Exam
Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

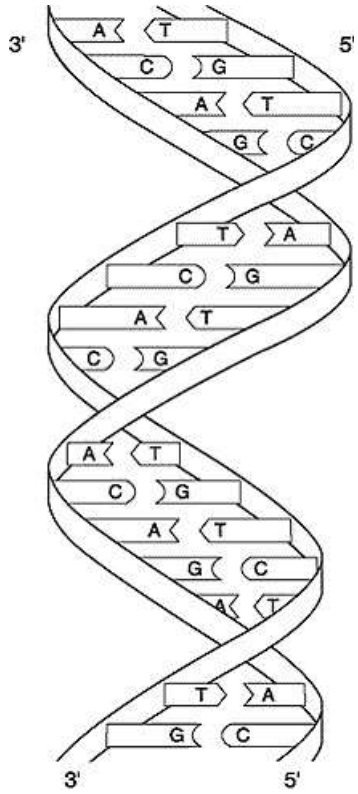

Figure 2.1

1) Which of the following nucleotide sequences accurately reflects the mRNA that would be produced from the double-stranded DNA shown in Figure 2.1? 1) _____
   A) 5'ACAGAGTGACAGAAC3'
   B) 3'TGTCTCACTGTCTTG5'
   C) 5'UGUCUCACUGUCUUG3'
   D) 3'ACAGAGUGACAGAAC5'
   E) 3'GTTCTGTCACTCTGT5'

2) Based upon a sequence of 15 nucleotides in a strand of DNA, what is the maximum amount of amino acids produced? 2) _____
   A) 50 B) 3 C) 2 D) 5 E) 7

3) What interaction between complementary bases holds the two strands of a DNA molecule together? 3) _____
   A) disulfide bridges
   B) hydrogen bonds
   C) van der Waals forces
   D) covalent bonds
   E) ionic bonds

4) What interaction between the phosphate and the carbohydrate of a nucleotide holds the backbone of a DNA strand together? 4) _____
   A) hydrogen bonds

B) ionic bonds
C) disulfide bridges
D) covalent bonds
E) van der Waals forces

5) Which of the following is NOT a monosaccharide? 5) _____
A) fructose
B) galactose
C) lactose
D) glucose
E) deoxyribose

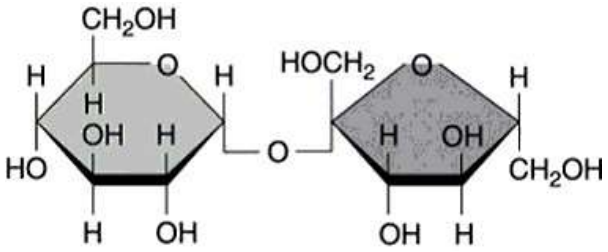

Figure 2.2

6) What type of molecule is shown in Figure 2.2? 6) _____
A) disaccharide
B) monosaccharide
C) fatty acid
D) amino acid
E) phospholipid

7) The presence of _____ chemical groups makes carbohydrates _____. 7) _____
A) hydroxyl : nonpolar
B) amino : polar
C) hydroxyl : polar
D) amino : acidic
E) carboxyl : polar and acidic

8) Which of the following molecules is a disaccharide? 8) _____
A) glycogen B) galactose C) fructose D) glucose E) lactose

9) Which of the following correctly describes glycogen? 9) _____
A) It forms the regulatory molecules known as enzymes.
B) It serves as a structural component of human cells.
C) It contains the genetic information found in cells.
D) It is an important storage polysaccharide found in animal tissues.
E) It helps to protect vital organs from damage.

10) Which of the following is an example of a pentose sugar? 10) _____
A) lactose
B) glucose
C) sucrose
D) fructose

E) deoxyribose

11) _____ is a polysaccharide found in animal cells, whereas _____ is a polysaccharide found in plants that can be degraded by humans. 11) _____
A) Lactose : starch
B) Glycogen : cellulose
C) Galactose : starch
D) Galactose : cellulose
E) Glycogen : starch

12) Which of the following molecules will dissolve readily in water? 12) _____
A) NaCl
B) triglyceride
C) cholesterol
D) fatty acid
E) C_6H_{14}

13) Which of the following statements concerning hydrogen bonds is FALSE? 13) _____
A) They are strong attractive forces between hydrogen atoms and negatively charged atoms.
B) They are responsible for many of the unique properties of water.
C) They can occur within a single molecule.
D) They can form between neighboring molecules.
E) They are important forces for tertiary structure of proteins.

14) _____ are molecules that contain primarily carbons and hydrogens linked together by nonpolar covalent bonds. 14) _____
A) Carbohydrates
B) Nucleotides
C) Lipids
D) Polysaccharides
E) Proteins

15) _____ are molecules composed of a glycerol and three fatty acids. 15) _____
A) Triglycerides
B) Phospholipids
C) Steroids
D) Eicosanoids
E) Saturated fatty acids

16) A fatty acid that contains three double bonds in its carbon chain is said to be 16) _____
A) hypersaturated.
B) saturated.
C) monounsaturated.
D) polysaturated.
E) polyunsaturated.

17) _____ are molecules that form the bilayer of cell membranes and micelles. 17) _____
A) Phospholipids
B) Eicosanoids
C) Triglycerides
D) Steroids
E) Saturated fatty acids

18) The amphipathic property of phospholipids can be described as a 18) _____
A) nonpolar region that dissolves in water and a polar region that face one another.
B) single nonpolar region that is not miscible in aqueous solution.
C) single polar region that is miscible in aqueous solution.
D) polar region that dissolves in water and a nonpolar region that repels water.
E) nonpolar region facing the outside and a polar region facing the inside of a cell.

19) _____ are modified fatty acids that function in intercellular communication and include prostaglandins and thromboxanes. 19) _____
A) Phospholipids
B) Triglycerides
C) Steroids
D) Saturated fatty acids
E) Eicosanoids

20) _____ act(s) as the precursor to steroid molecules, many of which function as hormones. 20) _____
A) Saturated fatty acids
B) Unsaturated fatty acids
C) Eicosanoids
D) Phospholipids
E) Cholesterol

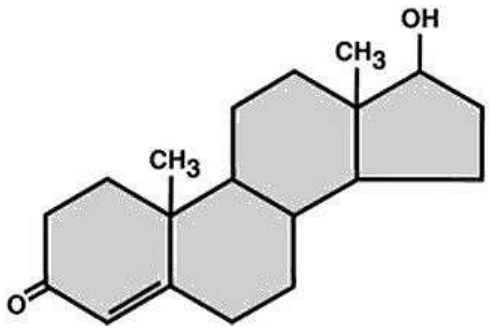

Figure 2.3

21) Based on Figure 2.3, what type of molecule is this? 21) _____
A) phospholipid
B) nucleotide
C) amino acid
D) fatty acid
E) steroid

22) _____ are molecules whose general structure includes a central carbon with a carboxyl group, an amine group, a hydrogen molecule, and a residual (R) group. 22) _____
A) Nucleotides
B) Carbohydrates
C) Proteins
D) Lipids
E) Amino acids

23) Alpha-helixes and β-pleated sheets are examples of _____ structures of a protein. 23) _____

A) primary
B) secondary
C) tertiary
D) quaternary
E) quinary

24) Formation of peptide bonds occurs by condensation reactions between the _____ group of one amino acid and the _____ group of another. 24) _____
A) fatty acid : glycerol
B) glucose : glucose
C) carboxyl : amino acid amino
D) amino acid : amino acid

25) The most common elements found in biomolecules are carbon, hydrogen, nitrogen, and 25) _____
A) phosphorous.
B) oxygen.
C) calcium.
D) chlorine.
E) potassium.

