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**AP Biology Exam Review : Evolution (Unit 1)**

**Helpful Videos and Animations:**

1. [Bozeman Science: Natural Selection](https://www.youtube.com/watch?v=R6La6_kIr9g&list=PLFCE4D99C4124A27A&index=2) (an overview of natural selection and Hardy-Weinberg Equilibrium)
2. [Bozeman Science: Examples of Natural Selection](https://www.youtube.com/watch?v=S7EhExhXOPQ&list=PLFCE4D99C4124A27A)
3. [Bozeman Science: Genetic Drift](https://www.youtube.com/watch?v=mjQ_yN5znyk&list=PLFCE4D99C4124A27A)
4. [Bozeman Science: Evidence of Evolution](https://www.youtube.com/watch?v=ooGKYediys8&list=PLFCE4D99C4124A27A)
5. [Bozeman Science: Essential Characteristics of Life](https://www.youtube.com/watch?v=bILvTe2_FEE&list=PLFCE4D99C4124A27A) (preserved by natural selection)
6. [Bozeman Science: Natural Selection Unit Review](https://www.youtube.com/watch?v=sBM9ZKTQ1PQ&list=PLFCE4D99C4124A27A) (a review from the previous five videos)
7. [Bozeman Science: Solving Hardy Weinberg Problems](https://www.youtube.com/watch?v=xPkOAnK20kw&list=PL7A750281106CD067)
8. [Bozeman Science: Speciation and Extinction](https://www.youtube.com/watch?v=yJLRl2G41nQ&list=PLFCE4D99C4124A27A)
9. [Bozeman Science: Speciation](https://www.youtube.com/watch?v=rlfNvoyijmo&list=PLFCE4D99C4124A27A)
10. [Bozeman Science: Evolution Continues](https://www.youtube.com/watch?v=yJLRl2G41nQ&list=PLFCE4D99C4124A27A)
11. [Bozeman Science: Mechanisms of Genetic Variation in Prokaryotic vs. Eukaryotic Cells](http://www.youtube.com/watch?v=UjMn4oHfYL4)
12. [Bozeman Science: Classification of Life](http://www.youtube.com/watch?v=tYL_8gv7RiE&list=PL7A750281106CD067)
13. [Bozeman Science: The Three Domains of Life](http://www.youtube.com/watch?v=wGVgIcTpZkk&list=PL7A750281106CD067&index=21)

**Unit Vocabulary:**

-Evolution

-Adaptation

-Natural Selection

-Fitness

-Artificial Selection

-Transitional Fossils

-Comparative Anatomy

-Homologous Structures

-Analogous Structures

-Vestigial Organs

-Stabilizing Selection

-Directional Selection

-Disruptive Selection

-Sexual Selection

-Sexual Dimorphism

-DNA (deoxyribonucleic acid)

-Gene

-Allele

-Genotype

-Phenotype

-Protein

-DNA Replication

-Mutation

-Genetic Variation

-Crossing Over

-Independent Assortment

-Random Fertilization

-Dominant Allele

-Recessive Allele

-Homozygous Dominant Genotype

-Homozygous Recessive Genotype

-Heterozygous Genotype

-Meiosis

-Homologous Chromosomes

-Fertilization

-Punnett Square

-New definition of Evolution

-Genetic Drift

-Gene Pool

-The Bottleneck Effect

-The Founder Effect

-Gene Flow (aka migration)

-Hardy Weinberg Equilibrium

-Microevolution

-Macroevolution

-Speciation

-Species

-Reproductive Isolation

-Geographic Isolation

-Allopatric Speciation

-Sympatric Speciation

-Prezygotic Barriers / Isolating Mechanisms

-Postzygotic Barriers / Isolating Mechanisms

-Divergent Evolution

-Adaptive Radiation

-Convergent Evolution

-Coevolution

-Gradualism

-Punctuated Equilibrium

-Phylogeny

-Cladograms

-Shared, Derived Traits (aka synapomorphies)

-Phylogenetic Trees

-Molecular Clock Sequences

-Universal Common Ancestor’

-Organic Molecule

-Miller and Urey

-RNA World Hypothesis

-Organic Soup (aka Primordial Soup) Hypothesis / Theory

-Iron-Sulfur World Hypothesis / Theory

-Extraterrestrial Origins Hypothesis / Theory

-Relative Dating

-Absolute Dating

-Endosymbiosis

**Topic Outline (Thank you to Megan Chirby and Amy Litz!)**

***Unit 9, Notes Part 1: Evolution Basics and Types of Selection***

1. Natural Selection
2. Major mechanism of change over time – Darwin’s theory of evolution
3. There is variation among phenotypes – genetic mutations play a role in increasing variation
4. Competition for resources results in differential survival, with individuals with the most favorable traits surviving to reproduce offspring
5. 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.
6. Fitness is the ability to survive and reproduce
7. Stabilizing selection- selects for average ex. birth weight
8. disruptive selection- selects for extremes ex. Beak type
9. directional selection- towards one extreme ex. Pepper moth
10. sexual selection- competition for mates
11. Evidence for Evolution
12. 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.
13. 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.
14. Biochemical and genetic similarities, in particular DNA nucleotide and protein sequences, provide evidence for evolution and ancestry.

