

1. Discuss the conditions on the Galapagos Islands that led to the evolution of the birds known as Darwin's finches.

The relatively great distance between the Galapagos Islands and the South American mainland and also between each of the islands in the archipelago ensured that once immigrants had arrived on an island, they would be genetically isolated for a substantial period of time. Also, because the islands differ greatly in climate and vegetation, the resident birds were subject to different selection pressures. This, in combination with reduced gene flow between the islands, led to a rapid evolutionary radiation of finches.

2. In autopolyploidy, a new species of plant can arise by the doubling of chromosome number in a single individual of one species (provided that the individual is capable of self-fertilization). Why is it virtually impossible for such a tetraploid plant to interbreed successfully with diploid individuals of the "same" species? It might help to draw out the chromosomes.

Recall from Chapter 9 that pairs of homologous chromosomes synapse during prophase and metaphase of the first division of meiosis. The homologs then separate so that each cell resulting from meiosis I is haploid, as are the products of meiosis II. In tetraploids as in diploids, meiosis is normal because pairing of homologs can occur.

3. Suppose that members of two populations are separated by a geographic barrier and begin to diverge genetically. Many generations later, when the barrier is removed, the two populations can interbreed, but the hybrid offspring do not survive and reproduce well. Explain how natural selection might lead to the evolution of more effective prezygotic barriers in these species.
4. Why is "reinforcement" an appropriate name for the concept that natural selection should favor divergence if populations experience postzygotic isolation?

*Reinforcement* is an appropriate term for natural selection in cases where the selected traits reinforce differences between the two populations—if the differences are reinforced, as occurs when hybrid offspring are not viable and usually die. This strong natural selection against the hybrids reinforces the differences between the parents.

5. Why would genetic drift be an especially important evolutionary process causing divergence during colonization events? If colonists occupy a different habitat than the source population, why would natural selection also be an important process causing divergence?

Genetic drift is particularly important during colonization events, because the colonizing population is typically small, and the effects of genetic drift are much greater on smaller populations. In habitats that differ, natural selection will result in increased survival of those variants in the colonizing population that are best adapted to the new environment.

6. A large amount of gene flow is now occurring among human populations due to intermarriage among people from different ethnic groups and regions of the world. Is this phenomenon increasing or decreasing racial differences in our species? Explain.

The large amount of gene flow between human populations should be decreasing racial differences in our species. Gene flow tends to equalize allele frequencies among populations.

7. Speciation resulting from polyploidy appears to be much more common in plants (especially ferns) than animals. According to one hypothesis, mutations leading to polyploidy are more common in plants because the germ line and soma are not separated, as they are in animals. As a result, polyploidy can arise from an error during mitosis as well as an error in meiosis. Specifically, if nondisjunction occurs at anaphase during mitosis, it can result in a polyploid cell line. If these cells later differentiate into germ-line cells and undergo meiosis, and if the diploid gametes self-fertilize, viable polyploid offspring result. Does this scenario make sense? Comment.

Yes, the scenario about why plant polyploidy is so much more common than animal polyploidy does make sense. Nondisjunctions during meiosis could create a polyploid cell line. Depending on the location of this line of cells in the

plant, these cells could become germ-line cells because plants do not separate future vegetative cells from future germ-line cells. The polyploid characteristic then could end up in a diploid gamete. If the plant self-fertilizes, two diploid gametes could fuse to create a polyploid that is viable, because each homologous chromosome would have a pairing partner during meiosis.

8. Ellen Censky and coworkers recently documented a colonization event. After two hurricanes passed through the Caribbean Sea in the fall of 1995, a large raft made up of fallen trees and other debris drifted to the shore of an island called Anguilla. At least 15 individuals of the green iguana left the raft and went onto the island. Iguanas were not found on Anguilla prior to this event. Based on the wind patterns during the storms, the researchers propose that the 15 iguanas originally lived on the island of Guadalupe.
- Outline a short-term study designed to test the hypothesis that genetic drift produced allele frequency differences in the two populations.
  - Outline a long-term study designed to test the hypothesis that natural selection will produce changes in the characteristics of the two populations over time.

A short-term study to test the hypothesis that genetic drift produced allele frequency differences in the Anguilla and Guadalupe populations of iguanas: (1) Determine the Hardy-Weinberg allele frequencies in the two populations. (2) Then test each of the two populations to determine actual allele frequencies. (3) Drift is expected to reduce allelic frequency, so if the allele frequencies of the Anguilla population indicate less diversity, it is an indication that drift may have occurred.

A long-term study to test whether natural selection will produce changes in the two populations over time: (1) Determine allele frequencies and genotype frequencies for each population. (2) Many years later, compare the allele and genotype frequencies again.

9. All over the world, natural habitats are being fragmented into tiny islands as suburbs, ranches, and farms expand. In effect, variance is occurring at a scale never before seen in the history of life. Based on what you learned from this chapter, do you predict that speciation will take place in the newly isolated populations? Or do you predict that they will be wiped out before speciation can occur?

In most cases, the rapid pace of fragmentation of habitat will tend to wipe out organisms before speciation can occur.