

Becker's The World of the Cell, 9e (Hardin/Bertoni/Kleinsmith)
Chapter 3 The Macromolecules of the Cell

3.1 Multiple-Choice Questions

- 1) What are the three general types of amino acids?
- A) α helices, β sheets, and looped segments
 - B) covalent, noncovalent, and van der Waals forces
 - C) positive, negative, and noncharged
 - D) hydrophobic, polar (noncharged), polar (charged)
 - E) acidic, basic, and neutral

Answer: D

Chapter Section: 3.1

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

- 2) You are researching a cytoplasmic protein associated with a nerve disorder. The native form of the enzyme appears to be globular protein; however, when a sample of the purified protein is treated with a chemical that reduces disulfide bonds, the enzymatic activity decreases dramatically and multiple globular proteins can be detected in the sample. What does this tell you about the protein?

- A) The primary structure of the protein contains multiple cysteine residues that are hydrolyzed by the chemical reductant.
- B) The protein is most likely composed of multiple polypeptide chains that are held together by disulfide bonds.
- C) The protein is most likely composed of α helices that are held together by disulfide bonds.
- D) The protein is most likely composed of β sheets that are held together by disulfide bonds.
- E) The primary and secondary structure of the protein depends on disulfide bonds.

Answer: B

Chapter Section: 3.1

Bloom's Taxonomy: Evaluation

Learning Outcome: 3.1

Global LO: G2, G5, G7

3) A peptide bond

A) is a covalent bond between the carboxyl carbon of one amino acid and the amino nitrogen of a second amino acid.

B) is a covalent bond between the functional R groups of adjacent amino acids.

C) is a covalent bond between the NH group of one polypeptide and the CO group of an adjacent polypeptide that holds together multimeric proteins.

D) is a noncovalent bond that dictates the tertiary structure of a protein.

E) is a covalent bond between adjacent glucose molecules in a peptide.

Answer: A

Chapter Section: 3.1

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

4) Disulfide bonds are often found to stabilize which of the following levels of protein structure?

A) primary

B) secondary

C) tertiary

D) primary, secondary, and tertiary

E) None of these structures involve disulfide bonds.

Answer: C

Chapter Section: 3.1

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

5) The primary structure of a protein

A) is important for determining the secondary and tertiary structure of a protein.

B) is simply the order of amino acids from one end of the protein to another.

C) is important both genetically and structurally.

D) is the linear sequence of amino acids that are linked together by peptide bonds.

E) All of these statements are true.

Answer: E

Chapter Section: 3.1

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G2, G7

- 6) Proline is referred to as the "helix breaker" because
- A) its only found in the L form, which is incompatible with helical protein structure.
 - B) it lacks the hydrogen atom needed for hydrogen bonding.
 - C) it lacks a charged functional groups for ionic bonding.
 - D) it is hydrophobic.
 - E) it has a polar functional group.

Answer: B

Chapter Section: 3.1

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G2, G7

- 7) Which of the following accurately describes the structure of fibrous proteins?
- A) Fibrous proteins usually contain a number of different domains with different structural motifs.
 - B) Fibrous proteins are composed of an equal mixture of α helices and β sheets with interconnecting looped segments.
 - C) Fibrous proteins have an extensive tertiary and quaternary structure that affects the strength and elasticity of each fiber.
 - D) Fibrous proteins have a simple primary structure and very little secondary structure, resulting in long, thin fibers.
 - E) Fibrous proteins are usually composed of either α helices or β sheets throughout the molecule, giving them a highly ordered, repetitive structure.

Answer: E

Chapter Section: 3.1

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

- 8) Hydrogen bonding is most important in stabilizing the _____ structure of many proteins.
- A) primary
 - B) secondary
 - C) tertiary
 - D) quaternary
 - E) primary, secondary, tertiary, and quaternary

Answer: B

Chapter Section: 3.1

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

9) Which of the following statements is *false*?

