Chapter 2: The Molecular Composition of Plant Cells

Multiple-Choice Questions

1. Introduction; p. 18; easy; ans: e
Which substance makes up more than half of all living matter and more than 90 percent of the weight of most plant tissues?

   a. Protein  
   b. Cellulose  
   c. Starch  
   d. Triglyceride  
   e. Water

2. Carbohydrates; p. 19; easy; ans: b
The most abundant organic molecules in nature are:

   a. proteins.  
   b. carbohydrates.  
   c. lipids.  
   d. nucleic acids.  
   e. water molecules.

3. Carbohydrates; p. 19; easy; ans: a
   __________ is a monosaccharide, and ____________ is a disaccharide.

   a. Fructose; lactose  
   b. Maltose; ribose  
   c. Cellulose; sucrose  
   d. Sucrose; glucose  
   e. Maltose; lactose

4. Carbohydrates; p. 19; easy; ans: e
   ________ is composed of two sugar subunits linked covalently.

   a. Cellulose  
   b. Fructose  
   c. Ribose  
   d. Glucose  
   e. Sucrose

5. Carbohydrates; p. 19; moderate; ans: a
The common transport form of sugar in plants is ______ and in animals is ______.

   a. sucrose; glucose  
   b. glucose; sucrose  
   c. starch; sucrose  
   d. maltose; lactose  
   e. fructose; maltose
6. **Carbohydrates; p. 20; moderate; ans: e**
   The formation of ______ from ______ occurs by dehydration synthesis.
   a. glucose and fructose; sucrose
   b. glucose; starch
   c. monomers; polymers
   d. glucose; cellulose
   e. sucrose; glucose and fructose

7. **Carbohydrates; p. 20; moderate; ans: b**
   Which of the following statements about hydrolysis reactions is FALSE?
   a. They are energy-yielding reactions.
   b. They are a type of condensation reaction.
   c. They involve the addition of a molecule of water.
   d. An example is the conversion of a polymer to its monomers.
   e. An example is the conversion of disaccharides to monosaccharides.

8. **Carbohydrates; p. 20; moderate; ans: c**
   The principal polysaccharide in the plant cell wall is:
   a. starch.
   b. fructan.
   c. cellulose.
   d. glycogen.
   e. sucrose.

9. **Carbohydrates; p. 20; easy; ans: a**
   What is the most abundant organic compound known?
   a. cellulose
   b. sucrose
   c. DNA
   d. phospholipid
   e. starch

10. **Carbohydrates; p. 21; moderate; ans: d**
    Which of the following consists of beta-glucose subunits?
    a. amylose
    b. amylopectin
    c. chitin
    d. cellulose
    e. glycogen
11. Carbohydrates; pp. 21-22; moderate; ans: b
The matrix of the plant cell wall contains:

a. microfibrils and pectins.
b. pectins and hemicelluloses.
c. hemicelluloses and oligosaccharins.
d. cellulose and chitin.
e. chitin and glycogen.

12. Carbohydrates; p. 22; moderate; ans: e
Which stabilize the cell wall by forming hydrogen bonds with it?

a. pectins
b. starches
c. chitins
d. lipids
e. hemicelluloses

13. Carbohydrates; p. 22; difficult; ans: b
Which comprise most of the middle lamella?

a. hemicelluloses
b. pectins
c. lipids
d. chitins
e. starches

14. Carbohydrates; p. 22; easy; ans: b
The principal component of the cell walls of fungi is:

a. cellulose.
b. chitin.
c. starch.
d. protein.
e. phospholipid.

15. Carbohydrates; p. 22; easy; ans: d
The monomer of ___________ is N-acetylglucoseamine.

a. microfibrils
b. enzymes
c. storage polysaccharides
d. chitin
e. fats
16. **Lipids; p. 22; moderate; ans: e**  
When an oil undergoes hydrolysis, the products are:

- a. 1 amino acid and 3 glycerols
- b. many glucose monomers
- c. 1 fatty acid and 3 glycerols
- d. 1 sucrose and 3 fatty acids
- e. 1 glycerol and 3 fatty acids

17. **Lipids; pp. 22-23; easy; ans: a**  
Which are examples of triglycerides?

