True/False
Indicate whether the sentence or statement is true or false.

___ 1. Even though Avery’s experiments clearly indicated that genetic material is composed of DNA, most scientists at that time continued to suspect that proteins were the genetic material.

___ 2. Most scientists at that time agreed with Avery’s experiments because of their extensive knowledge of DNA.

___ 3. It has been discovered that proteins are the genetic material, rather than DNA, because proteins are more complex than DNA.

___ 4. Bacteriophage is a type of bacteria that infects viruses.

___ 5. Hershey and Chase were the first two scientists to prove that genetic material is composed of proteins.

___ 6. The five-carbon sugar in DNA nucleotides is called ribose.

___ 7. A nucleotide consists of a sugar, a phosphate group, and a nitrogen base.

___ 8. Despite years of research, the actual structure of the DNA molecule is still unknown.

___ 9. Franklin’s X-ray diffraction images suggested that the DNA molecule resembled a tightly coiled spring, a shape called a helix.

___ 10. Chargaff observed that the amount of adenine in an organism always equaled the amount of thymine.

___ 11. Wilkins and Franklin were the first to suggest that the DNA molecule resembled a tightly coiled helix.

___ 12. The strands of a DNA molecule are held together by hydrogen bonding between adenine with guanine molecules and cytosine with thymine molecules.

___ 13. In all living things, DNA replication must occur after cell division.

___ 14. After replication, the nucleotide sequences in both DNA molecules are identical to each other and to the original DNA molecule.

___ 15. No two nucleotide sequences in DNA molecules are ever the same.

___ 16. Before a DNA molecule can replicate itself, it must make itself more compact. This is accomplished by the double helix coiling up on itself.

___ 17. Helicases unwind the double helix of DNA by breaking the nitrogen bonds that link the hydrogen bases.

___ 18. The two areas on either end of the bacterial DNA molecule where the double helix separates are called replication forks.

___ 19. DNA polymerases have the ability to check for errors in nucleotide pairings.

___ 20. Typically, during replication only one error occurs for every 10,000 nucleotides.

___ 21. Errors in nucleotide sequencing that occur during replication cannot be corrected.

___ 22. Multiple replication forks tend to slow down replication.
Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 23. A vaccine is
   a. a substance that kills bacteria or viruses.
   b. an antibody.
   c. a plasmid that contains disease-causing genes.
   d. a harmless version of a disease-causing microbe.

____ 24. Griffith’s transformation experiments
   a. changed proteins into DNA.
   b. caused harmless bacteria to become deadly.
   c. resulted in DNA molecules becoming proteins.
   d. were designed to show the effect of heat on bacteria.

____ 25. Griffith’s experiments showed that
   a. dead bacteria could be brought back to life.
   b. harmful bacteria were harder than harmless bacteria.
   c. heat caused the harmful and harmless varieties of bacteria to fuse.
   d. genetic material could be transferred between dead bacteria and living bacteria.

____ 26. Avery’s experiments showed that transformation
   a. is prevented by protein-destroying enzymes.
   b. is prevented by DNA-destroying enzymes.
   c. causes protein to become DNA.
   d. is caused by a protein.

____ 27. Avery and his research team concluded that
   a. RNA was the genetic material.
   b. protein bases were the genetic material.
   c. DNA and RNA were found in the human nucleus.
   d. DNA was the genetic material.

____ 28. Using radioactive tracers to determine the interactions of bacteriophages and their host bacteria, Hershey and Chase demonstrated without question that
   a. genes are composed of protein molecules.
   b. DNA and proteins are actually the same molecules located in different parts of cells.
   c. bacteria inject their DNA into the cytoplasm of bacteriophages.
   d. DNA is the molecule that stores genetic information in cells.

____ 29. All of the following are true of the viruses Hershey and Chase used in their study except
   a. they consisted of DNA surrounded by a protein coat.
   b. they injected their DNA into cells.
   c. they destroyed the DNA of the infected bacteria.
   d. they caused infected bacteria to make many new viruses.

____ 30. The scientist who worked with Martha Chase to prove that genetic material is composed of DNA was
   a. Alfred Hershey.
   b. Oswald Avery.
   c. Francis Crick.
   d. Rosalind Franklin.

____ 31. All of the following are true about the structure of DNA except
   a. short strands of DNA are contained in chromosomes inside the nucleus of a cell.
   b. every DNA nucleotide contains a sugar, a phosphate group, and a nitrogen base.
   c. DNA consists of two strands of nucleotides joined by hydrogen bonds.
   d. the long strands of nucleotides are twisted into a double helix.
32. Molecules of DNA are composed of long chains of
   a. amino acids.  
   b. fatty acids.  
   c. monosaccharides.  
   d. nucleotides.

33. Which of the following is not part of a molecule of DNA?
   a. deoxyribose  
   b. nitrogen base  
   c. phosphate  
   d. ribose

34. A nucleotide consists of
   a. a sugar, a protein, and adenine.  
   b. a sugar, an amino acid, and starch.  
   c. a sugar, a phosphate group, and a nitrogen base.  
   d. a starch, a phosphate group, and a nitrogen base.

