1. Albinism is rare in most human populations, occurring at a frequency of about 1 in 20,000 people. However, the trait occurs at a frequency of 1 in 200 in certain Hopi villages of Black Mesa in Arizona. Explain in terms of natural selection why albinism is so rare in most human populations.

2. Albinism is rare in most human populations, occurring at a frequency of about 1 in 20,000 people. However, the trait occurs at a frequency of 1 in 200 in certain Hopi villages of Black Mesa in Arizona. Explain in terms of natural selection why the trait is so much more common among the Hopis of Black Mesa.

3. Which one of the following pairings between the subdiscipline of genetics and the phenomenon is INCORRECT?
   A) evolution—population genetics
   B) gene regulation—molecular genetics
   C) allelic frequency alteration—population genetics
   D) arrangement of genes on chromosome—transmission genetics
   E) chemical nature of the gene—transmission genetics

4. Which one of the following topics of research belongs to the discipline of transmission genetics?
   A) inheritance pattern of gene alleles
   B) mechanism of DNA replication
   C) gene expression patterns
   D) evolution
   E) chemical modification of nucleic acids

5. The complete genetic makeup of an organism is referred to as its:
   A) chromosome.
   B) alleles.
   C) locus.
   D) genome.
   E) phenotype.

6. Identify a TRUE statement from the following descriptions concerning genetics.
   A) The theory of pangenesis states that all living organisms are composed of cells.
   B) Bacteria and viruses are not useful in studying genes and inheritance because they are structurally and metabolically different from eukaryotic cells.
   C) Charles Darwin accurately described the laws of inheritance in his landmark book, *On the Origin of Species.*
   D) Many human traits, such as skin and hair color, are determined by more than a single gene.
   E) Evolution can occur without genetic changes in the population.

7. Identify a FALSE statement from the following descriptions of genetics.
   A) Humans first applied genetics to the domestication of plants and animals between approximately 10,000 and 12,000 years ago.
   B) Some viruses use RNA to carry their genetic information.
   C) Albinism results from a mutation in the genes that control the synthesis and storage of melanin.
   D) All human traits that display blending inheritance are affected by a single gene.
   E) The process by which genetic information is copied and decoded is similar for all forms of life.

8. Which of the following species is considered a model genetic organism?
   A) the plant *Linaria vulgaris*
   B) the deer mouse *Peromyscus maniculatus*
   C) the worm *Caenorhabditis elegans*
   D) the frog *Hyla chrysoscelis*
   E) the chimpanzee *Pan troglodytes*

9. Which of the following would serve the LEAST well as a model for understanding basic mechanisms of inheritance?
   A) fruit flies
   B) humans
   C) yeast
   D) mice
   E) zebrafish

10. Which of the following statements is TRUE?
    A) Each subdiscipline of genetics is very specific as to what is explored and does not overlap with the other subdisciplines.
    B) All phenotypes or traits are always determined by multiple genes.
    C) Albinism arises from the overexpression of the gene that controls the synthesis and storage of melanin.
    D) Humans make excellent model organisms because they have a variety of well-defined traits.
    E) None of the statements provided are true.

11. Which of the following statements is CORRECT?
    A) All genomes are encoded in DNA only.
    B) All genomes are encoded in nucleic acids.
    C) All genomes are encoded in proteins only.
    D) The genetic instructions are decoded completely differently in each organism.
    E) Molecular studies suggest life evolved from multiple primordial ancestors.

