Chapter X-1: The Plant Cell and the Cell Cycle

Multiple-Choice Questions

29. **The Cell Cycle; p. 62; moderate; ans: e**
   In the cell cycle, interphase consists of:
   
   a. mitosis and cytokinesis.
   b. mitosis and the S phase.
   c. the G₁ and G₂ phases.
   d. the G₂ and S phases.
   e. the G₁, G₂, and S phases.

30. **The Cell Cycle; p. 62; moderate; ans: a**
    Which of the following statements concerning endoreduplication is FALSE?
    
    a. It may result in gigantic nuclei.
    b. It involves multiple rounds of DNA synthesis.
    c. It provides a mechanism for increasing the level of gene expression.
    d. It may result in thousands of copies of each gene.
    e. It usually occurs following the differentiation of cells.

31. **The Cell Cycle; p. 64; difficult; ans: e**
    Which of the following statements concerning checkpoints is FALSE?
    
    a. Checkpoints control the progression between certain phases of the cell cycle.
    b. Checkpoints control the rate at which cells are produced.
    c. Checkpoints enable a cell to sense whether certain conditions have been met.
    d. Checkpoints involve the control of DNA and protein synthesis.
    e. Checkpoints differ significantly among eukaryotic cells.

32. **Interphase; p. 64; easy; ans: d**
    DNA replication occurs during the ______ phase.
    
    a. G₀
    b. G₁
    c. G₂
    d. S
    e. M

33. **Interphase; pp. 64-65; easy; ans: a**
    Which of the following is unique to cell division in plants?
    
    a. migration of the nucleus to the center of the cell
    b. migration of the mitochondria to the periphery of the cell
    c. duplication of the centrosome
    d. duplication of the mitochondria
    e. duplication of the endoplasmic reticulum

34. **Interphase; p. 65; moderate; ans: c**
In the developing cell plate, the initial polysaccharide is:

a. cellulose.
b. pectin.
c. callose.
d. chitin.
e. hemicellulose.

35. Mitosis and Cytokinesis; p. 66; moderate; ans: d
In late prophase, sister chromatids are joined by a constriction at the:

a. phragmosome.
b. preprophase band.
c. centriole.
d. centromere.
e. centrosome.

36. Mitosis and Cytokinesis; p. 66; easy; ans: b
The ______ is the earliest manifestation of the mitotic spindle.

a. preprophase band
b. prophase spindle
c. phragmosome
d. centrosome
e. phragmoplast

37. Mitosis and Cytokinesis; p. 67; moderate; ans: c
Sister chromatids become daughter chromosomes at the beginning of:

a. prophase.
b. metaphase.
c. anaphase.
d. telophase.
e. interphase.

38. Mitosis and Cytokinesis; p. 68; moderate; ans: e
Chromosomes lengthen and become indistinct during:

a. anaphase.
b. metaphase.
c. prophase.
d. interphase.
e. telophase.

39. Mitosis and Cytokinesis; p. 68; easy; ans: e
During _____, the nuclear envelopes and nucleoli re-form.

a. anaphase
b. metaphase
c. prophase
d. interphase
e. telophase

40. **Mitosis and Cytokinesis; p. 68; easy; ans: c**  
The longest phase of mitosis is always:

a. anaphase.  
b. metaphase.  
c. prophase.  
d. interphase.  
e. telophase.

41. **Mitosis and Cytokinesis; pp. 68, 70; moderate; ans: d**  
Which of the following statements about the phragmoplast is FALSE?

a. It forms between the two daughter nuclei.  
b. It is composed of microtubules.  
c. Its formation precedes the growth of the cell plate.  
d. It begins to form at the walls of the dividing cell and grows inward.  
e. In cells with large vacuoles, it is formed within the phragmosome.

**Chapter X-2: Sexual Reproduction and Heredity**

**Multiple-Choice Questions**

7. **The Process of Meiosis; p. 156; easy; ans: c**  
A cell that unites with another cell is called a:

a. meiospore.  
b. mitospore.  
c. gamete.  
d. diploid cell.  
e. zygote.

8. **The Process of Meiosis; p. 156; moderate; ans: a**  
The pairing of homologous chromosomes is called:

a. synapsis.  
b. chiasma.  
c. crossing-over.  
d. recombination.  
e. bivalence.