26) Each amino acid differs from others only by the 26) _____
A) characteristic of its R group.
B) size of its amino group.
C) number of peptide bonds in the molecule.
D) number of its carboxyl groups.
E) number of central carbon atoms.

27) Hydrogen bonding between the amino hydrogen of one amino acid and the carboxyl oxygen of another is responsible for which of the following? 27) _____
A) holding the two strands of DNA together by the law of complementary base pairing
B) twisting the DNA into a helical structure
C) primary protein structure
D) secondary protein structure
E) tertiary protein structure

28) An acid is a molecule that acts as a(n) 28) _____
A) proton acceptor.
B) hydrogen acceptor.
C) proton donor.
D) electron donor.
E) hydroxide donor.

29) Ketoacids (a carboxylic acid group attached to a ketone) are often produced during fasting and uncontrolled diabetes mellitus. What potential outcome of this would be of greatest concern? 29) _____
A) burning ketone bodies
B) ketoacidosis
C) disoriented thinking
D) acetone breath
E) weight loss

30) The _____ structure of a protein is formed between residual (R) groups of the amino acid backbone by a number of different chemical interactions, dependent upon the nature of the residual groups interacting. 30) _____
A) primary

B) secondary
C) tertiary
D) quaternary
E) quinary

31) Which of the following is an example of a fibrous protein? 31) _____
A) insulin
B) hemoglobin
C) collagen
D) growth hormone
E) Na^+/K^+ pumps

32) _____ are molecules that are composed of one or more phosphate groups, a 5-carbon sugar, and a nitrogenous base. 32) _____
A) Lipids
B) Nucleotides
C) Amino acids
D) Phospholipids
E) Glycoproteins

33) Why are nucleotides (and their polymers) called nucleic acids when they contain nitrogenous bases? 33) _____
A) Acids ending in "-ic" are the ionized versions of those molecules ending in "-ate."
B) Phosphoric acid groups (becoming phosphates) are much stronger than nitrogen acts as a base.
C) Nitrogenous base is really a misnomer.
D) There are more acids on the molecule than bases.
E) Acids always win out over a base.

34) When the body needs to make the eicosanoid thromboxane for wound repair, what component of the plasma membrane does it use for their synthesis? 34) _____
A) transmembrane glycoprotein
B) fatty acid from phospholipid
C) glycolipid
D) ATP
E) cholesterol

35) Which of the following is/are found in DNA but not RNA? 35) _____
A) uracil
B) ribose
C) adenine
D) both adenine and thymine
E) both thymine and deoxyribose

36) All of the following are basic components of proteins EXCEPT 36) _____
A) hydrogen.
B) potassium.
C) nitrogen.
D) carbon.
E) oxygen.

37) Which of the following molecule types is NOT a polymer? 37) _____

A) glycogen B) protein C) RNA D) DNA E) fatty acid

38) Which of the following is NOT a base in RNA? 38) _____
A) cytosine B) adenine C) guanine D) uracil E) thymine

39) Which of the following descriptions of a polymer is FALSE? 39) _____
A) ATP is a polymer of phosphates.
B) Glycogen is a polymer of glucose.
C) A protein is a polymer of amino acids.
D) Starch is a polymer of glucose.
E) DNA is a polymer of nucleotides.

40) Which of the following is NOT a function of nucleotides? 40) _____
A) providing most of the energy for cellular processes
B) providing substrates for the citric acid cycle
C) storing the genetic code
D) providing electrons to the electron transport chain
E) expressing the genetic code

41) In eukaryotes, which of the following properties is TRUE for both DNA and RNA? 41) _____
A) follow the law of complementary base pairing
B) contain the bases uracil and thymine
C) double-stranded
D) propagation through semi-conservative replication
E) involved in translation

42) _____ is composed of a nucleotide, where the phosphate is bound to two spots on the ribose sugar. 42) _____
A) ADP B) mRNA C) tRNA D) DNA E) cAMP

43) The presence of _____ in the plasma membrane can inhibit crystallization. 43) _____
A) phospholipids
B) cholesterol
C) peripheral membrane proteins
D) glycoproteins
E) integral membrane proteins

44) Which of the following is NOT found in plasma membranes? 44) _____
A) proteins
B) chromatin
C) phospholipids
D) carbohydrates
E) cholesterol

45) Which of the following components of the plasma membrane forms ion channels? 45) _____
A) transmembrane proteins
B) transmembrane glycolipids
C) cholesterol
D) phospholipids
E) peripheral membrane proteins

46) Which of the following is NOT an integral membrane protein? 46) _____

A) actin
B) occludins
C) carrier proteins for mediated transport
D) connexons
E) channels for ion diffusion across membranes

47) Which of the following is an amphipathic molecule? 47) _____
A) integral membrane protein
B) glycogen
C) triglyceride
D) glucose
E) peripheral membrane protein

48) Which of the following is NOT an amphipathic molecule? 48) _____
A) glycolipid
B) integral membrane protein
C) connexon
D) phospholipid
E) glucose

49) What is the layer of carbohydrates on the external surface of a cell called? 49) _____
A) glycolysis
B) glycocalyx
C) desmosome
D) inclusion
E) glycogen

50) The _____ is the site of ribosomal RNA production. 50) _____
A) lysosome
B) mitochondria
C) nucleolus
D) nucleus
E) cytosol

51) Where is the genetic code stored? 51) _____
A) brain B) cytoplasm C) heart D) nucleus E) vaults

52) Where inside a cell is glycogen stored? 52) _____
A) mitochondria
B) smooth endoplasmic reticulum
C) lysosomes
D) cytosol
E) Golgi apparatus

53) Lipophobic molecules that are to be released by cells are stored in membrane-bound structures called 53) _____
A) excretory vesicles.
B) secretory vesicles.
C) inclusions.
D) the endoplasmic reticulum.
E) the Golgi apparatus.

54) Continuous with the outer portion of the nuclear pore, what membrane-bound structure functions in the synthesis of secretory proteins, integral membrane proteins, or proteins bound for other organelles? 54) _____
A) nucleolus
B) smooth endoplasmic reticulum
C) mitochondria
D) lysosome
E) rough endoplasmic reticulum

55) The _____ is the site where lipids, triglycerides, and steroids are synthesized, as well as where calcium is stored within the cell. 55) _____
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) lysosome
D) mitochondria
E) nucleolus

56) What is the site where steroids are stored in the cell? 56) _____
A) smooth endoplasmic reticulum
B) secretory vesicles
C) lysosome
D) Golgi apparatus
E) Steroids are lipid and will slide right through membranes; they cannot be stored in the cell.