- a. oils and fats
- b. fats and steroids
- c. oils and starches
- d. starches and proteins
- e. proteins and fats

18. **Lipids; pp. 22-23; difficult; ans: c**  
A fat differs from a phospholipid in that a fat contains:

- a. a phosphate group
- b. 1 glycerol
- c. 3 fatty acids
- d. a steroid
- e. a wax

19. **Lipids; p. 23; moderate; ans: b**  
The main function of cutin and suberin is to:

- a. serve as structural components of cellular membranes.
- b. prevent water loss.
- c. catalyze chemical reactions.
- d. provide strength to the cell wall.
- e. serve as hormones.

20. **Lipids; p. 23; moderate; ans: c**  
Which lipid is a major component of cork cell walls?

- a. phospholipid
- b. cutin
- c. suberin
- d. steroid
- e. lignin
21. **Lipids; pp. 23-24; difficult; ans: c**
   Who am I? I give cell walls a lamellar appearance?

   a. phospholipid
   b. cutin
   c. suberin
   d. wax
   e. lignin

22. **Lipids; p. 24; moderate; ans: b**
   The most water-repellant of the lipids are:

   a. steroids
   b. waxes
   c. celluloses
   d. suberins
   e. cutins

23. **Lipids; p. 24; easy; ans: a**
   Which of the following is characterized by the presence of four interconnected hydrocarbon rings?

   a. steroids
   b. lignin
   c. epicuticular wax
   d. phospholipids
   e. triglycerides

24. **Lipids; p. 24; moderate; ans: e**
   In all organisms except prokaryotes, an important role of sterols is to:

   a. serve as storage forms of energy.
   b. prevent water loss.
   c. catalyze chemical reactions.
   d. provide strength to the cell wall.
   e. stabilize the phospholipid tails in cell membranes.

25. **Proteins; p. 25; easy; ans: b**
   The monomers of proteins are:

   a. monosaccharides.
   b. amino acids.
   c. glycerol and fatty acids.
   d. nucleotides.
   e. fused hydrocarbon rings.
26. Proteins; p. 25; easy; ans: c
   How many different kinds of amino acids are used to build proteins?
   
   a. 5
   b. 10
   c. 20
   d. 50
   e. 100

27. Proteins; p. 27; easy; ans: a
   A peptide bond occurs between the _____ groups of adjacent amino acids in polypeptides.
   
   a. amino and carboxyl
   b. sulphydryl
   c. amino and phosphate
   d. carboxyl and hydroxyl
   e. amino

28. Proteins; p. 27; moderate; ans: b
   When a polypeptide undergoes hydrolysis, the products are:
   
   a. glycerols and fatty acids
   b. amino acids
   c. monosaccharides
   d. nucleotides
   e. polysaccharides

29. Proteins; p. 27; easy; ans: a
   The linear sequence of amino acids is called the _____ structure of a protein.
   
   a. primary
   b. secondary
   c. tertiary
   d. quaternary
   e. helix

30. Proteins; p. 28 and Fig. 2–16; difficult; ans: b
   A common _____ structure of proteins involves a hydrogen bond between the amino group of one amino acid and the carboxyl group of an amino acid farther along the peptide chain.
   
   a. primary
   b. secondary
   c. tertiary
   d. quaternary
   e. pentenary
31. **Proteins; p. 28; difficult; ans: e**
The tertiary structure of a protein is a result of all of the following EXCEPT:

a. the folding of the secondary structure.
b. the linear sequence of amino acids.
c. the formation of disulfide bridges.
d. interactions among the R groups of a single polypeptide.
e. interactions between two or more polypeptide chains.

32. **Proteins; p. 29; easy; ans: d**
The _____ structure of a protein involves interactions between two or more polypeptide chains.

a. primary  
b. secondary  
c. tertiary  
d. quaternary  
e. pentenary

33. **Proteins; p. 29; easy; ans: e**
Which of the following statements about enzymes is FALSE?

a. They are globular proteins.  
b. They enable cells to carry out chemical reactions at room temperature.  
c. They lower the energy of activation.  
d. They can be used over and over again.  
e. They are typically effective only at high concentrations.

34. **Organic Molecules; p. 29; moderate; ans: d**
Nucleic acids are different from proteins in that nucleic acids contain:

a. carbon.  
b. hydrogen.  
c. nitrogen.  
d. phosphorus.  
e. sulfur

35. **Nucleic Acids; p. 29; moderate; ans: b**
The monomers of nucleic acids are:

a. DNA and RNA.  
b. nucleotides.  
c. ribose and deoxyribose.  
d. ATP and ADP.  
e. genes.
36. **Nucleic Acids; p. 29; easy; ans: c**
The subunits of a nucleotide are a(n):

a. five-carbon sugar and an amino acid.
b. amino acid, glycerol, and a fatty acid.
c. five-carbon sugar, a nitrogenous base, and a phosphate group.
d. nitrogenous base, an amino acid, and a monosaccharide.
e. phosphate group, a disaccharide, and a fatty acid.