9. **The Process of Meiosis; p. 156; moderate; ans: a**  
Which of the following statements about the synaptonemal complex is FALSE?

a. It forms just before prophase.  
b. It is associated with the formation of bivalents.  
c. It connects the axial cores of homologs.  
d. It disappears during prophase I.  
e. It is associated with crossing-over.
10. **The Process of Meiosis; p. 156; easy; ans: e**
Crossing-over occurs during:

a. prophase II.
b. metaphase I.
c. telophase I.
d. metaphase II.
e. prophase I.

11. **The Process of Meiosis; p. 157; easy; ans: c**
Homologous pairs of chromosomes separate during:

a. prophase II.
b. metaphase I.
c. anaphase I.
d. metaphase II.
e. anaphase III.

12. **The Process of Meiosis; p. 158; moderate; ans: a**
Nuclear envelopes form around single-stranded chromosomes during:

a. telophase II.
b. metaphase I.
c. prophase I.
d. telophase I.
e. metaphase II.

13. **The Process of Meiosis; p. 158; moderate; ans: d**
Unpaired double-stranded chromosomes line up on the equatorial plane during:

a. prophase II.
b. metaphase I.
c. anaphase I.
d. metaphase II.
e. anaphase II.

14. **The Process of Meiosis; p. 158; moderate; ans: e**
Sister chromatids become daughter chromosomes during:

a. prophase II.
b. metaphase I.
c. anaphase I.
d. metaphase II.
e. anaphase II.

15. **The Process of Meiosis; p. 158; moderate; ans: d**
If a cell has three pairs of homologous chromosomes, in how many ways could they be distributed among the haploid cells produced by meiosis?

a. two
b. three
Chapter 6: Respiration

Multiple-Choice Questions

1. **An Overview of Glucose Oxidation; p. 107; easy; ans: c**
   Which of the following statements about the reactions of glucose oxidation is FALSE?
   
   a. The glucose molecule is hydrolyzed.
   b. Hydrogen atoms are removed.
   c. Oxygen is oxidized.
   d. Energy is released.
   e. Electrons go from higher to lower energy levels.

2. **An Overview of Glucose Oxidation; p. 108; easy; ans: b**
   Which of the following statements concerning fermentation is FALSE?
   
   a. It occurs under anaerobic conditions.
   b. It involves O₂ as the ultimate electron acceptor.
   c. It involves the breakdown of organic molecules.
   d. It releases less than 686 kcal/mole of glucose.
   e. It is an exergonic process.

3. **An Overview of Glucose Oxidation; p. 108; easy; ans: a**
   Which of the following does NOT occur during respiration?
   
   a. hydrolysis of starch to glucose
   b. formation of acetyl CoA
   c. electron transport chain
   d. citric acid cycle
   e. glycolysis

4. **An Overview of Glucose Oxidation; p. 108; moderate; ans: e**
   Formation of ATP from ADP and phosphate as a result of electron transport occurs in:
   
   a. the citric acid cycle.
   b. the formation of acetyl CoA.
   c. fermentation.
   d. glycolysis.
   e. oxidative phosphorylation.

5. **An Overview of Glucose Oxidation; p. 108; easy; ans: e**
   In respiration, most of the energy in the original glucose molecule is:
   
   a. stored in molecules of ADP.
   b. stored in molecules of ATP.
c. stored in molecules of pyruvate.
d. released in molecules of carbon dioxide.
e. released as heat.

6. Glycolysis; p. 108; easy; ans: c
In glycolysis, one molecule of glucose is converted to ______ molecules of ______.
   a. two; fructose
   b. three; fructose.
   c. two; pyruvate
   d. three; pyruvate
   e. two; sucrose

7. Glycolysis; p. 108; easy; ans: b
Which of the following statements concerning glycolysis is FALSE?
   a. It is considered a primitive process.
   b. It is an aerobic process.
   c. It occurs in a series of 10 steps.
   d. It is carried out by virtually all cells.
   e. Its reactions are catalyzed by specific enzymes.

8. Glycolysis; p. 108; easy; ans: a
Where in the cell does glycolysis occur?
   a. the cytosol
   b. mitochondria
   c. the nucleus
   d. the endoplasmic reticulum
   e. chloroplasts

9. Glycolysis; p. 108; moderate; ans: e
When one speaks of the cell’s “net energy harvest” from glycolysis one is referring to the amount of:
   a. ATP only.
   b. ADP only.
   c. NAD⁺ only.
   d. NADH only
   e. ATP and NADH.