57) What organelle packages and directs proteins to their proper destination? 57) _____
A) smooth endoplasmic reticulum
B) Golgi apparatus
C) rough endoplasmic reticulum
D) lysosomes
E) ribosomes

58) Which of the following is NOT a property of smooth endoplasmic reticulum? 58) _____
A) stores steroid hormones
B) In liver cells, it contains detoxifying enzymes.
C) steroid hormone synthesis
D) forms transport vesicles to move proteins to the Golgi apparatus
E) stores calcium

59) Hydrolytic reactions are when 59) _____
A) the bond between two molecules is broken through the splitting of a water molecule, thereby creating two new bonds with the H and OH of that water in its place.
B) the bond between two molecules is broken, resulting in the removal of a water molecule.
C) two molecules are joined together, resulting in the removal of a water molecule.
D) water is removed from the cell.
E) two molecules are joined together by adding a water molecule.

60) Which of the following descriptions of the function of the organelle is FALSE? 60) _____
A) Packaging of secretory products into vesicles occurs in the Golgi apparatus.
B) Calcium is stored in the smooth endoplasmic reticulum.
C) Oxidative phosphorylation occurs in the mitochondria.
D) Peptide hormone synthesis occurs in the rough endoplasmic reticulum.
E) Breakdown of phagocytosed bacteria occurs in the peroxisomes.

61) Detoxifying enzymes may be localized in what organelle? 61) _____
A) rough endoplasmic reticulum
B) peroxisomes
C) lysosomes
D) mitochondria
E) Golgi apparatus

62) In Tay-Sachs Disease, which organelle contains the impaired enzymes? 62) _____
A) lysosome
B) mitochondria
C) centriole
D) rough endoplasmic reticulum
E) Golgi apparatus

63) What organelle synthesizes most of the ATP used by cells? 63) _____
A) ribosomes
B) mitochondria
C) lysosomes
D) peroxisomes
E) Golgi apparatus

64) _____ are membrane-bound organelles containing enzymes that degrade cellular and extracellular debris. 64) _____
A) Lysosomes
B) Ribosomes
C) Vaults
D) Peroxisomes
E) Mitochondria

65) _____ are membrane-bound organelles that contain enzymes like catalase, which catalyzes the breakdown of H_2O_2 to H_2O and O_2. 65) _____
A) Mitochondria
B) Vaults
C) Peroxisomes
D) Lysosomes
E) Ribosomes

66) Which of the following characteristics concerning ribosomes is FALSE? 66) _____
A) contain ribosomal RNA
B) can be located in the Golgi apparatus
C) are the site of protein synthesis
D) can remain free in the cytosol
E) contain protein

67) Which of the following organelles contains its own DNA? 67) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) rough endoplasmic reticulum
D) Golgi apparatus
E) mitochondria

68) Which of the following is NOT a function of the cytoskeleton? 68) _____
A) suspension of organelles
B) mechanical support
C) contraction
D) cellular catabolism
E) cellular movement

69) Which cytoskeletal proteins provide the structural support for microvilli? 69) _____
A) microtubules
B) tight junctions
C) centrioles
D) microfilaments
E) intermediate filaments

70) Keratin is an example of which type of cytoskeletal protein? 70) _____
A) microtubules
B) centrioles
C) tight junctions
D) microfilaments
E) intermediate filaments

71) Which of the following filaments is found in cilia and flagella? 71) _____
A) microfilaments only
B) intermediate filaments only
C) microtubules only
D) microfilaments and microtubules
E) microfilaments and intermediate filaments

72) Which microtubular proteins are responsible for the distribution of chromosomes during cell division? 72) _____
A) spindle fibers
B) keratin
C) myosin
D) tubulin
E) actin

73) The protein _____ is responsible for generating force as microtubular proteins in cilia slide past one another. 73) _____
A) actin B) myosin C) dynein D) keratin E) tubulin

74) _____ are proteins that fuse adjacent cells together to form a nearly impermeable barrier. 74) _____
A) Occludins B) Tubulins C) Connexins D) Dyneins E) Cadherins

75) _____ are proteins attached to intermediate filaments in regions where cells are exposed to mechanical stresses. 75) _____
A) Dyneins B) Occludins C) Connexins D) Cadherins E) Tubulins

76) _____ are proteins that form channels between cells, allowing ions and small molecules to diffuse directly from one cell to the other. 76) _____
A) Dyneins B) Connexins C) Occludins D) Cadherins E) Tubulins

77) In some cases, signals originating within one cell can diffuse directly to a neighboring cell through

77) _____
A) desmosomes.
B) gap junctions.
C) occludins.
D) tight junctions.
E) cadherins.

78) In the digestive tract, absorption is controlled by mechanisms on the cell's apical membrane surface. What type of physical barriers would be in place to keep these mechanisms from being circumnavigated? 78) _____
A) desmosomes
B) tight junctions
C) microvilli
D) gap junctions
E) carrier proteins

79) Intercellular communication can occur through the binding of a chemical released from one cell to a specific _____ on another cell. 79) _____
A) phagosome
B) clathrin-coated vesicle
C) receptor
D) organelle
E) nucleus

80) Which of the following does NOT describe a part of post-transcriptional processing? 80) _____
A) formation of bonds between a phosphate group and a sugar
B) addition of a poly A tail at the 3' end
C) capping of the 5' end
D) splicing of nucleic acid fragments
E) removal of the introns from the strand

81) The process whereby a complementary mRNA is produced from a DNA template is called 81) _____
A) post-translational modification.
B) transoperon.
C) translation.
D) transcription.
E) transcytosis.

82) During translation, _____ is synthesized in the _____. 82) _____
A) protein : cytoplasm
B) protein : nucleus
C) RNA : cytoplasm
D) DNA : nucleus
E) RNA : nucleus

83) Based upon the triplet nature of a codon and the presence of four possible bases, how many possible amino acids might be coded for by mRNA? 83) _____
A) 32 B) 64 C) 8 D) 128 E) 16

84) The initiator codon is composed of the sequence 84) _____
A) CCC. B) CCG. C) AAC. D) UUG. E) AUG.

85) The initiator codon, that originates translation, codes for the amino acid 85) _____
A) tyrosine.
B) leucine.
C) arginine.
D) methionine.
E) proline.

86) What strand of mRNA would be transcribed from the following strand of DNA: 5'AATG? 86) _____
A) 5'GGUA B) 3'UUAC C) 3'TTAC D) 5'UUGT E) 5'TTUC

87) Which of the following statements about the genetic code is TRUE? 87) _____
A) The promoter sequence is found on the antisense strand of DNA.
B) A single codon may code for more than one amino acid.
C) The tRNA anticodon is complementary to the mRNA codon, and therefore is identical to the gene's DNA triplet.
D) A single gene contains only those nucleotides that code for a single protein.
E) Termination codons do not code for amino acids.

88) The strand of DNA that gets transcribed to mRNA is called the 88) _____
A) promoter sequence.
B) intron strand.
C) exon strand.
D) template strand.
E) ribophorin.

89) According to the law of complementary base pairing, which of the following would be expected in any strand of DNA? 89) _____
A) A + G = C + T
B) G + C = T + A
C) A = C and T = G
D) A = G and C = T
E) A = G

90) During transcription, 90) _____
A) RNA is synthesized from DNA in the cytoplasm.
B) RNA is synthesized from DNA in the nucleus.
C) DNA is synthesized from DNA in the nucleus.
D) protein is synthesized from RNA in the cytoplasm.
E) protein is synthesized from RNA in the nucleus.