12. Which of the following traits would make a species useful as a model genetic organism? (Select all that apply.)
    A) large number of progeny
    B) long generation time
    C) small size
    D) ability to be studied in a laboratory
    E) ability to be propagated inexpensively

13. Which one of the following topics belongs to a different subdiscipline of genetics when compared with the rest?
    A) mechanism of gene regulation
    B) allele frequencies of a certain gene in different environments
    C) transcription
    D) chemical alternation of chromosomes
    E) mechanism of DNA replication

14. The fruit fly *Drosophila melanogaster* is an important model system for studying inheritance in animals and genetic control of animal development, including humans. If researchers ultimately want to understand a biological process in humans, why might they want to study the process in fruit flies first? (Select all that apply.)
    A) Fruit flies are relatively easy to genetically manipulate and to isolate mutations.
    B) Fruit flies have short generation times and produce relatively large numbers of progeny.
    C) Fruit flies have simpler genomes than do humans.
    D) Fruit flies share all important physiological and developmental processes with humans.
    E) Fruit flies are small and easy to raise.

15. The complete genetic makeup of any organism is referred to as a:
    A) phylogeny.
    B) pheynotype.
    C) genome.
    D) genotype.
    E) single-nucleotide polymorphism.

16. A change in allele frequency within a population over time leads to:
    A) a genome.
    B) a phenotype.
    C) a genotype.
    D) mutations.
    E) evolution.

17. Assume that a geneticist is doing a study with a wild mouse species. She captures 100 of these mice, takes a DNA sample from each, and sequences the same specific gene from each mouse. This gene has two alleles within this population. She then calculates the frequency of each of the two alleles from the sequencing results. Which subdivisions of genetics would this study include?
    A) transmission and population genetics
    B) transmission and molecular genetics
    C) molecular genetics only
    D) molecular and population genetics
    E) transmission genetics only

18. Albinism is rare in most human populations, occurring at a frequency of about 1 in 20,000 people. However, the trait occurs at a frequency of 1 in 200 in certain Hopi villages of Black Mesa in Arizona. In light of this example and others that you might be aware of, what can you conclude about particular alleles such as the allele for albinism?
    A) An allele that leads to an abnormal phenotype will be rare in most populations but common in Native American populations.
    B) An allele that leads to abnormal phenotype will not be beneficial in any population.
    C) An allele that leads to an abnormal phenotype may be beneficial in some environments but harmful in others.
    D) An allele that leads to an abnormal phenotype will rise in frequency after many generations.
    E) An allele that leads to an abnormal phenotype will soon disappear from a population.

19. The fruit fly *Drosophila melanogaster* is an important model system for studying inheritance in animals and genetic control of animal development, including humans. Evaluate fruit flies as a model system for human biology. What are their strengths and weaknesses as a model system?

20. What common features of heredity suggest that all life on Earth evolved from a common ancestor?

21. Why might bacteria and viruses be good model organisms for studying the basics of inheritance? Describe two advantages over studying genetics in mice, dogs, or humans.

22. Many good ideas in science ultimately turn out to be incorrect, and this has happened several times in the history of genetics. In your own words, state one idea in the history of genetics that turned out to be incorrect.

23. Many good ideas in science ultimately turn out to be incorrect and this has happened several times in the history of genetics. Why do you think a particular idea was widely accepted by scholars of that time? Include in your answer some evidence in favor of the idea, observations that seemed to support the idea, or other rationale for accepting the idea.

24. Many good ideas in science ultimately turn out to be incorrect, and this has happened several times in the history of genetics. Summarize the evidence that ultimately caused the idea to be rejected by modern geneticists.

25. Describe one way in which discoveries in genetics currently impact your daily life apart from this course.

26. Describe one way in which discoveries in genetics will likely impact your life in the future.

27. Describe a discovery in genetics or an area of current research that you are concerned about that might have a negative impact on your life in the future. Explain why you think it might have a negative impact on you personally.