10. Glycolysis; p. 108; easy; ans: a
The preparatory phase of glycolysis involves:
   a. 2 molecules of ATP only.
   b. 2 molecules of NAD⁺ only.
   c. 2 molecules of NADH only.
   d. 1 molecule of ATP and 1 molecule of NADH.
   e. 1 molecule of ATP and 1 molecule of NAD⁺.
11. Glycolysis; p. 108; difficult; ans: c
As part of the first step in the first preparatory reaction of glycolysis:

a. the glucose molecule is rearranged.
b. the glucose molecule is split in half.
c. glucose is phosphorylated.
d. NAD\(^+\) is reduced.
e. NADH is oxidized.

12. Glycolysis; p. 108; moderate; ans: c
For every molecule of glucose that begins glycolysis, how many ATP molecules are consumed?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

13. Glycolysis; p. 109; difficult; ans: a
As part of the cleavage step in glycolysis, glucose is:

a. converted to glyceraldehyde 3-phosphate and dihydroxyacetone phosphate.
b. phosphorylated to glucose 6-phosphate.
c. oxidized to 1,3-bisphosphoglycerate.
d. reduced to phosphoenolpyruvate.
e. converted by the enzyme isomerase to fructose.

14. Glycolysis; pp. 109–110; moderate; ans: c
For each molecule of glucose that completes glycolysis, how many NAD\(^+\) molecules are reduced?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

For every glucose molecule that completes glycolysis, how many total molecules of ATP are produced?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4
16.  Glycolysis; p. 110; moderate; ans: c
In glycolysis, what is the net energy harvest of ATP molecules per molecule of glucose?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

17.  The Aerobic Pathway; p. 110; easy; ans: b
Most of the enzymes of the citric acid cycle are found in the _____ of the _____.

a. cytosol; cell  
b. matrix; mitochondria  
c. lumen; smooth ER  
d. cristae; mitochondria  
e. ribosomes; rough ER

18.  The Aerobic Pathway; p. 111; moderate; ans: b
Pyruvate is converted to acetyl CoA in the _____ of the _____.

a. cytosol; cell  
b. matrix; mitochondria  
c. lumen; smooth ER  
d. cristae; mitochondria  
e. ribosomes; rough ER

19.  The Aerobic Pathway; p. 111; moderate; ans: c
For every molecule of glucose that begins glycolysis, how many molecules of acetyl CoA are produced?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

20.  The Aerobic Pathway; p. 111; difficult; ans: a
During the conversion of pyruvate to acetyl CoA, _____ is produced.

a. CO₂  
b. ATP  
c. NAD⁺  
d. ADP  
e. 3-phosphoglycerate

21.  The Aerobic Pathway; p. 111; moderate; ans: c
Upon entering the citric acid cycle, the acetyl group combines with _____ to produce ______.

a. coenzyme A; pyruvate  
b. glucose; glucose 6-phosphate  
c. oxaloacetate; citrate
d. oxaloacetate; carbon dioxide
e. NADH; citrate

22. The Aerobic Pathway; p. 111; moderate; ans: e
After acetyl CoA enters the citric acid cycle, the coenzyme A portion of the molecule:

a. combines with oxaloacetate.
b. combines with citrate.
c. is oxidized.
d. is reduced.
e. is released.

23. The Aerobic Pathway; p. 111; difficult; ans: d
Which of the following does NOT occur during the citric acid cycle?

a. decarboxylation
b. substrate-level phosphorylation
c. oxidation
d. oxidative phosphorylation
e. regeneration of oxaloacetate

24. The Aerobic Pathway; p. 111; easy; ans: b
In each turn of the citric acid cycle, how many molecules of ATP are produced?

a. 0
b. 1
c. 2
d. 3
e. 4

25. The Aerobic Pathway; p. 111; moderate; ans: c
In the citric acid cycle, how many molecules of FADH are produced per molecule of glucose?

a. 0
b. 1
c. 2
d. 3
e. 4

26. The Aerobic Pathway; p. 111; moderate; ans: e
In the citric acid cycle, how many molecules of NADH are produced per molecule of glucose?

a. 0
b. 1
c. 2
d. 4
e. 6

27. The Aerobic Pathway; p. 112; easy; ans: d
Most of the carriers of the electron transport chain are:

a. in the cytosol.
b. in the mitochondrial matrix.
c. contained between the outer and inner mitochondrial membranes.
d. embedded in the inner mitochondrial membrane.
e. embedded in the outer mitochondrial membrane.