91) What is the portion of DNA that codes for a particular protein? 91) _____
A) gene
B) promoter sequence
C) triplet
D) codon
E) nucleotide

92) If guanine makes up 29% of the nucleotides in a sample of DNA, what percentage of the sample would be adenine? 92) _____
A) 42 B) 29 C) 35 D) 21 E) 11

93) What causes DNA to uncoil during transcription? 93) _____

A) binding of DNA polymerase to the leader sequence
B) binding of ubiquitin to the DNA
C) binding of RNA polymerase to the promoter sequence
D) binding of helicase to the DNA
E) binding of tRNA to the initiator codon

94) An anticodon is 94) _____
A) the code for a particular amino acid.
B) the complement to the complement of the gene.
C) the strand of DNA used to create mRNA.
D) a three-nucleotide series on tRNA that is complementary to the mRNA to which it binds.
E) the stop signal that does not code for an amino acid.

95) Which of the following statements about the genetic code is FALSE? 95) _____
A) mRNA is read 3 bases at a time and these units are called codons.
B) There are 3 termination codons that do not code for amino acids.
C) Each codon is specific for only one amino acid.
D) Each amino acid is coded for by only one codon.
E) There is one initiator codon and it codes for an amino acid.

96) Where does RNA polymerase bind to initiate transcription? 96) _____
A) leader sequence
B) hormone response element
C) initiation factor
D) promoter sequence
E) P subunit of the ribosome

97) The codon is 97) _____
A) DNA language coding for a particular amino acid.
B) the triplet of nucleotides found in a gene's sequence.
C) mRNA language coding for a particular amino acid.
D) the portion of mRNA that is retained after processing.
E) the genetic code.

98) The promoter sequence of the gene is recognized by _____, which initiates transcription. 98) _____
A) ligase
B) helicase
C) gyrase
D) RNA polymerase
E) DNA polymerase

99) What is the base sequence of the tRNA molecule that recognizes the complementary mRNA molecule? 99) _____
A) codon
B) sense
C) initiator codon
D) anticodon
E) nonsense

100) What is the correct order for the following list of steps for initiating translation?
1. Binding of initiator tRNA to mRNA
2. Binding of large ribosomal subunit to mRNA
3. g of
B small
indin riboso

mal subunit to mRNA
4. Binding of a 2nd tRNA with its amino acid to the A site
5. Formation of covalent bond between methionine and second amino acid

100) ____

A) 3, 1, 2, 4, 5 B) 3, 2, 1, 4, 5 C) 2, 3, 1, 4, 5 D) 1, 2, 3, 4, 5 E) 1, 3, 2, 4, 5

101) What happens at the P site of a ribosome? 101) _____
A) It holds the tRNA with the most recent amino acid that has been added to the polypeptide chain.
B) It causes the ribosome to attach to the endoplasmic reticulum.
C) It has the binding site for mRNA.
D) It contains the enzyme that catalyzes formation of a peptide bond.
E) It holds the tRNA with the next amino acid to be added to the polypeptide chain.

102) Post-transcriptional processing adds a(n) _____ to the 5' end of the mRNA molecule. 102) _____
A) exon B) intron C) cap D) poly C tail E) poly A tail

103) Post-transcriptional processing adds a(n) _____ to the 3' end of the mRNA molecule. 103) _____
A) poly A tail B) cap C) exon D) poly C tail E) intron

104) Which of the following is NOT a function of the initiation factors associated with translation of protein from mRNA? 104) _____
A) They form a complex with charged tRNA.
B) They bind to the cap group at the 5' end.
C) They form a complex with small ribosomal subunits.
D) They align the first tRNA with the A site on a ribosome.
E) They trigger binding of the small ribosomal subunit to AUG.

105) The leader sequence of any protein that has just been translated functions to 105) _____
A) initiate degradation of an incomplete protein.
B) determine the destination of the protein.
C) stimulate translation of a protein.

D) keep the protein in the cytosol.
E) end translation of a protein.

106) Which of the following processes is NOT a post-translational modification that occurs in the endoplasmic reticulum or Golgi apparatus to make proteins functional? 106) _____
A) the addition of carbohydrates
B) the removal of the leader sequence
C) the addition of lipids
D) the cleavage of excess amino acids
E) the addition of more amino acids

107) What is the outcome of having only the head of the sperm entering the oocyte? 107) _____
A) Paternal lineage is more easily traced.
B) Genetic abnormalities are reduced by one-half.
C) Flagella is free to move the fertilized egg to the uterus.
D) Mitochondrial DNA is only of maternal inheritance.
E) Genealogy lines become less conclusive.

108) Which of the following is NOT a possible destination for proteins that are completely synthesized on ribosomes free in the cytosol? 108) _____
A) peroxisome
B) nucleus
C) remains in cytosol
D) secreted from the cell
E) mitochondrion

109) When proteins are synthesized by ribosomes on the rough endoplasmic reticulum, where does the translation begin? 109) _____
A) cytosol
B) nucleus
C) rough endoplasmic reticulum
D) smooth endoplasmic reticulum
E) Golgi apparatus

110) Which of the following are NOT embedded in the lipid bilayer at all? 110) _____
A) transmembrane proteins
B) connexons
C) cadherins
D) peripheral proteins
E) integral proteins

111) Where is the leader sequence of preproinsulin removed? 111) _____
A) surface of rough endoplasmic reticulum
B) lumen of rough endoplasmic reticulum
C) at the proteasome
D) secretory vesicles of the Golgi apparatus
E) cis face of the Golgi apparatus

112) Ubiquitin tags proteins for what purpose? 112) _____
A) for the protein to be secreted by exocytosis
B) for the protein to enter the nucleus and alter transcription
C) to protect from degradation by proteasomes

D) for synthesis to continue on the rough endoplasmic reticulum
E) to mark for degradation by proteasomes

113) What enzyme catalyzes the reaction whereby nucleotides are added to the polynucleotide chain during replication? 113) _____
A) RNA polymerase
B) histone
C) DNA polymerase
D) helicase
E) chromatin

114) Aspirin and ibuprofen both block the enzyme cyclooxygenase from changing arachidonic acid, found in the phospholipid bilayer, into what? 114) _____
A) bile salts
B) prostaglandins
C) surfactant
D) leukotrienes
E) sterols

115) During replication, which strand of the new DNA is synthesized from the 5' to 3' strand of original DNA? 115) _____
A) beginning strand
B) trailing strand
C) ending strand
D) lagging strand
E) leading strand

116) Okazaki fragments are 116) _____
A) protein fragments released from a proteasome.
B) small sections of nonsense code found between genes.
C) small sections of newly formed DNA, built on the lagging (5' to 3') template strand.
D) small sections of DNA that do not code for protein found within a gene.
E) sections of newly formed DNA, built on the leading (3' to 5') template strand.