- A) There are more than 60 different kinds of amino acids present in cells.
- B) The R group of amino acids differs from one amino acid to another.
- C) Only around 20 amino acids are used in protein synthesis.
- D) Equal amounts of D- and L-amino acids are found in cells.
- E) An amino acid has an N-terminus, a C-terminus, and an R group.

Answer: D

Chapter Section: 3.1

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

10) Which of the following is *not* a major functional class of proteins?

- A) hereditary proteins
- B) enzymes
- C) motility proteins
- D) regulatory proteins
- E) structural proteins

Answer: A

Chapter Section: 3.1

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

11) Two proteins associated with a rare neurodegenerative disorder have been sequenced.

Protein A contains many polar amino acids with small regions containing nonpolar, hydrophobic amino acids. Protein B is rich in nonpolar, hydrophobic amino acids with only two small regions containing polar amino acids. What might this suggest about the two proteins?

- A) The two proteins may have different secondary structures.
- B) Protein A is fibrous and Protein B is globular.
- C) Protein A may be a cytoplasmic protein and Protein B may be a membrane associate protein.
- D) Protein A and Protein B are complementary parts of a supramolecular structure.
- E) Protein A is most likely an enzyme and Protein B is most likely a storage protein.

Answer: C

Chapter Section: 3.1

Bloom's Taxonomy: Evaluation

Learning Outcome: 3.1

Global LO: G2, G5, G7

12) Which of the following is a possible function of a terpene?

- A) cell surface receptor
- B) vitamin
- C) enzyme
- D) motility
- E) structure

Answer: B

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

13) Which of the following pairs correctly matches the monomer with its polymer?

- A) peptides; proteins
- B) amino acids; polysaccharides
- C) glucose; proteins
- D) terpenes; nucleic acids
- E) nucleotides; nucleic acids

Answer: E

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

14) Cellulose belongs to which of the following groups of macromolecules?

- A) lipids
- B) carbohydrates
- C) proteins
- D) nucleic acids
- E) none of these

Answer: B

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

15) Which of the following has the greatest number of glycosidic bonds?

- A) glucose
- B) triacylglycerol
- C) amylose
- D) DNA
- E) vitamin A

Answer: C

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

16) To which of the following classes of sugars does glucose belong?

- A) pentose
- B) hexose
- C) tetrose
- D) heptose
- E) triose

Answer: B

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

17) You are investigating the structure of the seeds of a newly discovered tropical plant. There is storage material inside the seed. You treat the seed with peptidase (an enzyme that breaks peptide bonds), glycoside hydrolases (an enzyme that breaks β glycosidic bonds), and amylase (an enzyme that breaks α glycosidic bonds). Only the amylase appears to dissolve the storage material in the seed. What does this tell you about the identity of the storage material?

- A) The seed contains fibrous proteins to store carbon and energy.
- B) The seed contains lipids to store carbon and energy.
- C) The seed contains starch to store carbon and energy.
- D) The seed contains cellulose to store carbon and energy.
- E) The seed contains globular proteins to store carbon and energy.

Answer: C

Chapter Section: 3.3

Bloom's Taxonomy: Application

Learning Outcome: 3.1

Global LO: G1, G2, G7

18) Fatty acids are _____; they function in the cell as _____.

- A) short chains of double-bonded carbon molecules; storage lipids
- B) short chains of double-bonded carbon molecules; vitamins and cofactors
- C) four-ringed hydrocarbon molecules; key components of membranes
- D) long, unbranched hydrocarbon chains with a carboxyl group at one end; building blocks for other lipids
- E) short chains of double-bonded carbon molecules; vitamins, cofactors, and storage lipids

Answer: D

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

- 19) The two strands of DNA are held together by _____; thus _____.
- A) covalent bonds; double-stranded DNA is very stable at a range of temperatures
 - B) ionic bonds; double-stranded DNA separates into two separate strands in water
 - C) hydrogen bonds; double-stranded DNA separates into two separate strands at high temperatures
 - D) antiparallel bonds; double-stranded DNA is amphipathic
 - E) hydrophobic interactions; double-stranded DNA separates into two separate strands when dissolved in a hydrocarbon (hydrophobic) solvent

Answer: C

Chapter Section: 3.2

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

- 20) RNA and DNA differ
- A) in that RNA contains ribose and DNA contains deoxyribose.
 - B) in that RNA contains nucleosides and DNA contains nucleotides.
 - C) in that RNA contains uracil and DNA contains thymine.
 - D) both A and C.
 - E) All of these are correct.