28. **The Aerobic Pathway; p. 113; difficult; ans: e**
Which of the following statements about iron-sulfur proteins is FALSE?

   a. They are components of the electron transport chain.
   b. Their iron is not attached to a porphyrin ring.
   c. Their iron is attached to sulfides.
   d. Their iron is attached to the sulfur of sulfur-containing amino acids.
   e. They carry electrons and protons.

29. **The Aerobic Pathway; p. 113; easy; ans: c**
The most abundant component(s) of the mitochondrial electron transport chain is/are:

   a. cytochromes.
   b. iron-sulfur proteins.
   c. coenzyme Q.
   d. NAD⁺.
   e. FAD.

30. **The Aerobic Pathway; p. 113; easy; ans: a**
Who am I? I move freely within the mitochondrial membrane and thus shuttle electrons between other carriers.

   a. CoQ
   b. Fe-S proteins
   c. cytochromes
   d. cytochrome oxidase
   e. CoA

31. **The Aerobic Pathway; p. 114; moderate; ans: e**
The energy released by the flow of electrons along the electron transport chain is used *directly* to:

   a. form ATP from ADP and phosphate.
   b. oxidize NADH.
   c. reduce FAD.
   d. decarboxylate citrate.
   e. pump protons.

32. **The Aerobic Pathway; p. 114; moderate; ans: d**
The final electron acceptor in the electron transport chain is:

   a. CoQ.
   b. a cytochrome.
   c. FMN.
   d. oxygen.
   e. carbon dioxide.

33. **The Aerobic Pathway; p. 114; easy; ans: d**
For each pair of electrons passing from NADH to oxygen, how many ATP molecules can be generated?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

34. **The Aerobic Pathway; p. 114; difficult; ans: d**  
Oxidative phosphorylation depends on a gradient of ______ across the mitochondrial membrane.

a. ADP  
b. phosphate  
c. glucose  
d. protons  
e. electrons

35. **The Aerobic Pathway; p. 115; moderate; ans: d**  
In the electron transport chain, electrons pass from complex ____ directly to O₂.

a. I  
b. II  
c. III  
d. IV  
e. V

36. **The Aerobic Pathway; p. 115; moderate; ans: c**  
The electrochemical gradient resulting from electron transport is due to differences in ______ across the inner mitochondrial membrane.

a. only the electric charge  
b. proton concentration only  
c. electric charge and proton concentration  
d. only the ATP concentration  
e. ATP and NAD⁺ concentrations

37. **The Aerobic Pathway; p. 115; difficult; ans: b**  
Which of the following statements about ATP synthase is FALSE?

a. It synthesizes ATP.  
b. It transports electrons.  
c. It binds phosphate.  
d. It binds ADP.  
e. It transports hydrogen ions.

38. **The Aerobic Pathway; p. 116; moderate; ans: c**  
The number of ATP molecules generated from each NADH produced in glycolysis is _______.

a. 0  
b. 1  
c. 2
39. **The Aerobic Pathway; p. 116; moderate; ans: c**
The number of ATP molecules generated from each NADH produced in the conversion of pyruvate to acetyl CoA is _______.

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

40. **The Aerobic Pathway; p. 117; easy; ans: a**
Most of the ATP formed in respiration is produced by reactions associated with:

a. the electron transport chain.  
b. the citric acid cycle.  
c. glycolysis.  
d. fermentation.  
e. the conversion of pyruvate to acetyl CoA.

41. **Other Substrates for Respiration; p. 117; moderate; ans: e**
The process of beta oxidation is involved in the breakdown of:

a. starch.  
b. sucrose.  
c. proteins.  
d. nucleic acids.  
e. triglycerides.

42. **Anaerobic Pathways; p. 118; moderate; ans: c**
Under anaerobic conditions, yeasts and most plant cells convert pyruvate to:

a. acetyl CoA.  
b. lactate.  
c. ethanol and carbon dioxide.  
d. ATP.  
e. glucose.