117) During what phase of the cell cycle is the cell carrying out its normal activity and NOT involved directly in cell division? 117) _____
A) G_0 B) G_1 C) G_2 D) S E) mitosis

118) During what phase of the cell cycle does cellular replication of DNA occur? 118) _____
A) G_0 B) G_1 C) G_2 D) S E) mitosis

119) During what phase of the cell cycle does rapid protein synthesis occur as the cell grows to double its size? 119) _____
A) G_0 B) G_1 C) G_2 D) S E) mitosis

120) Which of the following is NOT a phase of mitosis? 120) _____
A) prophase
B) metaphase
C) anaphase
D) meiosis
E) telophase

121) During what phase of cell division do chromosomes align along the midline? 121) _____
A) interphase
B) anaphase
C) metaphase
D) prophase
E) telophase

122) During what phase of cell division do two new nuclear envelopes begin to redevelop? 122) _____
A) interphase
B) telophase
C) prophase
D) anaphase
E) metaphase

123) What links sister chromatids together? 123) _____
A) histones
B) dyneins
C) chromatins
D) actins
E) centromeres

124) What is the correct level of structure for proteins containing more than one polypeptide chain? 124) _____
A) primary
B) secondary
C) tertiary
D) quaternary
E) quinary

125) What is the level of structure that corresponds to the sequence and number of amino acids in the polypeptide chain? 125) _____
A) primary
B) secondary
C) tertiary
D) quaternary
E) quinary

126) What is the level of structure that corresponds to the chemical interactions between R groups within the same polypeptide chain? 126) _____
A) primary
B) secondary
C) tertiary
D) quaternary
E) quinary

127) What level of structure is caused when the hydrogen bonds between the amino hydrogen of one amino acid and the carboxyl oxygen of another amino acid is formed? 127) _____
A) primary
B) secondary
C) tertiary
D) quaternary
E) quinary

128) The junctions created by intermediate filaments which penetrate the membranes between two cells at the site of protein plaques, thereby forming strong linkage between the two cells, are also known as 128) _____
A) basal lamina.
B) hemidesmosomes.
C) gap junctions.
D) tight junctions.
E) desmosomes.

129) What junctions are found in epithelial tissue where they prevent paracellular movement of molecules? 129) _____
A) tight junctions
B) hemidesmosomes
C) gap junctions
D) basal lamina
E) desmosomes

130) What junctions allow the passage of small molecules and ions from the cytosol of one cell to that of a neighboring cell? 130) _____
A) gap junctions
B) desmosomes
C) basal lamina
D) tight junctions
E) hemidesmosomes

131) Which of the following packages proteins into secretory vesicles? 131) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) mitochondria
D) Golgi apparatus
E) peroxisomes

132) Which of the following packages proteins into transport vesicles? 132) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) mitochondria
D) Golgi apparatus
E) peroxisomes

133) The enzyme catalase is located where? 133) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) mitochondria
D) Golgi apparatus
E) peroxisomes

134) Endocytotic vesicles fuse with what organelle? 134) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) mitochondria
D) Golgi apparatus
E) peroxisomes

135) The bulk of ATP production is performed where? 135) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) mitochondria
D) Golgi apparatus
E) peroxisomes

136) Lipids synthesis is performed where? 136) _____
A) smooth endoplasmic reticulum
B) lysosomes
C) mitochondria
D) Golgi apparatus
E) peroxisomes

137) Which cellular protein is found in gap junctions? 137) _____
A) tubulin B) cadherins C) dynein D) connexons E) occludins

138) Which cellular protein is found in tight junctions? 138) _____
A) dynein B) tubulin C) occludins D) connexons E) cadherins

139) Which cellular protein is found in desmosomes? 139) _____
A) tubulin B) occludins C) dynein D) connexons E) cadherins

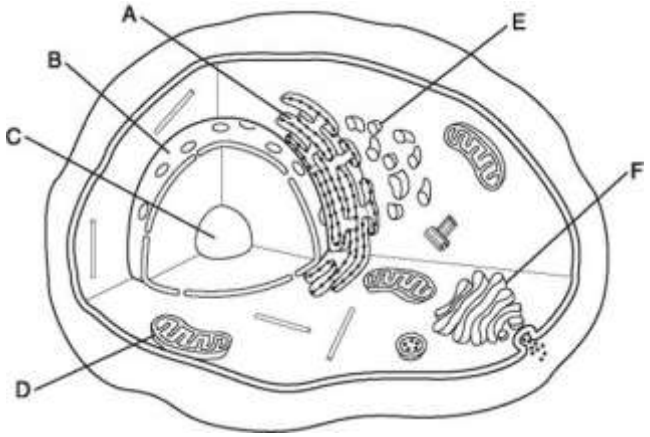

Figure 2.4

140) Identify the organelle referred to as "A" in Figure 2.4 and select the function of that organelle. 140) _____
A) smooth endoplasmic reticulum—site of lipid synthesis and storage of calcium
B) rough endoplasmic reticulum—synthesis of proteins to be packaged into vesicles
C) nucleus—contains the cell's DNA
D) mitochondria—production of cellular energy in the form of ATP
E) nucleolus—site within the nucleus for the synthesis of rRNA

141) Identify the organelle referred to as "B" in Figure 2.4 and select the function of that organelle. 141) _____
A) mitochondria—production of cellular energy in the form of ATP
B) nucleolus—site within the nucleus for the synthesis of rRNA
C) smooth endoplasmic reticulum—site of lipid synthesis and storage of calcium
D) nucleus—contains the cell's DNA

E) rough endoplasmic reticulum—synthesis of proteins to be packaged into vesicles

142) Identify the organelle referred to as "C" in Figure 2.4 and select the function of that organelle. 142) _____
A) rough endoplasmic reticulum—synthesis of proteins to be packaged into vesicles
B) nucleus—contains the cell's DNA
C) mitochondria—production of cellular energy in the form of ATP
D) nucleolus—site within the nucleus for the synthesis of rRNA
E) smooth endoplasmic reticulum—site of lipid synthesis and storage of calcium

143) Identify the organelle referred to as "D" in Figure 2.4 and select the function of that organelle. 143) _____
A) mitochondria—production of cellular energy in the form of ATP
B) smooth endoplasmic reticulum—site of lipid synthesis and storage of calcium
C) nucleolus—site within the nucleus for the synthesis of rRNA
D) rough endoplasmic reticulum—synthesis of proteins to be packaged into vesicles
E) nucleus—contains the cell's DNA

144) Identify the organelle referred to as "E" in Figure 2.4 and select the function of that organelle. 144) _____
A) nucleolus—site within the nucleus for the synthesis of rRNA
B) nucleus—contains the cell's DNA
C) smooth endoplasmic reticulum—site of lipid synthesis and storage of calcium
D) mitochondria—production of cellular energy in the form of ATP
E) rough endoplasmic reticulum—synthesis of proteins to be packaged into vesicles

145) Identify the organelle referred to as "F" in Figure 2.4 and select the function of that organelle. 145) _____
A) rough endoplasmic reticulum—synthesis of proteins to be packaged into vesicles
B) mitochondria—production of cellular energy in the form of ATP
C) nucleus—contains the cell's DNA
D) nucleolus—site within the nucleus for the synthesis of rRNA
E) Golgi apparatus—processes and packages peptides, directs them to their ultimate location

146) What is a glycerol with 3 fatty acids attached? 146) _____
A) saturated fat
B) eicosanoid
C) glycerolipid
D) triglyceride
E) phospholipid

147) What is the extensively branched polymer of hexose found in animals? 147) _____
A) lactose B) rRNA C) glycogen D) starch E) glucose