Answer: D

Chapter Section: 3.2

Bloom's Taxonomy: Analysis

Learning Outcome: 3.1

Global LO: G7

- 21) Complementary relationships between purines and pyrimidines
- A) allow adenine to form two hydrogen bonds with thymine (or uracil) and guanine to form three hydrogen bonds with cytosine to form double-stranded nucleic acids.
 - B) allow the interaction of the oppositely charged amino acids to form the tertiary structure of proteins.
 - C) allow adjacent bases in a nucleotide chain to stack tightly, stabilizing the DNA double helix.
 - D) provide highly ordered, repetitive bonding to form α helices and β sheets within proteins.
 - E) Both A and C are correct.

Answer: A

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

22) The components of a nucleotide are

- A) a carboxyl group, an amine group, and a variable R group.
- B) a five-carbon sugar, a phosphate group, and a nitrogen-containing aromatic base.
- C) a three-carbon alcohol with a hydroxyl group on each carbon and three fatty acids.
- D) two six-carbon sugars attached with an $\alpha(1\rightarrow4)$ glycosidic bond.
- E) a six-carbon sugar, an ester linkage, and a four-ringed hydrocarbon.

Answer: B

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

23) The chemical nature of each amino acid is determined by which of the following groups?

- A) amino
- B) carboxyl
- C) hydroxyl
- D) R
- E) hydrogen

Answer: D

Chapter Section: 3.1

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

24) The nucleoside triphosphate molecules in DNA are linked together in the 5'→3' by a(n) _____ bridge.

- A) phosphate
- B) covalent
- C) phosphodiester
- D) peptide
- E) phosphatidyl

Answer: C

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

- 25) The function of triglycerides is
- A) to store energy.
 - B) to form semipermeable membranes.
 - C) to transport substances in and out of cells.
 - D) store information.
 - E) Both B and C are correct.

Answer: A

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

- 26) A general trend in the structure of many biomolecules is
- A) that the order and bonding of monomers form the basis for the secondary and tertiary structure of the polymer.
 - B) that they are all soluble in water independent of the size of the polymer.
 - C) that each class of biomolecule forms one type of secondary structure independent of the order of the monomers in the polymer.
 - D) that each class of biomolecule can form either fibrous or globular conformations depending on the chemical conditions inside the cell.
 - E) that four different monomers form the basis for the functional and structural properties of each polymer.

Answer: A

Chapter Section: 3.1, 3.2, 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

- 27) Cholesterol is a _____, which _____.
- A) terpene; is the basis for many animal and plant vitamins
 - B) fatty acid; functions in energy storage
 - C) steroid; is a component of eukaryotic membranes
 - D) steroid; is the basis for many animal and plant hormones
 - E) steroid; is a component of eukaryotic membranes and is the basis for many animal and plant hormones

Answer: E

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

28) Which of the following is found exclusively in RNA?

- A) thymine
- B) guanine
- C) uracil
- D) adenine
- E) cytosine

Answer: C

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

29) Which of the following is *true* of purines?

- A) Cytosine is a purine.
- B) Adenine's bonding to thymine is stronger than is guanine's to cytosine.
- C) Purines have a double-ringed structure.
- D) Both adenine and thymine are purines.
- E) Purines bind readily to deoxyribose but not to ribose.

Answer: C

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

30) Which of the following contributes to the stability of the DNA double helix?

