Chapter 21: Evidence and Mechanisms of Evolution

1. Why were the Galapagos islands so formative for Charles Darwin’s thinking about evolution?
2. Describe the process of natural selection. Make sure your description includes all of the following features:
   1. overproduction of offspring
   2. variation among individuals
   3. limited resources
   4. competition
   5. differential reproductive success (“fitness”)
   6. adaptation
3. Explain the meaning of the saying “individuals are selected, populations evolve.”
4. Explain what the “modern synthesis” is. How is it different from Darwin’s original theory of evolution?
5. Why does evolution have to involve the change of the genetic makeup of a population over time?
6. Explain how each of the following demonstrate Darwinian selection. For each, indicate the source of selection, the criteria that determines fitness in the environment, and the end result of the selective process:
   1. Artificial selection
   2. Galapagos finches
   3. The evolution of resistance in a population of insects or bacteria (you pick).
7. Explain the idea of common ancestry, and some of the supporting evidence.
8. How is variation generated in a population? How is it maintained?
9. Explain the relationship between the terms alleles, genes and gene pool.
10. Explain the relationship between the terms genotype and phenotype.
11. Explain the relationship between the terms homozygous and heterozygous.
12. How is it possible that individuals with two different genotypes can have the same phenotype?
13. Explain how each of the following features of a (hypothetical) population in Hardy-Weinberg Equilibrium leads to that population not evolving over time:
    1. large population size
    2. random mating
    3. no immigration/emmigration
    4. no net mutation rate
    5. a constant environment
14. What are the two Hardy-Weinberg equations? What information do they provide?
15. If no real population of organisms is in Hardy-Weinberg Equilibrium, why is it a useful tool to study the effects of evolution?
16. Explain each of the following modes of evolution in a population. For each one, describe the cause of change in the genetic makeup of a population and how the population evolves as a result of that change, and provide a “real world” example of the process in action:
    1. Natural Selection
    2. Genetic Drift
    3. Gene Flow
    4. Sexual Selection
17. Why is natural selection the only mode of evolution that causes a population to adapt to the environment over time?
18. Compare the effects of disruptive, directional and stabilizing selection on the genetic makeup of a population.
19. Why do traits have to be heritable for evolution to affect them?

Chapter 22: Reconstructing and Using Phylogenies

1. Explain what a phylogenetic tree is and how one is made. Draw an example and label the root and node.
2. Explain how each of the following are used to make comparisons among species:
   1. homologies
   2. ancestral traits
   3. derived traits
   4. analogies (convergent evolution)
3. Briefly explain the following are used to construct phylogenetic trees
   1. morphology
   2. development
   3. paleontology
   4. behavior
   5. molecular data
4. Compare mono-, para-, and polyphyletic taxonomic groups. Draw examples of each.
5. Explain the relationship between taxonomy and phylogeny.
6. How has DNA technology changed the way that classification is done?

Chapter 23: Species and Their Formation

1. Explain the “Biological Species concept”. Describe its strengths and weaknesses.
2. Why does a biological species have to be reproductively isolated from other organisms?
3. Compare allopatric and sympatric speciation.
4. Explain how polyploidy leads to rapid speciation.
5. Briefly explain the following species barriers
   1. habitat isolation
   2. temporal isolation
   3. behavioral isolation
   4. mechanic isolation
   5. gametic isolation
   6. low hybrid zygote viability
   7. low hybrid adult viability
   8. hybrid infertility
6. Discuss factors resulting in various speciation rates.
7. Explain how varying speciation rates result from adaptive radiation.