37. **Nucleic Acids; p. 29; moderate; ans: e**
When many nucleotides undergo dehydration synthesis, the product(s) is(are):

a. a five-carbon sugar, a nitrogenous base, and a phosphate group.
b. many amino acids.
c. many monosaccharides.
d. a polysaccharide
e. a nucleic acid

38. **Nucleic Acids; p. 30; moderate; ans: e**
Adenosine triphosphate is a type of:

a. fatty acid.
b. amino acid.
c. enzyme.
d. steroid.
e. nucleotide.

39. **Nucleic Acids; p. 30; easy; ans: b**
The principal role of ATP in the cell is:

a. catalyzing chemical reactions.
b. providing energy.
c. serving as structural support.
d. functioning as a hormone.
e. keeping the phospholipid tails of membranes aligned

40. **Secondary Metabolites; p. 30; moderate; ans: a**
Which of the following statements about secondary metabolites is FALSE?

a. They are found in all cells of a plant.
b. Some function as chemical signals or in the defense of the plant against herbivores.
c. They frequently are synthesized in one part of the plant and stored in another.
d. Some are produced only after the plant has been damaged.
e. Their concentration in a plant can vary greatly over a 24-hour period.
41. **Secondary Metabolites; p. 30; moderate; ans: c**
   Which of the following is a primary metabolite?
   
   a. phytoalexin  
   b. morphine  
   c. glucose  
   d. taxol  
   e. rubber

42. **Secondary Metabolites; p. 30; easy; ans: e**
   The major classes of secondary plant metabolites are:
   
   a. sugars and proteins.  
   b. alkaloids and sugars.  
   c. nucleic acids, alkaloids, and phenolics.  
   d. terpenoids, phenolics, and proteins.  
   e. alkaloids, phenolics, and terpenoids.

43. **Secondary Metabolites; p. 31; easy; ans: b**
   ______ is an alkaloid used to dilate pupils in eye examinations.
   
   a. Cocaine  
   b. Atropine  
   c. Caffeine  
   d. Morphine  
   e. Nicotine

44. **Secondary Metabolites; p. 32; easy; ans: a**
   Who am I? I form a “blanket” that stabilizes photosynthetic membranes and thus helps the plant cope with heat.
   
   a. isoprene.  
   b. taxol.  
   c. anthocyanin.  
   d. salicylic acid.  
   e. tannin.

45. **Secondary Metabolites; p. 32; easy; ans: d**
   Essential oils are types of:
   
   a. tannins.  
   b. flavonoids.  
   c. alkaloids.  
   d. terpenoids.  
   e. anthocyanins.
46. **Secondary Metabolites; p. 32; moderate; ans: d**
Which of the following secondary metabolites consists of isoprene units?

a. morphine  
b. atropine  
c. anthocyanin  
d. taxol  
e. salicylic acid

47. **Secondary Metabolites; p. 33; easy; ans: c**
The largest group of plant phenolics are the:

a. tannins.  
b. cardiac glycosides.  
c. flavonoids.  
d. lignins.  
e. salicylic acids.

48. **Secondary Metabolites; p. 34; easy; ans: b**
_____ is a secondary metabolite responsible for adding compressive strength, stiffness, and waterproofing to the plant cell wall.

a. Tannin  
b. Lignin  
c. Cellulose  
d. Flavone  
e. Flavonol

**True-False Questions**

1. **Introduction; p. 18; easy; ans: T**
   Only six elements make up 99 percent of the weight of all living matter.

2. **Organic Molecules; p. 18; moderate; ans: F**
   By definition, all organic molecules contain carbon, hydrogen, and oxygen.

3. **Carbohydrates; p. 19; moderate; ans: F**
   Pentoses and hexoses have a carbonyl group in the ring form but not the chain form.

4. **Carbohydrates; p. 19; moderate; ans: F**
   Plants break down their carbohydrate reserves and transport starch to the site where it is needed.

5. **Carbohydrates; p. 20; easy: ans: T**
   Amylose and amylopectin are the two forms of starch.