- A) hydrophobic interactions between aromatic bases at the center of the double helix
- B) hydrogen bonding between the phosphate and sugar groups in the backbone of the double helix
- C) covalent bonding between complementary purine and pyrimidine bases.
- D) ionic bonds between the negatively charged phosphate groups and the positively charged pyrimidine bases.
- E) hydrophobic interactions between aromatic bases at the center of the double helix and ionic bonds between the negatively charged phosphate groups and the positively charged pyrimidine bases

Answer: A

Chapter Section: 3.2

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G2, G7

31) Which of the following is *false*?

- A) Phospholipids are important in membrane structure.
- B) Serine is a molecule that may be part of a phosphoglyceride.
- C) Phosphatidic acid contains two fatty acids and a phosphate group.
- D) Sphingolipids are the predominant phospholipid in membranes.
- E) Phospholipids are amphipathic.

Answer: D

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

32) The term *amphipathic* describes the characteristic of some molecules that have

- A) two polar regions.
- B) only a single polar region.
- C) both a polar and a nonpolar region.
- D) no polar regions.
- E) two nonpolar regions.

Answer: C

Chapter Section: 3.1, 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1, 3.2

Global LO: G7

33) Which of the following is *not* one of the six classes of lipids?

- A) steroids
- B) terpenes
- C) fatty acids
- D) triacylglycerols
- E) pectins

Answer: E

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

34) Which of the following statements is *true*?

- A) Fatty acids are synthesized by the stepwise addition of three carbon units.
- B) Unsaturated fatty acids are usually branched.
- C) Fatty acids with 24 carbons are most common.
- D) Saturated fatty acids have no double bonds between carbons.
- E) Hormones are unsaturated fatty acids.

Answer: D

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

35) Which of the following is *true* of glycolipids?

- A) Glycolipids are usually found on the exterior surface of the plasma membrane.
- B) Glycolipids are found in plastids and are used to store energy.
- C) Fructose and sucrose are often part of glycolipids.
- D) Glycolipids contain steroids.
- E) Usually more than 10 sugar units are attached to the glycolipid.

Answer: A

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

36) Which of the following is *not* a steroid?

- A) testosterone
- B) estradiol
- C) cortisol
- D) aldosterone
- E) phenylalanine

Answer: E

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

37) Which of the following is a terpene?

- A) testosterone
- B) vitamin A
- C) glycerol
- D) estrogen
- E) chitin

Answer: B

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

38) Which of the following is *not* a polymer of numerous monomer units?

- A) a phospholipid
- B) a polypeptide
- C) an RNA molecule
- D) cellulose
- E) starch

Answer: A

Chapter Section: 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.2

Global LO: G7

39) *Trans* fats

- A) are unsaturated fatty acids.
- B) resemble saturated fatty acids in shape.
- C) are associated with an increased risk of heart disease.
- D) are present in small amounts in meat and dairy products.
- E) All of these statements are true.

Answer: E

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

40) Lipid rafts are

- A) regions of the membrane that are high in sphingolipids, which facilitate communication with the external environment of the cell.
- B) important regions of membrane structure comprised of phospholipids.
- C) regions not typically associated with signal transduction.
- D) regions where greater concentrations of sphingolipids are on the inner side of the membrane.
- E) rafts of lipids inside of the cell that serve to store energy.

Answer: A

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

3.2 Matching Questions

Match the choice on the left with the choice on the right.

- A) spatial structure
- B) linear structure
- C) AMP
- D) monosaccharide
- E) adenine
- F) quaternary structure
- G) starch
- H) cytosine
- I) collagen
- J) amino acid
- K) enzyme
- L) steroids
- M) guanine

1) monomer of protein
Chapter Section: 3.1, 3.2, 3.3
Bloom's Taxonomy: Analysis
Learning Outcome: 3.1
Global LO: G2, G7

2) polymer of glucose
Chapter Section: 3.1, 3.2, 3.3
Bloom's Taxonomy: Analysis
Learning Outcome: 3.1
Global LO: G2, G7

3) pyrimidine
Chapter Section: 3.1, 3.2, 3.3
Bloom's Taxonomy: Analysis
Learning Outcome: 3.1
Global LO: G2, G7