43. **Anaerobic Pathways; p. 118; moderate; ans: d**
Which of the following processes occurs in both lactate fermentation and alcohol fermentation?

a. formation of acetyl CoA  
b. release of carbon dioxide  
c. pumping of protons  
d. oxidation of NADH  
e. activation of ATP synthase

44. **Anaerobic Pathways; p. 118; easy; ans: c**
In lactate fermentation and alcohol fermentation, the net ATP production is _______ molecules of ATP per molecule of glucose.
45.  The Strategy of Energy Metabolism; p. 119; easy; ans: b
“Catabolism” specifically refers to the various pathways in which organisms ______ organic molecules.

a.  synthesize  
   b.  break down  
   c.  phosphorylate  
   d.  oxidize  
   e.  reduce

46.  The Strategy of Energy Metabolism; p. 110; easy; ans: e
The metabolic “hub” of the cell is:

a.  fermentation.  
   b.  glycolysis.  
   c.  oxidative phosphorylation.  
   d.  the electron transport chain.  
   e.  the citric acid cycle.

Chapter 7: Photosynthesis, Light, and Life

Multiple-Choice Questions

1.  Photosynthesis: A Historical Perspective; p. 122; easy; ans: e
Who provided the first experimental evidence that soil alone does not nourish the plant?

a.  Jan Ingenhousz  
   b.  Aristotle  
   c.  F. F. Blackman  
   d.  Joseph Priestley  
   e.  Jan Baptista van Helmont

2.  Photosynthesis: A Historical Perspective; p. 123; moderate; ans: b
The O₂ evolved in photosynthesis comes from:

a.  carbon dioxide.  
   b.  water.  
   c.  glucose.
d. \((\text{CH}_2\text{O})\).
e. \((\text{C}_3\text{H}_3\text{O}_3)\).

3. **Photosynthesis: A Historical Perspective; p. 124; easy; ans: c**
F. F. Blackman showed that:

a. air “restored” by vegetation could support the breathing of animals.
b. air is “restored” only in the presence of light and only by the green parts of the plant.
c. photosynthesis has a light-dependent stage and a light-independent stage.
d. isolated chloroplasts are able to produce \(\text{O}_2\) in the absence of light.
e. all the substance of a plant is provided by water and not the soil.

4. **The Nature of Light; p. 125; moderate; ans: e**
Which of the following statements about the electromagnetic spectrum is FALSE?

a. All radiations travel in waves.
b. White light consists of a number of different colors.
c. Different colors of light are refracted at different angles.
d. A wavelength is the distance from one wave crest to the crest of another.
e. The longer the wavelength of light, the more energy it has.

5. **The Nature of Light; p. 126; easy; ans: e**
Light is composed of particles called:

a. electrons.
b. protons.
c. neutrons.
d. gamma rays.
e. photons.

6. **The Role of Pigments; p. 126; moderate; ans: c**
Chlorophyll absorbs light principally in the ______ wavelengths.

a. blue and green
b. green and violet
c. blue and violet
d. violet and green
e. green and red

7. **The Role of Pigments; p. 126; difficult; ans: e**
An action spectrum is different from an absorption spectrum in that an action spectrum:

a. provides evidence that a particular pigment is responsible for a particular process.
b. provides information about the extent of reflectance.
c. is the light-transmitting pattern of a pigment.
d. is the light-absorbing pattern of a pigment.
e. is the relative effectiveness of different wavelengths for a specific process.

8. **The Role of Pigments; p. 126; difficult; ans: c**
Which of the following is the very next event that occurs when a chlorophyll molecule absorbs light?

a. The energy is released as heat.
b. Fluorescence occurs.
c. The electron is boosted to an excited state.
d. Resonance energy transfer occurs.
e. The electron is transferred to an electron transport chain.

9. The Role of Pigments; p. 129; easy; ans: a
Which pigment occurs in all photosynthetic eukaryotes?

a. Chlorophyll a
b. Chlorophyll b
c. Chlorophyll c
d. Bacteriochlorophyll
e. Chlorobium chlorophyll

10. The Role of Pigments; p. 129; easy; ans: b
The primary function of ______ is as an anti-oxidant.

a. chlorophyll a
b. carotenoids
c. phycobilins
d. bacteriochlorophyll
e. chlorobium chlorophyll

11. The Role of Pigments; p. 129; easy; ans: c
Xanthophylls and carotenes:

a. are the principal photosynthetic pigments in green plants.
b. are the principal sources of vitamin C for humans.
c. are carotenoids.
d. are normally present in the cytosol rather than in plastids.
e. can substitute for chlorophylls in photosynthesis.

