetic diversity allows individuals in a population to respond differently to the same changes in environmental conditions.
* Not all individuals in a population in a disease outbreak are equally affected; some may not show symptoms, some may have mild symptoms, or some may be naturally immune or resistant to the disease.
 | **Natural Selection and Relative Fitness**Chapter 23.4 (p.480-485) | [Examples of Natural Selection](http://www.bozemanscience.com/002-examples-of-natural-selection) |
| 1. Allelic variation within a population can be modeled by the Hardy- Weinberg equation(s).
 | **Hardy-Weinberg Equilibrium**Chapter 23.2 (p.473-476) | [Solving Hardy-Weinberg Problems](http://www.bozemanscience.com/solving-hardy-weinberg-problems)[Population Modeling](http://www.bozemanscience.com/population-modeling) |

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| **Vocabulary** |
| adaptation | comparative anatomy | gene flow | hybrid breakdown | natural selection | punctuated equilibria | sympatric speciation |
| adaptive radiation | convergent evolution | gene pool | ingroup | order | radiometric dating | systematics |
| allopatric speciation | derived ancestral character | genetic drift | intersexual selection | outgroup | random mutation | taxon |
| analagous | directional selection | genetic variability | intrasexual selection | paleontology | reduced hybrid viability | taxonomy |
| analogous structures | disruptive selection | genus | Jean-Baptiste Lamarck | paraphyletic | reduced hybrid viability | temporal isolation |
| artificial selection | divergent evolution | geographic variation | kingdom | phylogenetic tree | relative fitness | vestigial structures |
| basal taxon | domain | geologic record | macroevolution | phylogeny | reproductive isolation |  |
| behavioral isolation | embryology | habitat isolation | mass extinction | polyphyletic | sexual dimorphism |  |
| biogeography | endemic | Hardy-Weinberg Equilibrium | maximum liklihood | polyploidy | sexual selection |  |
| bottleneck effect | endosymbiont theory | heterozygote advantage | maximum parsimony | polytomy | shared ancestral character |  |
| Charles Darwin | evolution | homeotic genes | mechanical isolation | population | sister taxa |  |
| clade | family | homologous structures | microevolution | postzygotic barrier | speciation |  |
| cladistics | founder effect | homology | molecular biology | pre-zygotic barrier | species |  |
| cline | gametic isolation | hybrid | monophyletic | prezygotic barrier | stabilizing selection |  |