**Chapter 14**

**Constant Allele Frequencies**

**Multiple Choice Questions**

1. Gene flow is the   
A. migration of individuals between populations.  
B. transfer of genes within a population.  
C. variation of alleles within a population.  
**D.** movement of alleles between populations.

2. All of the genes in a population comprise its   
A. genotype.  
**B.** gene pool.  
C. gene reservoir.  
D. genome.

3. Which choice describes a biological population?   
A.  A bird, a lizard, and an insect in a cage at a zoo  
B.  An all-male army  
**C.**  People living in an apartment building  
D.  Pebbles on a beach

4. The difference between microevolution and macroevolution is that   
A. microevolution affects bacteria and macroevolution affects larger organisms.  
B. microevolution happens slowly and macroevolution happens quickly.  
C. macroevolution happens slowly and microevolution happens quickly.  
**D.** microevolutionary changes are small, and macroevolutionary changes are large.

5. Which of the following would not alter a gene's frequency in a population?   
A. mutation  
B. migration  
**C.** random mating  
D. inbreeding

6. Which of the choices best describes macroevolution?   
A. Individuals with one genotype reproduce more than individuals with another genotype in a population.  
B. Mutation creates new alleles that are dominant.  
**C.** A new species emerges.  
D. Dominant and recessive allele frequencies are in equilibrium in a population.

7. In the Hardy-Weinberg equation, 2pq refers to   
**A.** the proportion of heterozygotes in a population.  
B. the number of homozygous dominant individuals in a population.  
C. the most common phenotype in a population.  
D. individuals who are homozygous recessive.

8. The allele *T* is in 85 percent of a population (p=0.85). According to the Hardy-Weinberg equation, what percentage of the population will have the recessive allele *t* (q=?)?   
**A.** 15%  
B. 50%  
C. 85%  
D. 0%

9. In a population in Hardy-Weinberg equilibrium, 75 percent of the individuals have a dominant allele for a particular gene (p=0.75) and 25 percent have a recessive allele (q=0.25). The proportion of homozygous recessive individuals in the F1 generation will be   
A. 2.5%.  
**B.** 6.25%.  
C. 18.75%.  
D. 0%.

10.  In a population in Hardy-Weinberg equilibrium, the frequency of recessive alleles will \_\_\_\_\_ over time.   
A. increase  
B. decrease  
**C.** remain the same  
D. increase and then decrease

11. If one person in 50 is a carrier of an autosomal recessive disorder in a population, the chance that an unrelated man and woman are both carriers is   
A. 1/50.  
B. 1/100.  
C. 1/1000.  
**D.** 1/2500.

12. Which group is used to calculate the frequency of an allele in a population?   
**A.** Homozygous recessives  
B. The most fertile individuals  
C. Autosomal dominants  
D. Heterozygotes

13. In a population in Hardy-Weinberg equilibrium, frequency of a dominant allele is   
**A.** p.  
B. p2.  
C. 2pq.  
D. q.

14. Hardy-Weinberg calculations are based on   
**A.** the binomial expansion.  
B. the quadratic equation.  
C. the Pythagorean theorem.  
D. comparing DNA sequences.

15. Hardy-Weinberg equilibrium is possible only if the population is   
A.  small, with no migration out or in, and females outnumbering males.  
**B.** large, with random mating and no migration, mutation, genetic drift, or natural selection.  
C. small, with nonrandom mating and no migration, mutation, genetic drift, or artificial selection.  
D. large, with nonrandom mating, mutation, genetic drift, and natural selection.

16. If the incidence of an autosomal recessive condition is 1/3600 live births, what is the carrier frequency?   
A. 0.0003  
**B.** 0.029  
C. 0.286  
D. 0.684

17. An autosomal recessive disorder strikes 1 in 1,800 newborns in a population. The frequency of carriers of this disorder is approximately   
A. 0.00055.  
B. 0.023.  
**C.** 0.045.  
D. 0.5.

18. For a very rare inherited disease, the frequency of heterozygotes in a population is   
A. half that of the dominant allele.  
**B.** double that of the recessive allele.  
C. very close to 0.  
D. near 1.

19. Tay-Sachs disease affects in 1 in 3,600 Ashkenazim births. The value of q2 is   
A. 0.1.  
B. 0.05.  
C. 0.017.  
**D.** 0.0003.

20. If the incidence of Tay-Sachs is 1/3,600 Ashkenazim births, what is the heterozygote (carrier) frequency? \_

A. 0.0003  
**B.** 0.033  
C. 0.286  
D. 0.017

21. Frequency of an X-linked recessive allele in males equals   
A. p2.  
B. 2pq.  
C. q2.  
**D.** q.

22. The parts of the genome that are used in markers of identity in DNA profiling   
**A.** are in Hardy-Weinberg equilibrium and therefore not affected by natural selection acting on a phenotype.  
B. are in Hardy-Weinberg equilibrium and therefore not affected by natural selection acting on a genotype.  
C. are not in Hardy-Weinberg equilibrium and therefore not affected by natural selection acting on a phenotype.  
D. are not in Hardy-Weinberg equilibrium and therefore not affected by natural selection acting on a genotype.