12. The Reactions of Photosynthesis; p. 129; easy; ans: a
The energy-transduction reactions of photosynthesis are also called the ______ reactions.

a. light
b. dark
c. light-independent
d. carbon-fixation
e. biosynthetic

13. The Reactions of Photosynthesis; p. 130; moderate; ans: e
Which of the following statements about an antenna complex is FALSE?

a. It is part of a photosystem.
b. It “funnels” energy to the reaction center.
c. It contains chlorophyll molecules.
d. It contains carotenoid pigments.
e. It converts light energy into chemical energy.

14. The Reactions of Photosynthesis; pp. 130-131; difficult; ans: b
The light-harvesting complex is different from a photosystem in that the light-harvesting complex:

a. lacks chlorophyll a.
b. lacks a reaction center.
c. lacks carotenoids.
d. collects light energy.
e. contains pigment-binding proteins.

15. The Reactions of Photosynthesis; p. 131; moderate; ans: c
In the antenna complex, light energy is transferred from one pigment molecule to another by:

a. pigment activation.
b. fluorescence.
c. resonance energy transfer.
d. reduction.
e. oxidation.

16. The Reactions of Photosynthesis; p. 131; moderate; ans: c
In contrast to Photosystem I, Photosystem II is located primarily:

a. in the chloroplast.
b. in the cytosol.
c. in grana thylakoids.
d. in stroma thylakoids
e. in the plasma membrane.

17. The Reactions of Photosynthesis; p. 131; moderate; ans: e
In Photosystem II, energized electrons are transferred from pheophytin directly to:

a. chlorophyll a.
b. NADP+.
c. the oxygen-evolving complex.
d. plastoquinol.
e. PQA.

18. The Reactions of Photosynthesis; p. 132; difficult; ans: a
In the light reactions, the cytochrome hof complex receives electrons directly from:

a. plastoquinol.
b. ferredoxin.
c. pheophytin
d. manganese.
e. plastocyanin.

19. The Reactions of Photosynthesis; p. 132; difficult; ans: a
Following photolysis, the resulting protons are released into the ______, contributing to the proton gradient across the ______ membrane.

a. lumen of the thylakoid; thylakoid
b. chloroplast stroma; outer chloroplast
c. chloroplast stroma; thylakoid
d. chloroplast matrix; inner chloroplast
e. cytosol; inner mitochondrial

20. The Reactions of Photosynthesis; pp. 132-133; moderate; ans: e
The ______ complex links photosystems I and II.
   a. ATP synthase
   b. light-harvesting
   c. oxygen-evolving
   d. water photolysis
   e. cytochrome b6/f

21. The Reactions of Photosynthesis; p. 133; moderate; ans: b
   In photophosphorylation, the role of the ATP synthase complex is to provide a channel for protons to
   flow back into the:
   a. lumen of the thylakoid.
   b. chloroplast stroma.
   c. intermembrane space of the mitochondrion.
   d. intermembrane space of the chloroplast.
   e. cytosol.

22. The Reactions of Photosynthesis; pp. 133-134; moderate; ans: c
   Which of the following events is NOT associated with Photosystem I?
   a. absorption of light by antenna molecules
   b. excitation of an electron from P700
   c. transfer of electrons from cytochromes to iron-sulfur proteins
   d. reduction of NADP+
   e. reduction of A0

23. The Reactions of Photosynthesis; p. 134; difficult; ans: b
   Which of the following statements concerning ferredoxin is FALSE?
   a. It is the final electron acceptor of Photosystem I.
   b. It is found in the chloroplast grana.
   c. It transfers electrons to NADP+.
   d. It is an iron-sulfur protein.
   e. It is a mobile protein.

24. The Reactions of Photosynthesis; pp. 134-135; difficult; ans: d
   Which of the following is produced during noncyclic AND cyclic electron flow?
   a. water
   b. NADPH
   c. sugar
   d. ATP
   e. O2

25. The Reactions of Photosynthesis; p. 135; easy; ans: c
   During cyclic electron flow, electrons are transferred directly from P700 to A0 to:
a. $P_{700}$.
b. $P_{680}$.
c. the photosynthetic electron transport chain.
d. the photosynthetic ATP synthase.
e. the lumen of the thylakoid.