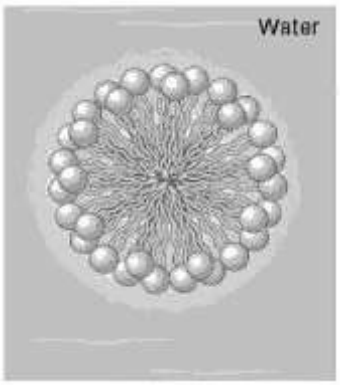

Figure 2.5

148) In Figure 2.5, what is this structure and what type of molecule makes up its composition? 148) _____
A) micelle, composed of phospholipids.
B) desmosome, composed of cadherins
C) cilia, composed of microtubules and dynein
D) sperm, composed of haploid DNA and microtubules
E) peroxisome, composed of peroxidase enzymes and fatty acids

149) What two structural characteristics of proteins are formed by hydrogen bonds between the carboxyl O and the amino H of amino acids within the same protein? 149) _____
A) flexibility : shear resistance
B) strength : resilience
C) double helix : folded sheets
D) α-helices : β-pleated sheets
E) fibrous : globular

150) What spherical structures are involved in the transport of nonpolar molecules through the aqueous environment and are composed of a phospholipid monolayer? 150) _____
A) peroxisomes
B) micelles
C) vacuoles
D) proteasomes
E) lysosomes

151) What are the three components of a nucleotide? 151) _____
A) deoxyribonucleic acid, base pairs, phosphate/sugar backbone
B) pentose, nitrogenous base, phosphorus
C) pentose sugar, 5-carbon carbohydrate, phosphate
D) 5-carbon carbohydrate, phosphate, nitrogenous base
E) ribonucleic acid, base pairs, phosphate backbone

152) Of the five bases found in nucleic acids, which are purines and which are pyrimidines? 152) _____
A) Pyrimidines = thymine and uracil : Purines = cytosine, adenine and guanosine
B) Pyrimidines = adenine and guanosine: Purines = cytosine, thymine, and uracil
C) Pyrimidines = cytosine and uracil : Purines = adenine, thymine and guanosine
D) Pyrimidines = cytosine, adenine and guanosine: Purines = thymine, and uracil
E) Pyrimidines = cytosine, thymine and uracil : Purines = adenine and guanosine

153) What type of integral membrane protein spans the membrane, thereby allowing part of it to face the cytosol and another part to face the extracellular fluid? 153) _____
A) peripheral membrane protein
B) transmembrane protein
C) paramembrane protein
D) steroid receptor
E) glycoprotein

154) What structure separates the nucleus from the cytosol? 154) _____
A) nuclear envelope
B) nucleolus
C) matrix
D) plasma membrane

E) nuclear pore

155) Through what structure in the nucleus can mRNA pass through to get into the cytosol? 155) _____
A) matrix
B) nuclear pore
C) nucleolus
D) plasma membrane
E) nuclear envelope

156) What are masses of glycogen in the cytosol of some cells called? 156) _____
A) Lewy bodies
B) Heinz bodies
C) inclusions
D) stipplings
E) granules

157) The membrane of the rough endoplasmic reticulum is continuous with what other membrane(s)? 157) _____
A) matrix
B) plasma membrane
C) smooth endoplasmic reticulum and nuclear envelope
D) Golgi apparatus
E) nucleolus and nuclear pore

158) What is the innermost chamber of a mitochondrion called? 158) _____
A) matrix
B) nucleolus
C) nuclear envelope
D) nuclear pore
E) plasma membrane

159) Components of the electron transport chain are found in what region of a mitochondrion? 159) _____
A) matrix
B) intermembrane space
C) inner mitochondrial membrane
D) outer membrane
E) cristae

160) What organelle contains alcohol dehydrogenase, used in the liver to metabolize alcohol? 160) _____
A) lysosomes
B) desmosomes
C) peroxisomes
D) proteasomes
E) liposomes

161) What two types of molecules make up ribosomes? 161) _____
A) proteins and phospholipids
B) rRNA and proteins
C) rRNA and tRNA
D) mRNA and tRNA
E) phospholipids and RNA

162) Myosin is composed of what type of molecule? 162) _____

A) globular protein
B) microtubule
C) microfilament
D) integral protein
E) intermediate filament

163) Certain epithelial cells have a decided polarity where the _____ membrane faces the lumen of a hollow tube, whereas the _____ membrane faces the extracellular fluid. 163) _____
A) upper : lower
B) luminal : extracellular
C) positively charged : negatively charged
D) apical : basolateral
E) apical : basement

164) The CAP region of mRNA is necessary for _____ of translation. 164) _____
A) propagation
B) termination
C) initiation
D) accuracy
E) transcription

165) What are the tRNA binding sites on the ribosome called? 165) _____
A) A and P sites
B) T and R sites
C) translation sites
D) proteogenic sites
E) nucleotide complement sites

166) What modifications made to mRNA function to prevent its degradation in the cytoplasm by exonucleases? 166) _____
A) CAP and poly A tail
B) promoter regions
C) introns
D) exons
E) protein coat

167) Proteins tagged with the polypeptide _____ are targeted for degradation by a protein complex called a proteasome. 167) _____
A) apoptosin B) amyloid C) degratin D) cachectin E) ubiquitin

168) Within the nucleus, chromosomes are coiled around which proteins? 168) _____
A) histones
B) introns
C) chromatids
D) histamines
E) proteasomes

169) What is the proper order of the five phases of mitosis? 169) _____
A) prophase, interphase, metaphase, anaphase, telophase
B) interphase, prophase, prometaphase, metaphase, telophase
C) prophase, metaphase, anaphase, protelophase, telophase
D) prophase, prometaphase, metaphase, anaphase, telophase

E) prophase, prometaphase, anaphase, metaphase, telophase

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

170) Sucrose is a disaccharide composed of a glucose and a lactose molecule. 170) _____

171) Disulfide bridges contribute to the tertiary structure of proteins by covalent bonds between the sulfhydryl groups on two cysteine amino acids. 171) _____

172) Cholesterol is the precursor molecule for all steroids in the body. 172) _____

173) Glycoproteins have a glycogen molecule covalently bound to a protein. 173) _____

174) Cyclic nucleotides form ring structures due to the covalent bonding between an oxygen of the phosphate group and a carbon of the carbohydrate. 174) _____

175) Thymine is a pyrimidine. 175) _____

176) Guanine and cytosine are held together by two hydrogen bonds. 176) _____

177) Inclusions are intracellular stores of glycogen or triglycerides. 177) _____

178) The innermost compartment of a mitochondrion is called the matrix. 178) _____

179) Vaults direct the development of the mitotic spindle during cell division. 179) _____

180) The cytoskeleton suspends the organelles within the cytoplasm. 180) _____

181) Movement between cells in an epithelium is called transepithelial transport. 181) _____

182) Anabolism describes the breakdown of large molecules to smaller molecules. 182) _____

183) Every adenine nucleotide of DNA will be transcribed into a thymine on the mRNA. 183) _____

184) The exon is cut from the original mRNA sequence, leaving the intron as the portion of mRNA that leaves the nucleus to be translated into a protein. 184) _____

185) The mRNA codon UUU codes for the amino acid phenylalanine. Therefore, no other codon can code for phenylalanine. 185) _____

186) Each strand of mRNA is translated by one ribosome at a time. 186) _____

187) The Golgi apparatus sorts and packages proteins into vesicles targeted for their final destination. 187) _____

188) The anticodon is complementary to the triplet coding for a particular amino acid. 188) _____

189) The hormone insulin is a peptide hormone consisting of two polypeptides held together by disulfide bridges. 189) _____

190) The semiconservative nature of the replication of DNA means that a new strand is coupled to an old strand. 190) _____

191) When insulin is first translated by ribosomes, the initial inactive polypeptide that is formed is called preinsulin. 191) _____

192) Bonding between Okazaki fragments forms the lagging strand of DNA. 192) _____

193) Helicase catalyzes the unwinding of DNA during transcription. 193) _____

194) Proteases break peptide bonds. 194) _____

195) Microtubules are dynamic structures in that they may form and disassemble repeatedly in a cell. 195) _____

196) The mitotic spindle forms from the centrosome during cell division. 196) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

197) Carbohydrates and lipids are important biomolecules that store energy for the body to use later. Describe the structures and properties of carbohydrates and lipids, including the different forms of these biomolecules that are present within the body.