28. The experiments of Gregor Mendel can be placed into which subdivision of genetics?
    A) molecular genetics
    B) population genetics
    C) transmission genetics
    D) molecular genetics and transmission genetics
    E) population genetics and transmission genetics

29. Among the model genetic organisms, *Escherichia coli*, a single-celled bacterium, is a prokaryote; *Saccharomyces cerevisiae*, one-celled yeast, is a eukaryote, as are *Caenorhabditis elegans*, a multicellular nematode worm, and *Arabidopisis thaliana*, a multicellular plant. Which of these organisms would NOT contain membrane-bound organelles?
    A) *Escherichia coli*
    B) *Saccharomyces cerevisiae*
    C) *Escherichia coli* and *Saccharomyces cerevisiae*
    D) *Caenorhabditis elegans*
    E) *Caenorhabditis elegans* and *Arabidopisis thaliana*

30. In the late 1990s what important discovery in genetics was made?
    A) The three-dimensional structure of DNA was described, which showed how DNA might be replicated.
    B) The first recombinant DNA experiments were performed that started the biotechnology field.
    C) DNA sequencing methods were first discovered.
    D) Genes were found to be located on chromosomes.
    E) Tiny RNAs were discovered that play important roles in the regulation of gene expression.

31. CRISPR/Cas9 is a powerful new method that allows:
    A) DNA sequencing to be done very quickly so that numerous individual genomes can be sequenced in a short period of time.
    B) precise editing of specific DNA sequences in living cells.
    C) the identification of genes involved in important medical conditions.
    D) the introduction of genes from one species into another species.
    E) the arrangement of genes on chromosomes.

32. The golden mutation in the zebrafish was useful because of which of the following results?
    A) It led to the discovery of a similar gene in humans that is involved in skin pigmentation.
    B) It led to the development of new varieties of wheat.
    C) It led to the ability to identify many of the genes that result in an increase in heart attacks.
    D) It allowed the zebrafish to be grown in captivity and become commercially profitable.
    E) It became the first gene in a model organism to be sequenced.

33. In humans, single nucleotide differences among individuals, called single nucleotide polymorphisms (SNPs), have been used to show:
    A) how a mutation in a gene can lead to a particular trait.
    B) how gene therapy can be used to treat various disorders.
    C) the correlation of a set of genetic differences with a particular medical condition.
    D) that the concept of the inheritance of acquired characteristics is not correct.
    E) that genetic information can be transferred from DNA to RNA.

34. Which of the following are epigenetic changes?
    A) Gene mutations that can be passed on from parent to offspring
    B) Changes that convert a prokaryotic cell to an eukaryotic cell
    C) Changes in DNA base sequence that are inherited from only one of the two parents of an individual
    D) Changes to the RNA base sequence that cause it to not pass on genetic information to proteins
    E) Alterations to DNA and chromosome structure that do not involve the base sequence of the DNA

35. What commonsense observation makes the theory of preformationism unlikely?
    A) An individual may inherit traits found in both of his or her parents.
    B) Anatomical changes such as loss of a limb are not seen in the offspring of an individual.
    C) Evolution requires genetic change in populations.
    D) Alleles that result in abnormal phenotypes may be less common in some populations than in others.
    E) Offspring often look more like their parents than unrelated individuals.

36. What commonsense observation makes the theory of acquired characteristics UNLIKELY?
    A) An individual may inherit traits found in both of his or her parents.
    B) Anatomical changes such as loss of a limb are not seen in the offspring of an individual.
    C) Evolution requires genetic change in populations.
    D) Alleles that result in abnormal phenotypes may be less common in some populations than in others.
    E) Offspring often look more like their parents than unrelated individuals.

37. Which of the following theories of inheritance is currently considered TRUE?
    A) germ-plasm theory
    B) pangenesis
    C) blending inheritance
    D) inheritance of acquired characteristics
    E) None of these theories is considered true based on new evidence.

38. Which of the following theories of inheritance is no longer accepted as TRUE?
    A) pangenesis
    B) blending inheritance
    C) inheritance of acquired characteristics
    D) preformationism
    E) None of the provided theories is currently considered true.

39. Which of the following CORRECTLY describes the cell theory?
    A) Genetic information from different parts of the body travels to the reproductive organs.
    B) The cell is the compositional and functional unit of all life.
    C) Inside the germ cells, there exists a fully formed miniature adult that enlarges in the course of development.
    D) The genetic material itself blends, which cannot be separated out in future generations.
    E) Traits acquired in a person's lifetime become incorporated into the person's hereditary information, which will be passed onto his or her offspring.