***Unit 9, Notes Part 2: Genetic Variation and Hardy-Weinberg Equilibrium***

1. Genetic Variation
2. Be able to describe the basic structure of DNA and its organization in chromosomes in eukaryotic cells
3. Be able to describe how chromosomes are divided into gametes (sex cells) during meiosis and how these gametes come together during fertilization to create a zygote
4. Be able to describe the mechanisms of creating new genes and combining genes in different ways to increase genetic variation – mutation, crossing over, independent assortment, and random fertilization.
5. Be able to explain why genetic variation is important for the survival of a population (Hint: see cheetah example!)
6. Hardy-Weinberg Equilibrium
7. A mathematical model used to calculate changes in allele frequency, providing evidence for the occurrence of evolution in a population.
8. 5 conditions must be met for a population to be in HW equilibrium – conditions are seldom met
9. Large population / no genetic drift (must understand why genetic drift has a more significant effect on the gene pool of small populations and be able to describe both the bottleneck and founder effects)
10. No migration
11. No mutations
12. Random mating
13. No natural selection
14. Equations
15. p = the frequency of dominant alleles in a population
16. q = the frequency of recessive alleles in a population
17. p2 = the frequency of homozygous dominant individuals in a population
18. q2 = the frequency of homozygous recessive individuals in a population
19. 2pq=the frequency of heterozygous individuals in a population
20. p + q = 1
21. p2 + 2pq + q2 = 1

***Unit 9, Notes Part 3: Macroevolution and the History of Life***

1. Speciation
2. An evolutionary process by which 2 or more species arise from 1 species and 2 new species can no longer breed and reproduce successfully
3. Many mechanisms by which it can occur
4. Geographic isolation

* Species separated by physical barrier

1. Reproductive isolation

* Different behaviors limit mating
* Different habitats limit mating
* Different mating seasons limit mating
* Different anatomical structures limit mating

