

## 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-acetylglucosamine.

- 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. sulfhydryl
- 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?