23. VNTRs and STRs differ in that   
A. a VNTR repeat is shorter than an STR repeat.  
**B.** a VNTR repeat is longer than an STR repeat.  
C. a VNTR is a type of copy number variant and an STR is not.  
D. an STR is a type of copy number variant and a VNTR is not.

24. Researchers began using short tandem repeats (STRs) because   
**A.** shorter DNA molecules were more likely to persist in a violent situation.  
B. each person has no more than one copy of each STR.  
C. STRs are nonuniformly distributed.  
D. restrictive enzymes cannot be used to cut short DNA molecules.

25. Principles of population genetics must be applied to determine identity based on DNA profiling because   
A. VNTRs are not found in all populations.  
B. individuals are their own populations.  
**C.**  nonrandom mating does not occur in all populations.  
D. alleles are invariant between all human populations.

26. DNA analysis to determine genetic identity applies   
**A.** Mendel's law of independent assortment and the product rule.  
B. Mendel's law of segregation and the product rule.  
C. the law of polymorphism.  
D. Darwin's mathematical principles.

27. Which of the following have the longest DNA sequences?   
**A.** VNTRs  
B. STRs  
C.  Thymine dimers  
D.  Base pairs

28. A common source of DNA for forensic testing is   
A. the skin between the toes.  
**B.**  cells scraped from inside the cheek.  
C. red blood cells.  
D. mucus.

29. Who invented DNA profiling?   
A. Godfrey Hardy  
B. William Weinberg  
**C.**  Sir Alec Jeffreys  
D. Linus Pauling

30. The DNA sequence GATCTGATCTGATCTGATCT is a(n)   
**A.** VNTR.  
B. STR.  
C. RFLP.  
D. SNP.

31. A series of markers have the following frequencies. Which would be the most useful for DNA profiling?   
A. 1/60  
**B.** 1/5200  
C. 1/500  
D. 1/40

32. A suspect's guilt seems highly likely when a very rare combination of markers is   
A. found in the population the suspect comes from and at the crime scene.  
B. not found in the population the suspect comes from, but present at the crime scene.  
C. found in the suspect's DNA but not at the crime scene or in the population the suspect comes from.  
**D.** found in the population the suspect comes from, in the suspect's DNA, and at the crime scene.

33. Mitochondrial DNA (mtDNA) is helpful in obtaining a DNA profile for very degraded genetic material because   
**A.** cells have many mitochondria, and therefore several copies of mtDNA sequences.  
B. mitochondria contain oxidative enzymes that protect the DNA.  
C. mtDNA consists of a single helix, so it cannot be unwound.  
D. it uses uracil instead of thymine, which is a more stable nitrogenous base.

34. Combined DNA Index System (CODIS) is   
A. a fifteen-base DNA sequence used in DNA profiling.  
B. a type of mutation used in forensic applications.  
**C.** a system for crime laboratories to share DNA profiles.  
D. a technology used to amplify DNA found at crime scenes.

35.  To compensate for the barriers to implementing DNA profiling in mass disasters, Sir Alec Jeffreys advises assessing \_\_\_\_\_ STRs.   
**A.**  15 to 20  
B.  20 to 35  
C.  25 to 30  
D.  40 to 50

36. DNA profiling was less useful in identifying remains from the 2004 tsunami than in criminal cases because   
A. the DNA after the tsunami was too wet to analyze.  
**B.** the tsunami left few bodies with collectible DNA.  
C. not enough repeats were profiled.  
D. none of the victims were listed in the FBI's files.

37. In order to identify (or rule out identity) from a DNA sample that is a mixture, the investigator should know   
A. how long the DNA has been exposed to the environment.  
B. how the person perished.  
**C.** the population groups to which the person of interest belongs or belonged.  
D. the genome sequence of the suspect or missing person.

**True / False Questions**

38. Capillary electrophoresis is a technique used to separate DNA pieces.   
**TRUE**

39. Familial DNA search was used in the case of California’s “Grim Sleeper.”   
**TRUE**

40.

In a familial DNA search, DNA from a crime scene is compared to DNA in databases from convicted felons, and if nearly half the CODIS sites match, a first-degree relative of the convict becomes a suspect.   
**TRUE**

41. DNA on a glove left at the crime scene is an example of primary DNA transfer.   
**TRUE**

42. Familial DNA searches are controversial since innocent people may be accused based on sharing CODIS markers with convicted felons.   
**TRUE**