40. Which of the following examples of scientists and their contribution is matched INCORRECTLY?
    A) Watson and Crick—three-dimensional structure of DNA
    B) Mendel—principles of heredity using pea plants
    C) Gilbert and Sanger—DNA sequencing methods
    D) Morgan—polymerase chain reaction
    E) Sutton—genes on chromosomes as units of inheritance

41. Choose the correct match between the scientists and the field of genetics to which they contributed.
    A) Haldane and Wright—transmission genetics
    B) Mendel—molecular genetics
    C) Gilbert and Sanger—population genetics
    D) Darwin—molecular genetics
    E) Morgan—transmission genetics

42. The first complete DNA sequence of a nonviral, free-living organism was obtained for:
    A) a bacterium in 1900.
    B) a bacterium in 1945.
    C) a bacterium in 1995.
    D) humans in 1990.
    E) humans in 2000.

43. The three-dimensional structure of DNA was first deciphered based on the work of which of the following individuals? (Select all that apply.)
    A) James Watson
    B) Francis Crick
    C) Maurice Wilkins
    D) Thomas Hunt Morgan
    E) Rosalind Franklin

44. Which of the following scientists contributed significantly to the foundations of population genetics?
    A) James Watson
    B) Thomas Hunt Morgan
    C) Ronald Fisher
    D) Charles Darwin
    E) Frederick Sanger

45. Which of the following scientists contributed significantly to the foundations of molecular genetics?
    A) James Watson
    B) Thomas Hunt Morgan
    C) John B. S. Haldane
    D) Charles Darwin
    E) Sewall Wright

46. Which of the following scientists contributed significantly to the foundations of transmission genetics?
    A) James Watson
    B) Thomas Hunt Morgan
    C) John B. S. Haldane
    D) Charles Darwin
    E) Sewall Wright

47. The contribution Charles Darwin made to biology was to:
    A) demonstrate the connection between Mendel's principles of inheritance and evolution.
    B) propose that evolution occurs by natural selection.
    C) develop the theory of evolution, based on earlier theories of population genetics.
    D) connect the fields of evolution and molecular genetics.
    E) determine the first DNA sequence for a free-living organism.

48. Which of the following combines molecular biology and computer science?
    A) single-nucleotide polymorphism
    B) microRNAs
    C) polymerase chain reaction
    D) bioinformatics
    E) eukaryotics

49. What commonsense observation makes the theory of blending inheritance unlikely?
    A) An individual may inherit traits found in only one of his or her parents.
    B) Anatomical changes such as loss of a limb are not seen in the offspring of an individual.
    C) Evolution requires genetic change in populations.
    D) Some traits disappear in one generation and then reappear in the next generation.
    E) Offspring often look more like their parents than unrelated individuals.

50. List and describe two significant events in the history of genetics that occurred during the twentieth century.

51. Write a paragraph explaining why genetics is considered a young science, even though people have been applying genetic principles for thousands of years.

52. A measurable or observable trait or characteristic is called a:
    A) phenotype.
    B) genotype.
    C) single-nucleotide polymorphism.
    D) small interfering RNA.
    E) gene bank.

53. Genetic information can be carried in which of the following biomolecules?
    A) proteins
    B) DNA but not RNA
    C) RNA but not DNA
    D) either DNA or RNA
    E) proteins but not RNA

54. Which of the following sequences CORRECTLY shows the flow of genetic information during gene expression?
    A) RNA $\rightarrow$ DNA $\rightarrow$ protein
    B) protein $\rightarrow$ DNA $\rightarrow$ RNA
    C) DNA $\rightarrow$ RNA $\rightarrow$ protein
    D) DNA $\rightarrow$ protein $\rightarrow$ DNA
    E) None of the answers is correct.