4) nucleotide
Chapter Section: 3.1, 3.2, 3.3
Bloom's Taxonomy: Analysis
Learning Outcome: 3.1
Global LO: G2, G7

5) multimeric complex
Chapter Section: 3.1, 3.2, 3.3
Bloom's Taxonomy: Analysis
Learning Outcome: 3.1
Global LO: G2, G7

6) Haworth projection

Chapter Section: 3.1, 3.2, 3.3

Bloom's Taxonomy: Analysis

Learning Outcome: 3.1

Global LO: G2, G7

7) a fibrous protein

Chapter Section: 3.1, 3.2, 3.3

Bloom's Taxonomy: Analysis

Learning Outcome: 3.1

Global LO: G2, G7

Answers: 1) L 2) G 3) H 4) C 5) F 6) A 7) I

List all the functions that match with each biomolecule. Note that the functions may match with more than one biomolecule and each biomolecule may have multiple functions.

- A) carbon and energy storage
- B) enzyme cofactor
- C) hormone
- D) enzyme
- E) vitamin
- F) structural component of cells
- G) cell receptor
- H) informational molecule
- I) motility

8) protein

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1, 3.2

Global LO: G2, G7

9) DNA

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1, 3.2

Global LO: G2, G7

10) lipids and steroids

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1, 3.2

Global LO: G2, G7

11) terpenes

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1, 3.2

Global LO: G2, G7

12) polysaccharides

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1, 3.2

Global LO: G2, G7

13) RNA

Chapter Section: 3.1, 3.2, 3.3, 3.4

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1, 3.2

Global LO: G2, G7

Answers: 8) A, C, D, F, G, I 9) H 10) C, F 11) B, E 12) A, F 13) H

3.3 Short Answer Questions

1) _____ is the major storage polysaccharide for animals, while _____ is the major storage polysaccharide for plants.

Answer: Glycogen; starch

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

2) A _____, a _____, and a _____ are the major parts of a nucleotide, whereas a _____ and a _____ are the major parts of a nucleoside.

Answer: phosphate group, pentose sugar (ribose or deoxyribose), aromatic base (in any order); pentose sugar, aromatic base (either order)

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

3) Nucleotides are to nucleic acids as amino acids are to _____.

Answer: proteins

Chapter Section: 3.1, 3.2

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

4) Triglycerides are composed of three fatty acids attached to a molecule of _____.

Answer: glycerol

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

5) _____ RNA is a component of the ribosomes that serve as the site of protein synthesis.

Answer: Ribosomal (or r)

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

6) Cellulose is a polymer of _____, a common monosaccharide.

Answer: glucose

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

7) _____ and _____ are the two kinds of sugars found in bacterial cell walls.

Answer: *N*-acetylglucosamine (GlcNAc); *N*-acetylmuramic acid (MurNAc)

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

8) The _____ projection illustrates saccharides as linear, whereas the _____ projection suggests the spatial relationships of saccharides.

Answer: Fischer; Haworth

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

9) Structurally, starch exists as both unbranched polysaccharide chains called _____ and branched polysaccharide chains called _____.

Answer: amylose; amylopectin

Chapter Section: 3.3

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

10) In 1953 the structure of DNA was determined to be a _____.

Answer: double helix

Chapter Section: 3.2

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

11) For the amino acid glutamine, the three-letter abbreviation is _____ and the one-letter abbreviation is _____.

Answer: Gln; Q

Chapter Section: 3.1

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.1

Global LO: G7

12) _____ fatty acids are liquid at room temperature, while _____ fatty acids are solid.

Answer: Unsaturated; saturated

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

13) Because of their structure, *trans* fats resemble _____ fatty acids in shape and are produced artificially during the manufacture of shortening and margarine.

Answer: saturated

Chapter Section: 3.4

Bloom's Taxonomy: Knowledge

Learning Outcome: 3.2

Global LO: G7

3.4 Inquiry

1) As a protein is being synthesized, the correct folding of the protein is aided by the movement of nonpolar amino acids toward the inner areas of the protein. How can this phenomenon be explained? How will this influence other levels of protein structure?