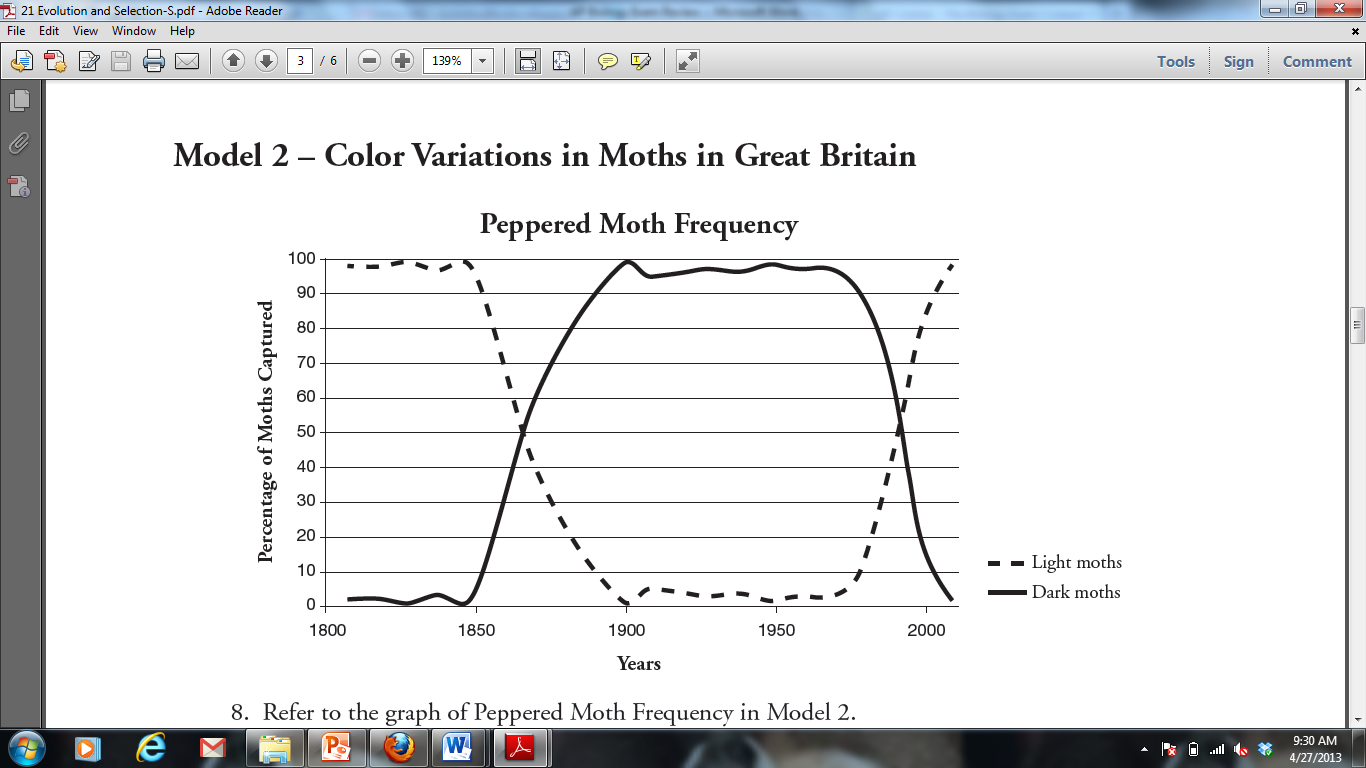
1. Can take place over millions of years or rapidly (after extinction events, for example)
2. Be able to describe the difference between divergent evolution / adaptive radiation, convergent evolution, and coevolution
3. Be able to describe the difference between the two theories regarding the rate of speciation: gradualism vs. punctuated equilibrium
4. Be able to describe the factors that could cause speciation between two populations: geographic isolation vs. reproductive isolation
5. Be able to explain the difference between prezygotic and postzygotic barriers to population interbreeding and provide examples of each
6. The Origin and History of Life
7. Primitive Earth provided inorganic precursors from which organic molecules could have been synthesized due to the presence of available free energy and the absence of a significant quantity of oxygen.
8. Chemical experiments have shown that it is possible to form complex organic molecules from inorganic molecules in the absence of life.
9. These complex reactions could have occurred in solution (organic soup model) or as reactions on solid reactive surfaces.
10. The RNA World hypothesis proposes that RNA could have been the earliest genetic material.

***Unit 9, Notes Part 4: Classification and Biodiversity***

1. Phylogenetic Trees
2. Phylogenetic trees and cladograms illustrate the relatedness between two species, in that relatedness of any two groups on the tree is shown by how recently two groups had a common ancestor.
3. Phylogenetic trees and cladograms can be constructed from morphological similarities of living or fossil species, and from DNA and protein sequence similarities.
4. Phylogenetic trees and cladograms are dynamic, constantly changing due to current and emerging knowledge.
5. Be able to analyze an existing cladogram, and create a cladogram from a chart comparing organisms and their traits.
6. Be able to explain the development of the six kingdom and three domain classification systems and discuss major characteristics of organisms in each group.