55. The contribution of Gilbert and Sanger to modern genetics was to:
    A) develop the PCR technique.
    B) discover DNA in the nucleus of cells.
    C) describe the structure of DNA.
    D) show that genes were made of DNA.
    E) develop a method for sequencing DNA.

56. Which of the following pairs is a part of a single nucleotide?
    A) nitrogenous base and sugar
    B) sugar and amino acid
    C) guanine and cytosinetwo nitrogenous bases
    D) amino acid and nitrogenous base

57. A form of a gene that has a slightly different sequence than other forms of the same gene but encodes the same type of an RNA or protein is called a(n):
    A) locus.
    B) allele.
    C) homologous chromosome.
    D) heterozygote.
    E) homozygote.

58. _____ is a change in allele frequency of a population over time.
    A) Blending inheritance
    B) Preformation
    C) Genome
    D) Evolution
    E) Phenotype

59. Permanent, heritable changes in genetic information (DNA) are called:
    A) evolution.
    B) defects.
    C) SNP.
    D) alleles.
    E) mutations.

60. Within cells, genes are located on structures called:
    A) genomes.
    B) chromosomes.
    C) phenotypes.
    D) genotypes.
    E) alleles.

61. Which of the following statements is FALSE concerning prokaryotic cells?
    A) They lack a nuclear membrane.
    B) They lack organelles such as chloroplasts.
    C) They are less complex than eukaryotic cells.
    D) They lack genetic information.
    E) They lack a true nucleus.

62. Which of the following statements is the CORRECT definition of meiosis?
    A) It is the method by which prokaryotic cells divide and produce daughter cells.
    B) It is the process by which the genetic information in DNA is transferred to RNA.
    C) It is the separation of chromosomes in the division of sex cells to produce gametes.
    D) It is the separation of chromosomes in the division of somatic cells in plants and animals.
    E) It is the process that produces multiple alleles of genes.

63. Assume that a mutation occurs within a gene within an individual fruit fly. What will be the most likely series of consequences of this mutation?
    A) It will initially change the RNA sequence; then this change in genetic information will be transferred to the DNA sequence and finally result in a change in the protein made by the gene.
    B) It will initially change the DNA sequence; then this change in genetic information will be transferred to the RNA sequence and finally result in a change in the protein made by the gene.
    C) It will initially change the RNA sequence; then this change in genetic information will be transferred to the protein made by the gene and finally result in a change in the DNA.
    D) It will initially change the DNA sequence; then this change in genetic information will be transferred to the protein made by the gene and finally result in a change in the RNA.
    E) It will initially change the protein sequence made by the gene; then this change in genetic information will be transferred to DNA and finally result in a change in the RNA.

64. How do DNA and RNA differ?
    A) DNA contains the nitrogenous base thymine while RNA contains the base uracil instead of thymine.
    B) DNA contains the nitrogenous base guanine while RNA contains the base cytosine instead of guanine.
    C) DNA is composed of repeating units called nucleotides while RNA is composed of repeating units called amino acids.
    D) DNA is composed of repeating units called amino acids while RNA is composed of repeating units called nucleotides.
    E) In DNA the nucleotides contain a sugar, a base, and a phosphate while in RNA the nucleotides contain no sugar.

65. Which features distinguish a prokaryotic cell from a eukaryotic cell?

Answer Key

1.
2.
3. E
4. A
5. D
6. D
7. D
8. C
9. B
10. E
11. B
12. A, C, D, E
13. B
14. A, B, C, E
15. C
16. E
17. D
18. C
19.
20.
21.
22.
23.
24.
25.
26.
27.
28. C
29. A
30. E
31. B
32. A
33. C
34. E
35. A
36. B
37. A
38. E
39. B
40. D
41. E
42. C
43. A, B, C, E
44. C

45. A
46. B
47. B
48. D
49. D
50.
51.
52. A
53. D
54. C
55. E
56. A
57. B
58. D
59. E
60. B
61. D
62. C
63. B
64. A
65.