198) Define and describe the structure of proteins, including the forces that determine the three-dimensional structure of these molecules.

199) Describe the structure and function of nucleotides and nucleic acids.

200) The membrane of a cell is an important structure that isolates the cell's cytosol from the external environment. The components of membranes are important determinants of their function. What are the components of a membrane and how do those components function?

201) List the membranous organelles that are present within the cell and describe their function.

202) All of the organelles present within a cell are not bound by membranes. Describe the non-membrane-bound organelles that are found in cells.

203) Describe the three types of proteins that comprise the cytoskeleton.

204) In order for tissues to maintain their structure and function, there must be some way for cells to adhere to their neighbors. Describe the adhesion proteins that function in coupling one cell to the next.

205) Describe the process of gene transcription, including how that process is regulated.

206) In general, describe the process whereby mRNA that has exited the nucleus is used to synthesize a functional protein.

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

52) D
53) B
54) E
55) A
56) E
57) B
58) A
59) E
60) E
61) B
62) A
63) B
64) A
65) C
66) B
67) E
68) D
69) D
70) E
71) C
72) A
73) C
74) A
75) D
76) B
77) B
78) B
79) C
80) A
81) D
82) A
83) B
84) E
85) D
86) B
87) E
88) D
89) A
90) B
91) A
92) D
93) C
94) D
95) D
96) D
97) C
98) D
99) D
100) A
101) A
102) C
103) A

104) D
105) B
106) E
107) D
108) D
109) A
110) D
111) B
112) E
113) C
114) B
115) D
116) C
117) A
118) D
119) C
120) D
121) C
122) B
123) E
124) D
125) A
126) C
127) B
128) E
129) A
130) A
131) D
132) A
133) E
134) B
135) C
136) C
137) D
138) C
139) E
140) B
141) D
142) D
143) A
144) C
145) E
146) D
147) C
148) A
149) D
150) B
151) D
152) E
153) B
154) A
155) B

156) C
157) C
158) A
159) C
160) C
161) B
162) E
163) D
164) C
165) A
166) A
167) E
168) A
169) D
170) FALSE
171) TRUE
172) TRUE
173) FALSE
174) FALSE
175) TRUE
176) FALSE
177) TRUE
178) TRUE
179) FALSE
180) TRUE
181) FALSE
182) FALSE
183) FALSE
184) FALSE
185) FALSE
186) FALSE
187) TRUE
188) TRUE
189) TRUE
190) TRUE
191) FALSE
192) TRUE
193) TRUE
194) TRUE
195) TRUE
196) FALSE
197) Carbohydrates have the general structure of $C_nH_{2n}O_n$. They are polar molecules that readily dissolve in water. They are described based on their size as mono-, di-, and polysaccharides. Monosaccharides are simple sugars composed of six carbons, including glucose, fructose, and galactose, or five carbons, as with ribose and deoxyribose. Disaccharides are combinations of simple sugars covalently bound together, as with sucrose (glucose and fructose) and lactose (glucose and galactose). Polysaccharides are formed by many simple sugars bound together covalently, including glycogen and starch.
Lipids are a diverse group of molecules primarily containing carbons and hydrogens bound by nonpolar covalent bonds. Some contain oxygen, while others contain phosphate groups that polarize the molecule. Triglycerides are a form of lipid typically referred to as a fat composed of one glycerol with three fatty acids bound to it. Fatty acids are long carbon chain molecules with a carboxyl group at the end. Saturated fatty acids have no double bonds between the carbons, whereas unsaturated fatty acids have at least one (monounsaturated) or more (polyunsaturated)

double bonds between carbons on the fatty acid. Triglycerides and fatty acids are both nonpolar and do not readily dissolve in water. Phospholipids are similar to triglycerides except one of the fatty acids attached to glycerol is replaced with a phosphate group. Therefore, the molecule is amphipathic with a polar (phosphate) and nonpolar (fatty acids) region. Eicosanoids are fatty acid derivatives that function in cellular communication. Finally, steroids are produced from the precursor cholesterol and act as hormones to communicate between cells.

198) Proteins are chains of amino acids bound by peptide bonds formed by the condensation reaction of the amine group on one amino acid with the carboxyl group on the other amino acid. The difference between peptides and proteins is the number of amino acids; peptides are composed of fewer than 50 amino acids, whereas proteins have more than 50. Once formed, there are many chemical interactions involved in the creation of this three-dimensional structure that can be described at different levels. Primary structure refers to the sequence of amino acids that comprise a particular peptide or protein. Secondary structure involves the folding of that primary structure, produced by hydrogen bonds between amine groups with the oxygen on the carboxyl group of another amino acid. This forms proteins into α-helices and β-pleated sheets. Tertiary structure is formed by the interaction between residual groups (R groups) on particular amino acids. Hydrogen bonds can form between polar R groups. Ionic bonds can form between ionized or charged R groups. Van der Waals forces are a temporary intermolecular electrical attraction between the warped electron field of one molecule being slightly more negative, with the warped electron field of another molecule being slightly more positive, whereas covalent bonds can form disulfide bridges between sulfhydryl groups on cysteine residues. Quaternary structure exists only in proteins with more than one polypeptide chain, like hemoglobin, which contains four separate polypeptide chains.

199) Nucleotides are composed of one or more phosphate groups, a five-carbon sugar (ribose or deoxyribose), and a nitrogenous base. The nitrogenous bases in nucleotides can be from one of two classes: purines (a double carbon-nitrogen ring for adenine and guanine) or pyrimidines (a single carbon-nitrogen ring for cytosine, thymine, and uracil). Nucleotides can function in the exchange of cellular energy in molecules like adenosine triphosphate (ATP), nicotinamide adenine dinucleotide (NAD^+) and flavin adenine dinucleotide (FAD). Cyclic nucleotides function as intracellular second messengers, like cyclic guanosine monophosphate (cGMP) and cyclic adenine monophosphate (cAMP). Nucleotide polymers function in the storage of genetic information, like deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). The polymeric strands of DNA and RNA are identified by the 3' and 5' end, with the 3' being the carboxyl end (from the carbohydrate) and the 5' end containing the phosphate group. The Law of Complementary Base Pairing ensures that double-stranded DNA will have matching information on both strands. Cytosine is always paired with guanine, whereas adenine is always paired with thymine. In RNA, the thymine is replaced with uracil. DNA stores the genetic code whereas RNA is necessary for expression of the code.