**Practice “Thinking” Questions**

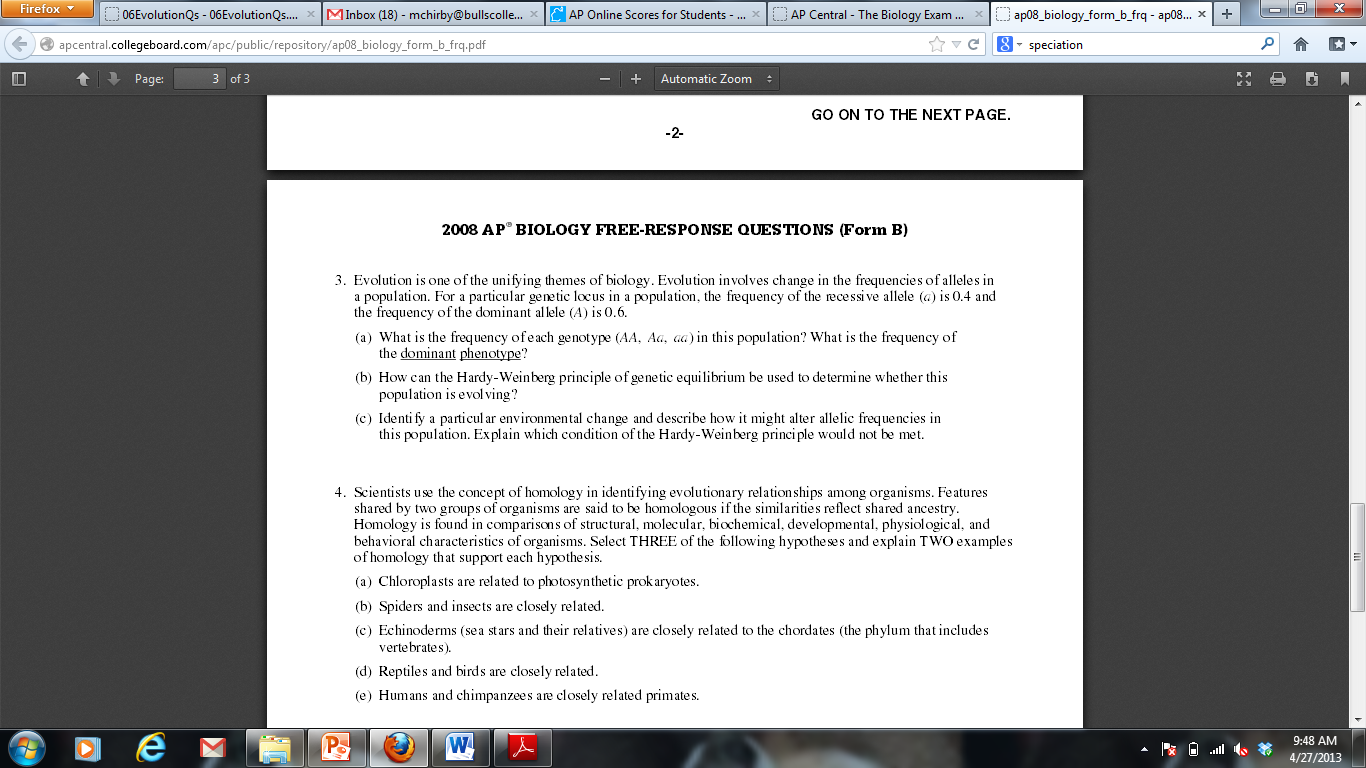
1. As a field researcher you are sent to the Arizona desert to study the prairie dog species C. ludivincianus to determine if the population is in Hardy-Weinberg equilibrium. Specifically, you are studying this population with respect to the gene that determines the coat color in C. ludivincianus. This trait is coded for by a single gene (the NDY6 gene) with two alleles (N, n) and is passed down from one generation to the next. After sampling 170 of these prairie dogs, you find that 36% of the C. ludivincianus population is homozygous recessive for coat color. Assuming that the population is in Hardy-Weinberg equilibrium…
2. What is the allele frequency of the N allele?
3. What is the frequency of homozygous dominant prairie dogs?
4. What is the frequency of heterozygous prairie dogs?
5. What conditions must be being satisfied for this population to be in HW equilibrium?
6. Sixty flowering plants are planted in a flowerbed. Forty of the plants are red-flowering homozygous dominant. Twenty of the plants are white-flowering homozygous recessive. The plants naturally pollinate and reseed themselves for several years. In a subsequent year, 178 red-flowered plants, 190 pink-flowered plants, and 52 white-flowered plants are found in the flowerbed. Use a chi-square analysis to determine if the population is in Hardy-Weinberg equilibrium.
7. For the past 10 to 25 years, farmers have planted crop seeds that have been genetically modified to withstand treatment with a common weed killer called Roundup®. This allows the farmers to spray their fields to get rid of weeds without harming their crops. Recently, more and more farmers have discovered that their fields have Roundup-resistant pigweed growing along with their crop. Describe what has most likely happened over time to lead to this.
8. Peppered moths have wings that vary in color, ranging from white to dark gray. During the Industrial Revolution through the mid-20th century, factories and power plants, which burned coal, produced large quantities of soot and smog. Near industrialized areas, black powder covered surfaces, including the moth habitat.
9. Use this information to explain the changes seen in light and dark peppered moths from 1800-1950, as shown in the graph below.



1. Propose an explanation for the return of the peppered moth population to more light than dark moths by the year 2000.
2. Five new species of bacteria were discovered in Antarctic ice core samples. The nucleotide (base) sequences of rRNA subunits were determined for the new species. The table below shows the number of nucleotide differences between the species. **Draw** a phylogenetic tree **indicating** the relatedness of these 5 species.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Species | 1 | 2 | 3 | 4 | 5 |
| 1 | - | 2 | 23 | 19 | 17 |
| 2 |  | - | 24 | 19 | 18 |
| 3 |  |  | - | 23 | 23 |
| 4 |  |  |  | - | 1 |
| 5 |  |  |  |  | - |

**Practice Long Response**

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**Practice Calculation Question**

