

Name _____

Period _____

AP Biology

Date _____

REVIEW 5: EVOLUTION UNIT

A. Top “10” — If you learned anything from this unit, you should have learned:

1. Darwin’s Principle of Natural Selection

- a. Variation
individuals within a population possess heritable variation within traits
 - sexual recombination
 - mutation
- b. Overproduction
organisms produce more offspring than can survive
- c. Competition
those individuals with advantageous adaptations will out-compete others
- d. Survival & Reproduction of the Fittest
individuals with favorable characteristics tend to have more offspring & pass on these traits to their offspring
 - alleles for favorable traits increase in the population
 - individuals are selected, but populations evolve

2. Selection

- a. directional vs. stabilizing vs. disruptive
- b. sexual selection
- c. genetic drift = effect of chance events
 - bottleneck effect (cheetahs)
 - founder’s effect (European settlers in Americas)
- d. gene flow

3. Evidence

- a. fossil record
- b. biogeography
 - convergent evolution (analogous structures)
- c. comparative anatomy
 - homologous structures
 - vestigial structures
- d. comparative embryology
- e. comparative genomics (molecular biology)
 - universal genetic code

- conserved proteins (hemoglobin, cytochrome C)
 - f. artificial selection
 - agriculture, dog breeding, pesticide resistance, antibiotic resistance
4. Hardy Weinberg equilibrium
- a. $p + q = 1$ (allele frequency)
 - b. $p^2 + 2pq + q^2 = 1$ (phenotype frequency)
 - c. H-W conditions:
 - infinitely large population
 - random mating
 - no mutation
 - no gene flow (migration in or out)
 - no selection
5. Speciation
- a. biological species concept (Ernst Mayr)
 - population able to interbreed & produce viable, fertile offspring
 - b. allopatric = geographically isolated populations
 - c. sympatric = populations in same environment adapt to fill different niches
 - adaptive radiation (Galapagos finches)
 - mechanisms:
 - pre-zygotic: habitat factors, temporal factors, behavioral factors, mechanical factors, gamete factors
 - post-zygotic: reduced hybrid viability, reduced hybrid fertility
 - d. rate of speciation
 - gradualism (Darwin)
 - punctuated equilibrium (Stephen Jay Gould & Niles Eldridge)
6. Origin of Life
- a. Earth is 4.5 billion years old
 - b. abiotic origin
 - atmosphere of CO₂, methane (CH₄) & ammonia (NH₃) energized by lightning & UV rays
 - formation organic compounds in seas (Miller – Urey experiment)
 - formation of protobionts & then bacteria (3.5 bya)

B. Labs

1. Hardy-Weinberg Population Genetics Lab

Be sure to review the procedures and the conclusions, and understand:

- Factors that affect evolution (changes in allele frequency) in populations
- How & when to use both H-W formulas
- Compare expected frequencies to actual to test for evolution

C. Sample Multiple Choice Questions

- Which of the following is most often associated with the elaborate courtship rituals conducted by many birds? (1990:14)
 - species recognition
 - migration
 - feeding response
 - altruism
 - kin selection
- The replacement of glutamic acid by valine at a specific position in the beta chains of hemoglobin leads to sickle cell anemia. This change represents which of the following mutational events? (1990:32)
 - DNA base-pair substitution
 - DNA base-pair deletion
 - DNA base-pair addition
 - chromosomal deletion
 - frameshift mutation
- The differences in cricket calls among sympatric species of crickets are examples of (1990:51)
 - habitat isolation
 - temporal isolation
 - physiological isolation
 - behavioral isolation
 - geographic isolation
- Which of the following principles is NOT part of Darwin's theory of evolution by natural selection? (1999:53)
 - Evolution is a gradual process that occurs over long periods of time.
 - Variation occurs among individuals in a population.
 - Mutations are the ultimate source of genetic variation
 - More individuals are born than will survive
 - Individuals that possess the most favorable variations have the best chance of reproducing.

5. In a small group of people living in a remote area, there is a high incidence of “blue skin”, a condition that results from a variation in the structure of hemoglobin. All of the “blue-skinned” residents can trace their ancestry to one couple, who were among the original settlers of this region. The unusually high frequency of “blue skin” in the area is an example of (1999:44)
- a. mutation
 - b. genetic drift
 - c. natural selection
 - d. sexual selection
 - e. heterozygote advantage
6. Which of the following statements best expresses the concept of punctuated equilibrium? (1990:51)
- a. Small variations gradually accumulate in evolving lineages over periods of millions of years.
 - b. Random mating ensures that the proportions of genotypes in a population remain unchanged from generation to generation.
 - c. Stability is achieved when selection favors the heterozygote, while both types of homozygotes are at a relative disadvantage.
 - d. Evolutionary changes consist of rapid bursts of speciation alternating with long periods in which species remain essentially unmodified.
 - e. Under competition for identical resources, one of the two competing species will be eliminated or excluded.
7. In certain Native American groups, albinism due to a homozygous recessive condition in the biochemical pathway for melanin is sometimes seen. If the frequency of the allele for this condition is 0.06, which of the following is closest to the frequency of the dominant allele in this population? (Assume Hardy-Weinberg equilibrium.) (1999:54)
- a. 0.04
 - b. 0.06
 - c. 0.16
 - d. 0.36
 - e. 0.94

Question 8–9. In a certain flock of sheep, 4 percent of the population has black wool and 96 percent has white wool. Assume Hardy-Weinberg equilibrium. (1994:49-50)

8. If black wool is a recessive trait, what percentage of the population is heterozygous for this trait?
- a. 4%
 - b. 20%
 - c. 32%
 - d. 64%
 - e. 80%
9. What percentage of the population is homozygous for white wool?
- a. 20%
 - b. 40%
 - c. 64%
 - d. 80%
 - e. 96%

D. Sample Free Response Questions

1. 2004:2

Darwin is considered the "father of evolutionary biology." Four of his contributions to the field of evolutionary biology are listed below.

- The nonconstancy of species
 - Branching evolution, which implies the common descent of all species
 - Occurrence of gradual changes in species
 - Natural selection as the mechanism for evolution
- a. For EACH of the four contributions listed above, **discuss** one example of supporting evidence.
- b. Darwin's ideas have been enhanced and modified as new knowledge and technologies have become available. **Discuss** how TWO of the following have modified biologists' interpretation of Darwin's original contributions.
- Hardy-Weinberg equilibrium
 - Punctuated equilibrium
 - Genetic engineering

2. 2003B:4

Biologists are interested in preserving the diversity of living organisms on the planet.

- a. **Explain THREE** of the following processes or phenomena, using an appropriate example for each.
- mutation
 - adaptive radiation
 - polyploidy
 - population bottlenecks
 - growth of the human population
- b. For each process or phenomena you selected in (a), **discuss** its impact on the diversity of life on Earth.

3. 2001:2

Charles Darwin proposed that evolution by natural selection was the basis for the differences that he saw in similar organisms as he traveled and collected specimens in South America and on the Galapagos Islands.

- a. **Explain** the theory of evolution by natural selection as presented by Darwin.
- b. Each of the following relates to an aspect of evolution by natural selection. **Explain** three of the following.
 - Convergent evolution and the similarities among species (ecological equivalents) in a particular biome (e.g., tundra, taiga, etc.)
 - Natural selection and the formation of insecticide-resistant insects or antibiotic-resistant bacteria
 - Speciation and isolation
 - Natural selection and behavior such as kinesis, fixed-action-pattern, dominance hierarchy, etc.
 - Natural selection and heterozygote advantage