ANSWERS TO EXERCISES

1. Adaptation
2. balanced polymorphism
3. gene flow
4. Genetic drift
5. Kin selection
   altruism
6. Evolution
   coevolution
7. disruptive selection
8. Darwin
9. founder effect
10. Hardy-Weinberg principle
11. population
12. allele frequency
13. gene pool
14. Fitness
15. predation
    prey
16. false, do not change
17. true
18. false, selection
19. false, small
20. false, phenotypes
21. false, lack of change
22. true
23. true
24. false, altruism
25. false, become extinct
26. 588 (294 *AA* x 2) + 252 (252 *Aa* x 1) = 840 ÷ 1200 (600 plants x 2 alleles each) = 0.70 = 70%.
27. 108 (54 *aa* x 2) + 252 (252 *Aa* x 1) = 360 ÷ 1200 = 0.30 = 30%.
28. 294 *AA* ÷ 600 total plants = 0.49 = 49%.
29. 252 ÷ 600 = 0.42 = 42%.
30. 54 ÷ 600 = 0.09 = 9%.
31. 294 *AA* + 252 *Aa* ÷ 600 total plants = 546÷600 = 0.91 = 91%.
32. 54 *aa* ÷ 600 = 0.09 = 9%.

33. m	39. a	45. m	51. d
34. c	40. l	46. l	52. a
35. g	41. l	47. e	53. c
36. d	42. f	48. k	54. c
37. i	43. k	49. m	55. c
38. b	44. j	50. h	56. b

57. In Africa, stabilizing selection is at work with sickle cell anemia: normal individuals (*HH*) are at a disadvantage due to susceptibility to malaria and those with sickle cell anemia (*hh*) are at a disadvantage as well. Heterozygotes (*Hh*) have the highest fitness since they are somewhat resistant to malaria and do not suffer from sickle cell disease. Thus, both alleles are maintained at relatively high frequencies in those areas of Africa. In the United States, normal individuals (*HH*) have the highest fitness since there is no malaria and their children will not have sickle cell disease. Heterozygotes (*Hh*) are healthy but can produce offspring with sickle cell disease (*hh*) if two heterozygotes mate; hence, their fitness is slightly reduced. Thus, in the United States, the *H* allele is slowly rising and the *h* allele is slowly declining due to directional selection favoring normal homozygotes.
58. A population will remain in genetic equilibrium as long as: (1) there is no mutation to change the frequency of genes; (2) there is no gene flow (migration) between populations to alter the gene frequencies in the populations; (3) the population is extremely large so that no chance deviations occur in gene frequencies; (4) all mating is random so that each individual has an equal chance of mating with any other individual; and (5) there is no natural selection so that all genotypes in the population will reproduce equally well.
59. Because the rate of mutation is very low (less than 1 in 100,000 for most genes), mutation alone will not change gene frequencies quickly enough to account for observed evolutionary changes. However, mutation is important in the process of evolution by natural selection because mutation is the ultimate source of the genetic variation upon which natural selection acts in natural populations.

60. Small populations are subject to relatively large random changes in allele frequencies (genetic drift). In large populations, chance events are unlikely to significantly alter the overall gene frequencies, but in small populations chance events could reduce or eliminate alleles, greatly altering in a random way its genetic makeup. Genetic drift tends to reduce genetic variability within small populations, and genetic drift tends to increase genetic variability between or among small populations.

61. In this population of flies, the dark ones are being eaten at a higher percentage (60%) than their frequency in the population (36%) would predict. Perhaps this is due to the dark flies being more easily visible to the birds than the light flies. If body color is an inherited trait in flies, the light flies are more likely than the dark flies to live longer and produce more offspring with light bodies. So, in each generation, the frequency of light flies should increase and the frequency of flies with dark bodies should decrease. This is an example of natural selection.

62. (a) Genetic drift is acting on this mouse population, usually with the consequence of loss of genetic variation.
(b) Gene flow or migration is occurring between the two bird populations, with the result that any genetic differences between the populations will be decreased over time.
(c) The rate of mutation is increasing in this population, which will increase genetic variation among the mice but probably decrease their fitness, since mutations are usually harmful.
(d) The directional selection form of natural selection is occurring in this population, which allows the population to become better adapted to the presence of DDT in the environment.

63. Physicians are in the habit of prescribing antibiotics for practically any illness, even when they will not have a therapeutic effect, as in the cases of viral infections. Patients simply insist upon it. Also, farmers have gotten into the habit of mixing antibiotics in the food given to their livestock animals, as a way of preventing infections in their herds. They feel that this is cheaper and easier than keeping the habitats of the animals clean and free from infectious microbes. In addition, people have been convinced by advertising that it is healthier to use soaps and household cleansers that contain antibiotics, even though this contributes to the environmental pressure leading to the evolution of microbes resistant to the antibiotics, which makes this practice self-defeating and dangerous.

64 According to K. Bush at NBCi.com, there are two main categories of antibiotics, based on their effect on cells. Some antibiotics do not allow bacteria to make cell wall components, and other antibiotics cause inhibition of synthesis of nucleic acids, proteins, or other cytoplasmic molecules. The main mechanisms of bacterial resistance to these antibiotics are: the bacteria modify the antibiotic's target of activity, the bacteria pump out the antibiotic, the bacteria enzymatically destroy the antibiotic, and the bacteria do not allow the penetration of the antibiotic into the bacteria.

65. In a report for the Food Safety Network, Guelph, Ont., W. J. Powell states that in response to environmental changes, bacteria quickly duplicate and exchange genes that confer a selective advantage. The prevalent mechanisms of genetic exchange are: plasmids that are involved in the exchange of genes, by conjugation, through a direct connection formed by a sex pilus; transposons, or "jumping genes" which facilitate the movement of genes in both directions, between chromosomes and plasmids and between bacteria; transduction, which is the transfer of genes by a virus, and is considered to be clinically important, particularly among the Gram-positive bacteria; and transformation, which is the movement of small pieces of DNA from the environment into the bacterial chromosome and is no longer considered clinically significant.