6. **Carbohydrates; pp. 20-21; moderate; ans: T**
   Starch consists of alpha-glucose subunits, whereas cellulose consists of beta-glucose.
7. **Carbohydrates; p. 22; moderate; ans: T**
   Pectins and hemicelluloses constitute the matrix of the plant cell wall in which cellulose microfibrils are embedded.

8. **Lipids; p. 23; easy; ans: F**
   In contrast to unsaturated fatty acids, saturated fatty acids have one or more kinks that prevent close packing.

9. **Lipids; p. 23; easy; ans: F**
   Unsaturated fats are usually solid at room temperature.

10. **Lipids; p. 23; moderate; ans: T**
    In a phospholipid, the phosphate group is attached directly to the glycerol backbone.

11. **Lipids; p. 23; difficult; ans: F**
    In a phospholipid bilayer, each hydrophobic tail is oriented next to a hydrophilic head of the adjacent molecule.

12. **Lipids; p. 24; easy; ans: F**
    A steroid is characterized by the presence of three interconnected hydrocarbon rings.

13. **Proteins; p. 25; easy; ans: T**
    A peptide bond is a linkage between an amino group and a carboxyl group.

14. **Proteins; p. 27; moderate; ans: F**
    When a polypeptide is hydrolyzed, many peptide bonds are formed.

15. **Proteins; pp. 27-29; difficult; ans: F**
    All proteins have primary, secondary, tertiary, and quaternary structures.

16. **Proteins; p. 29; easy; ans: T**
    The denaturation of a protein involves a disruption in its tertiary structure.

17. **Nucleic Acids; p. 29; easy; ans: F**
    A nucleotide consists of a sugar, a phosphate group, and an amino group.

18. **Nucleic Acids; p. 29; easy; ans: T**
    DNA molecules are the largest macromolecules found in cells.

19. **Nucleic Acids; p. 30, Fig. 2-20; moderate; ans: T**
    An RNA molecule consists of a single strand of nucleotides.

20. **Nucleic Acids; p. 30; difficult; ans: F**
    Energy is released in the reaction in which a phosphate group is linked to ADP forming ATP.

21. **Secondary Metabolites; p. 31; easy; ans: T**
    Allelopathy is the process by which a chemical produced by one plant inhibits the growth of competitors.

22. **Secondary Metabolites; p. 32; difficult; ans: F**
    Essential oils, components of plant fragrances, are phenolic compounds.
23. Secondary Metabolites; p. 34; moderate; ans: F
It is thought that lignin first evolved as a support molecule and only later functioned as an antibacterial and antifungal agent.

Essay Questions

1. Carbohydrates; pp. 19-20; moderate
   Explain the difference between hydrolysis and dehydration synthesis, and give an example of each.

2. Carbohydrates; pp. 20–22; moderate
   What features do the structural polysaccharides and energy-storage polysaccharides of plants have in common? How are they different?

3. Carbohydrates; pp. 21-22; difficult
   Describe the molecular structure of the plant cell wall in relation to its function.

4. Lipids; pp. 22–23; moderate
   Discuss the relationship between (a) the structure and the solubility of saturated and unsaturated fats; (b) triglycerides and phospholipids.

5. Lipids; pp. 23-24; moderate
   Describe the molecules and structures involved in the prevention of water loss in plants.

6. Proteins; p. 27; difficult
   What is a peptide bond, and in what type of molecule is it found? Explain what happens to a peptide bond during a) hydrolysis and b) dehydration synthesis.

7. Proteins; pp. 27–28; difficult
   Explain how each level of protein organization is influenced by the previous level.

8. Proteins; p. 29; moderate
   Discuss the importance of enzymes in the plant cell.

9. Nucleic Acids; p. 29; easy
   How do DNA and RNA differ in structure and function?

10. Nucleic Acids; p. 30; moderate
    In what way is ATP the cell’s energy currency?

11. Secondary Metabolites; pp. 30-35; easy
    What is the difference between a primary metabolite and a secondary metabolite? Name the three main classes of secondary metabolites and give an example of each.

12. Secondary Metabolites; p. 34; moderate
    What type of molecule is lignin? Discuss the importance of lignification in plants.

13. Secondary Metabolites; pp. 34-35; easy
    Explain what is meant by systemic acquired resistance (SAR). What phenolic molecule is essential for the development of SAR?