200) Cell membranes are composed of phospholipids, cholesterol, integral proteins, peripheral proteins, and carbohydrates. Phospholipids are the major constituent of membranes. They are amphipathic molecules with polar (hydrophilic) and nonpolar (hydrophobic) regions. The phospholipids form a bilayer with the hydrophilic region exposed to the outside and inside of the cell, and the nonpolar region associated with itself within the core of the phospholipid bilayer. As a consequence, the membrane is a fluid structure with no strong bonds between its components. Cholesterol can also be present within the membrane, which acts to interfere with hydrophobic interactions lining up the molecules within the membrane, thereby decreasing viscosity and increasing membrane fluidity. Integral membrane proteins are intimately associated with the membrane and cannot be easily removed. Many are transmembrane proteins whose amino acid chain passes through the lipid bilayer multiple times. These transmembrane proteins can function as ion channels and transporters to move ions across the membrane. Other integral membrane proteins are located on the cytosolic or interstitial side of the membrane. Peripheral membrane proteins are more loosely associated with the membranes and, therefore, can be easily removed. Most are located on the cytosolic side of the membrane and can be associated with the cytoskeleton. Carbohydrates are often located on the extracellular side of the membrane and can act as a protective layer (glycocalyx) or be involved in cell recognition.

201) The endoplasmic reticulum is composed of two structures that are smooth and rough in character. The rough portion contains ribosomes that are involved in the translation of proteins. Those proteins can be secreted from the cell (hormones), incorporated into the cell membrane (receptors and ion channels), or incorporated into lysosomes. The smooth portion of the endoplasmic reticulum is the site of lipid synthesis and the storage of calcium. The Golgi apparatus is closely associated with the endoplasmic reticulum, processing molecules that were synthesized in the endoplasmic reticulum and packaging them into vesicles for delivery to their site of action. Mitochondria are

structures that contain an inner and outer membrane. The innermost compartment contains the enzymes of the Krebs cycle. The inner membrane contains the components of the electron transport chain. The lysosome is a membrane-bound vesicle that contains lytic enzymes, which can degrade debris (intra or extracellular). Old organelles can be degraded in this manner. Peroxisomes are vesicles, usually smaller than lysosomes, which contain enzymes that degrade amino acids, alcohols and fatty acids. A byproduct of this degradation is hydrogen peroxide, which is toxic to cells. However, they also contain catalase, an enzyme that degrades hydrogen peroxide.

202) Ribosomes are dense granules composed of rRNA and protein, some of which are associated with the rough endoplasmic reticulum. These structures play an important role in protein synthesis. The ribosomes that are free within the cytosol synthesize proteins that remain in the cytosol, or can enter the mitochondria, the nucleus, or the peroxisome. Proteins synthesized within the rough endoplasmic reticulum will cross the membrane (be secreted) or become associated with membranes, such as a plasma membrane or an organelle. The other non-membranous structures of the cell are vaults. These recently discovered organelles are barrel-shaped and three times larger than ribosomes, but their function is not yet clearly understood. They may be involved in the transport of molecules between the nucleus and cytoplasm. They have received considerable attention of late for their role in the development of resistance to chemotherapies.

203) Microfilaments are the smallest of the cytoskeletal proteins. The functions of microfilaments, such as actin, include contraction, amoeboid-like movement of cells, and separation of the cytoplasm during cell division. Other microfilaments provide the structural support for the microvilli of cells within the small intestines and hair cells of the cochlea. Intermediate filaments tend to be stronger and more stable than microfilaments, and include proteins like keratin (located in the skin) and myosin. The largest of the cytoskeletal proteins are microtubules, which are composed of proteins called tubulin. Microtubules form the spindle fibers that are involved in the distribution of chromosomes during cell division. Microtubules are also the primary component of cilia and flagella—hair-like protrusions involved in motility. Cilia are composed of ten pairs of microtubules in a nine pair surrounding one pair configuration, connected by the protein dynein that generates the force necessary to cause the microtubules to slide past one another, thereby moving the cilia. Flagella are similar in structure, except they are longer than cilia.

204) Tight junctions are composed of integral membrane proteins called occludins that fuse neighboring cells, creating an impermeable barrier. Because of this barrier, most polar solutes must pass through the cell itself by transepithelial transport, rather than by moving between cells (paracellular transport). These tight junctions are commonly found between epithelial cells that line hollow organs in order to maintain separation between fluid compartments. The extent to which fluid compartments are separated is determined by the expression of occludin proteins. Desmosomes are strong filamentous junctions that provide the structural support for cell attachment. Proteins called cadherins are involved in creating these connections between cells. Gap junctions are protein channels formed by connexin proteins. Gap junctions allow for communication between neighboring cells. Molecules, some relatively large (cAMP), can diffuse from one cell to the next when these channels are open.

205) The section of DNA that contains a gene is identified by the promoter that is upstream from the gene. There is a specific promoter sequence that is recognized by an RNA polymerase causing that enzyme to bind and uncoil the DNA. Free nucleotides align with the sense strand of DNA based upon the Law of Complementary Base Pairing. The RNA polymerase will catalyze the formation of bonds between the free nucleotides, thereby forming a single-stranded mRNA. As it is being synthesized, segments of the mRNA called introns are spliced from the mRNA strand until all that is left are the exons, which are joined together. A cap is added to the 5' end, which is necessary for the initiation of translation. At the same time, many adenine molecules (the poly A tail) are added to the other end (the 3' region) of the mRNA molecule, which along with the CAP, serves to protect the mRNA from degradation once it is in the cytosol. The regulation of mRNA concentration in the cytosol can occur through a number of mechanisms. The mRNA can be bound to a protein, thereby inactivating that mRNA. In addition, both stability and synthesis rates of mRNA are an important determinant of the amount of mRNA coding for a particular protein that is present. This process of transcription can be regulated by DNA binding proteins, whose binding to the promoter region of the gene can either enhance or inhibit binding of the RNA polymerase to the gene, thereby altering expression of the gene.

206) mRNA is read in triplets, from the initiator codon (AUG), which codes for the amino acid methionine, to a termination codon. Translation is started by initiation factors that bind to the cap group on the mRNA, while other factors form a complex with small ribosomal subunits and a charged tRNA (containing an amino acid). The tRNA with an anticodon will bind to the codon on the mRNA by the Law of Complementary Base Pairs. The large

ribosomal subunit then binds, causing initiation factors to dissociate, thereby aligning the first tRNA with the P site of the ribosome. A second charged tRNA with the appropriate anticodon will attach itself to the A site on the ribosome. An enzyme within the ribosome then catalyzes the formation of a peptide bond between amino acids, and the first tRNA will be released from the amino acid. The ribosome will then move three bases down to the next codon. As the first tRNA leaves the P site, the second tRNA will move from the A to the P site. Then, a new charged tRNA will bind to the A site; the tRNA with the anticodon that matches the mRNA. This process will continue until the termination codon is reached. The leader sequence will determine whether the protein will remain in the cytosol or attach to the endoplasmic reticulum. Post-translational modification is required in order to make the protein functional, and this process can occur anywhere from the rough endoplasmic reticulum to the Golgi apparatus. The leader sequence must first be cleaved as well as any other excess amino acids that are present on the protein. Thereafter, other molecules can be added to proteins, like carbohydrates (glycoprotein), or lipids (lipoproteins), in order to make the protein functional.