The Evolution of Populations
Chapter 23

1. Explain why genetic variation within a population is a prerequisite for evolution. (Natural selection requires some individuals to have an advantage over others. Without genetic differences among individuals, there is nothing for natural selection to select.)

2. Describe how new alleles are formed. (Mutation results in a formation of new alleles.)

3. Why are only a small fraction of mutations preserved and become widespread in a population? (Mutations in somatic cells are not passed to offspring. Of mutations that are passed on, some have no phenotypic effect, and some are harmful.)

4. If a population stopped reproducing sexually, but still reproduced asexually, predict how the genetic variation would change over time. (Variation would likely decrease as crossing over, independent assortment and random fertilization during sexual reproduction are major contributors to diversity.)

5. Suppose that in a particular pea population, flowers with the white phenotype are favored by natural selection. Predict what would happen over time to the frequency of the p allele in the population. Justify your response. (The frequency of the p allele should increase over time. If the proportion of white individuals increases, the frequency of the p allele should increase also.)

6. In order for a population to be in Hardy-Weinberg equilibrium, five conditions must be met. Make a general statement to explain why these five conditions must be met. (If any of the five conditions are not met, allele frequencies in the population could change. Such a change would constitute evolution, and the population would not be in equilibrium.)

7. A population has 700 individuals, 85 of genotype AA, 320 of genotype Aa, and 295 of genotype aa. State the frequencies of alleles A and a. (

$$p = \frac{(2 \times 85) + (1 \times 320) + (0 \times 295)}{1,400} = 0.35$$

A=0.35; a = 1.A = 0.65)

8. The frequency of allele a is 0.45 for a population in Hardy-Weinberg equilibrium. Calculate the expected frequencies of genotypes AA, Aa, and aa. (If the frequency of allele a is 0.45, the frequency of allele A must be 0.55. The expected genotype frequencies are p2 = 0.3025 for genotype AA, 2pq = 0.4952 for genotype Aa, and q2 = 0.2025 for genotype aa.)

9. A gene that affects susceptibility to a degenerative brain disease has two alleles, V and v. In a population, 16 people have genotype VV, 92 have genotype Vv, and 12 have genotype vv. Make a claim about the evolution of this population. Justify your claim. (There are 120 individuals and 240 alleles in the population. The frequency of V = ((16x2)+92)/240 = 0.52 and the frequency of v = 0.48. HW predicts the frequency of VV should be 0.27, Vv = 0.5, and vv = 0.23. In a population of 120, we would expect 32 VV, 60 Vv, and 28 vv. The actual numbers differ from these, so the population is evolving.)

10. A person claims that natural selection is more “predictable” than genetic drift. Provide reasoning to justify the claim. (Natural selection affects allele frequencies in a nonrandom way such that beneficial alleles are selected for, increasing in frequency while alleles that decrease reproductive success are selected against. Genetic drift affects allele frequencies randomly, regardless of whether

they increase or decrease fitness.)

11. Distinguish between genetic drift and gene flow in terms of how they occur and their effects on future genetic diversity. (Genetic drift changes allele frequencies randomly and tends to decrease genetic diversity. Gene flow is the movement of alleles between populations, possibly introducing new alleles and increasing the genetic diversity of a population.)

12. Suppose two plant populations exchange pollen and seeds. In one population, individuals of genotype AA are more common (9,000 AA, 900 Aa, 100 aa), while the opposite is true in the other population (100 AA, 900 Aa, 9,000 aa). If neither allele has a selective advantage, predict what will happen to the allele and genotype frequencies of these two populations over time. (Gene flow should cause the allele and genotype frequencies of the two populations to become more similar over time.)

13. A population of birds lives on a coastal island and some individuals are blown by a storm to a nearby island where no birds of that species lived previously. Identify this event as an example of The Bottleneck Effect or The Founder Effect. (As a few individuals became isolated from the larger population, this is an example of The Founder Effect.)

14. Consider a species of ant in which individuals heterozygous for a gene controlling antenna length have antennae that are longer than homozygotes. Longer antennae make it easier for the ants to find food. Identify this as directional, disruptive, or stabilizing selection. Justify your response. (Because heterozygotes have a more extreme phenotype, this is directional selection.)

15. Explain how sexual selection can contribute to sexual dimorphism. (When a female chooses a male based on a particular trait, if the choice results in increased reproductive success, that trait and the female preference for it are preserved.)