Answer: The exclusion of hydrophobic groups from the aqueous surface is called the hydrophobic effect. This then influences the other levels in orientation. (Many correct answers are possible.)

Chapter Section: 3.1

Bloom's Taxonomy: Synthesis

Learning Outcome: 3.1

Global LO: G7, G8

2) A transmembrane protein has 1000 amino acids. The fifth amino acid is found on the external surface of the cell membrane. It interacts with the aqueous environment outside the cell. Amino acids 25 and 205 are covalently bonded to each other and are required to give the protein its three-dimensional shape. Amino acid 554 is found on the outer surface of the protein, but it is deep in the interior of the membrane. Amino acid 979 is found on the external surface of the protein, where it forms a weak ionic bond with a chloride ion. Can you identify each of the numbered amino acids by structural group and name? Please note that there may be more than one specific amino acid possible in some cases.

Amino acids:

5

25

205

554

979

Answer: 5: polar, charged or uncharged (hydrophilic) amino acid; any amino acid in this group

25: polar, uncharged (hydrophilic) amino acid; cysteine

205: polar, uncharged (hydrophilic) amino acid; cysteine

554: nonpolar (hydrophobic) amino acid; any amino acid in this group

979: polar, charged (hydrophilic) amino acid; any positively charged amino acid in this group (Lys, Arg, or His)

Chapter Section: 3.1

Bloom's Taxonomy: Evaluation

Learning Outcome: 3.1

Global LO: G2, G7, G8

3) 5'-ATAGGGCTT-3' is a short sequence of a strand of DNA. What will be the complementary sequence of the other strand? What will be the complementary mRNA sequence derived from the second strand of DNA? Be sure to indicate the 5' or 3' ends of each sequence.

Answer: Complementary DNA: 3' TATCCCGAA5' or 5'AAGCCCTAT3'

Complementary mRNA: 5'AUAGGGCUU3'

Chapter Section: 3.2

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7

4) Amylose, cellulose, and glycogen are all polysaccharides composed of glucose. What makes each of these polysaccharides unique in spite of the fact that all are composed solely of glucose?

Answer: Amylose: is produced by plants and is a nutritional form; linear structure with glucose molecules connected by $\alpha(1\rightarrow4)$ linkages.

Cellulose: is produced by plants and is a structural form; linear structure with glucose molecules connected by $\beta(1\rightarrow4)$ linkages; mammals do not have the enzyme needed to break this type of linkage.

Glycogen: is produced by animals and is a nutritional form; branched form with $\alpha(1\rightarrow4)$ linkages with $\alpha(1\rightarrow6)$ linkages at the branch points.

Chapter Section: 3.3

Bloom's Taxonomy: Comprehension

Learning Outcome: 3.1

Global LO: G7, G8

5) Give an example of both fibrous and globular proteins and explain how their structure relates to their unique functions.

Answer: Fibrous proteins such as (silk, collagen, elastin, or keratin) have extensive secondary structure (either helix or β sheet) throughout the molecule that gives them a highly ordered, repetitive structure. Fibrous proteins usually have an extended, filamentous structure. Often multiple proto-filaments will interact to create thicker, stronger filaments. Small hydrophobic amino acids that pack tightly are common in fibrous proteins. In contrast, globular proteins, such as (enzymes, transport proteins, or transmembrane proteins) have extensive tertiary structure wherein β sheets and/or α helices are connected by loops that fold into a compact structure. Globular proteins often have multiple regions, or domains, that have different functions. The diverse shapes of globular proteins create binding pockets for substrates, regions of hydrophobicity that interact with membranes, and other domains that allow globular proteins to act as enzymes, receptors, and a diversity of other functions in the cell.

Chapter Section: 3.1

Bloom's Taxonomy: Synthesis

Learning Outcome: 3.1

Global LO: G7, G8