35. The part of the molecule for which deoxyribonucleic acid is named is the
   a. phosphate group.  
   b. sugar.  
   c. nitrogen base.  
   d. None of the above

36. The entire molecule shown in the diagram above is called a(n)
   a. amino acid.  
   b. nucleotide.  
   c. polysaccharide.  
   d. pyrimidine.

37. Purines and pyrimidines are
   a. nitrogen bases found in amino acids.  
   b. able to replace phosphate groups from defective DNA.  
   c. names of specific types of DNA molecules.  
   d. classification groups for nitrogen bases.

38. Of the four nitrogen bases in DNA, which two are purines and which two are pyrimidines?
   a. adenine—thymine; uracil—cytosine  
   b. adenine—thymine; guanine—cytosine  
   c. adenine—guanine; thymine—cytosine  
   d. uracil—thymine; guanine—cytosine

39. Watson and Crick built models that demonstrated that
   a. DNA and RNA have the same structure.  
   b. DNA is made of two strands that twist into a double helix.  
   c. guanine forms hydrogen bonds with adenine.  
   d. thymine forms hydrogen bonds with cytosine.

40. The scientists credited with establishing the structure of DNA are
   a. Avery and Chargaff.  
   b. Hershey and Chase.  
   c. Mendel and Griffith.  
   d. Watson and Crick.
41. X-ray diffraction photographs by Wilkins and Franklin suggested that
   a. DNA and RNA are the same molecules.
   b. DNA is composed of either purines or pyrimidines, but not both.
   c. DNA molecules are arranged as a tightly coiled helix.
   d. DNA and proteins have the same basic structure.

42. Watson and Crick : DNA
   a. Avery : nucleotides
   b. Hershey and Chase : protein
   c. Wilkins and Franklin : DNA
   d. Chargaff : X rays

43. The amount of guanine in an organism always equals the amount of
   a. protein
   b. thymine
   c. adenine
   d. cytosine

44. During DNA replication, a complementary strand of DNA is made for each original DNA strand. Thus, if a portion of the original strand is CCTAGCT, then the new strand will be
   a. TTGCATG
   b. AAGTATC
   c. CCTAGCT
   d. GGATCGA

45. adenine : thymine
   a. protein : DNA
   b. Watson : Crick
   c. guanine : cytosine
   d. adenine : DNA

46. The attachment of nucleotides to form a complementary strand of DNA
   a. is accomplished by DNA polymerase.
   b. is accomplished only in the presence of tRNA.
   c. prevents separation of complementary strands of RNA.
   d. is the responsibility of the complementary DNA mutagens.

47. Which of the following is not true about DNA replication?
   a. It must occur before a cell can divide.
   b. Two complementary strands are duplicated.
   c. The double strand unwinds and unzips while it is being duplicated.
   d. The process is catalyzed by enzymes called DNA mutagens.

48. The enzymes responsible for adding nucleotides to the exposed DNA template bases are
   a. replicases.
   b. DNA polymerases.
   c. helicases.
   d. None of the above

49. The enzymes that unwind DNA are called
   a. double helices.
   b. DNA helicases.
   c. forks.
   d. phages.

Completion
Complete each sentence or statement.

50. A(n) ____________ is a harmless version of a disease-causing microbe that can stimulate a person's immune system to ward off infection by the infectious form of the microbe.

51. Griffith's experiment showed that live bacteria without capsules acquired the ability to make capsules from dead bacteria with capsules in a process Griffith called ________________.

52. The ability of a microorganism to cause disease is referred to as its ________________.

53. Avery's prevention of transformation using DNA-destroying enzymes provided evidence that ________________ molecules function as the hereditary material.

54. Viruses that infect bacteria are called ________________.
55. A DNA subunit composed of a phosphate group, a five-carbon sugar, and a nitrogen-containing base is called a(n) ____________________.

56. The name of the five-carbon sugar that makes up a part of the backbone of molecules of DNA is ____________________.

57. Watson and Crick determined that DNA molecules have the shape of a(n) ____________________ ____________________.

58. Chargaff’s observations established the ____________________ ____________________ rules, which describe the specific pairing between bases on DNA strands.

59. Watson and Crick used the X-ray diffraction photographs of ____________________ and ____________________ to build their model of DNA.

60. Due to the strict pairing of nitrogen bases in DNA molecules, the two strands are said to be ____________________ to each other.

61. The process by which DNA copies itself is called ____________________.

62. The enzyme that is responsible for replicating molecules of DNA by attaching complementary bases in the correct sequence is called ____________________ ____________________.

63. Enzymes called ____________________ are responsible for unwinding the DNA double helix by breaking the hydrogen bonds that hold the complementary strands together.

64. Errors in nucleotide sequencing are corrected by enzymes called ____________________ ____________________.

65. The circular DNA molecules in prokaryotes usually contain ____________________ replication forks during replication, while linear eukaryotic DNA contains many more.

Essay

66. Briefly summarize the highlights of the experiments performed by Hershey and Chase that indicated that DNA was probably the genetic material.

67. The DNA molecule is described as a double helix. Describe the meaning of this expression and the general structure of a DNA molecule.

68. Describe how a molecule of DNA is replicated.

69. How does the number of replication forks in the DNA of prokaryotic cells differ from number of replication forks in the DNA of eukaryotic cells?