26. The Carbon-Fixation Reactions; p. 135; moderate; ans: b
The Calvin cycle takes place in the:

a. lumen of the thylakoid.
b. chloroplast stroma.
c. thylakoid membrane.
d. cytoplasm.
e. mitochondrial matrix.

27. The Carbon-Fixation Reactions; p. 136; easy; ans: c
Carbon dioxide is “fixed” by bonding to:

a. glyceraldehyde 3-phosphate.
b. 3-phosphoglycerate.
c. ribulose 1,5-bisphosphate.
d. NADP$^+$.  
e. ADP.

28. The Carbon-Fixation Reactions; p. 136; easy; ans: a
The role of Rubisco is to catalyze the conversion of:

a. CO$_2$ to an unstable six-carbon compound.
b. CO$_2$ to glyceraldehyde 3-phosphate.
c. 3-phosphoglycerate to glyceraldehyde 3-phosphate.
d. glyceraldehyde 3-phosphate to sucrose.
e. glyceraldehyde 3-phosphate to starch.

29. The Carbon-Fixation Reactions; p. 136; easy; ans: a
How many molecules of CO$_2$ are fixed during each turn of the Calvin cycle?

a. one  
b. two  
c. three  
d. four  
e. five

30. The Carbon-Fixation Reactions; p. 136; difficult; ans: b
Which of the following does NOT occur in the Calvin cycle?

a. ATP is hydrolyzed.
b. ADP is phosphorylated to ATP.
c. NADPH is oxidized.
d. Ribulose 1,5-bisphosphate is regenerated.
e. CO$_2$ is fixed.
31. **The Carbon-Fixation Reactions; p. 136; difficult; ans: e**
   Which of the following statements about the Calvin cycle is FALSE?
   
   a. It requires more ATP than NADPH.
   b. Each reaction is catalyzed by a specific enzyme.
   c. It regenerates ribulose 1,5-bisphosphate.
   d. It fixes CO₂.
   e. It uses ATP from noncyclic, but not cyclic, photophosphorylation.

32. **The Carbon-Fixation Reactions; p. 138; easy; ans: d**
   Most of the glyceraldehyde 3-phosphate not exported to the cytosol is converted to ______ and stored in the chloroplasts.
   
   a. 3-phosphoglycerate
   b. sucrose
   c. glucose
   d. starch
   e. ribulose 1,5-bisphosphate

33. **The Carbon-Fixation Reactions; p. 138; easy; ans: b**
   Rubisco can use ______ or CO₂ as a substrate.
   
   a. 3-phosphoglycerate
   b. O₂
   c. glyceraldehyde 3-phosphate
   d. serine
   e. oxaloacetate

34. **The Carbon-Fixation Reactions; p. 138; moderate; ans: a**
   Which of the following statements about photorespiration is FALSE?
   
   a. It yields ATP but not NADPH.
   b. Phosphoglycolate is an intermediate.
   c. It consumes oxygen and releases CO₂.
   d. It is a wasteful process.
   e. Three cellular organelles participate in the process.

35. **The Carbon-Fixation Reactions; p. 139; difficult; ans: d**
   Which of the following conditions favors photorespiration?
   
   a. a ratio of CO₂ to O₂ that favors CO₂
   b. conditions that cause the stomata to open
   c. plants growing far apart
   d. a hot, dry environment
   e. darkness

36. **The Carbon-Fixation Reactions; p. 140; moderate; ans: b**
   One of the benefits of photorespiration is removing toxic:
   
   a. 3-phosphoglyceraldehyde.
   b. phosphoglycolate.
c. ribulose-bisphosphate.
d. 3-phosphoglycerate.
e. oxaloacetate.

37. The Carbon-Fixation Reactions; p. 140; moderate; ans: e
In the C₄ pathway, the enzyme PEP carboxylase:

a. uses O₂ as a substrate.
b. uses CO₂ as a substrate.
c. operates inefficiently when the CO₂ concentration is low.
d. is active only in the chloroplasts of mesophyll cells.
e. catalyzes the formation of oxaloacetate.

38. The Carbon-Fixation Reactions; p. 142; moderate; ans: a
The malate or aspartate produced in the C₄ pathway moves next into:

a. the bundle-sheath cells.
b. the mesophyll cells.
c. the stomata.
d. Photosystem I.
e. Photosystem II.

39. The Carbon-Fixation Reactions; p. 143; easy; ans: b
Kranz anatomy is characterized by a layer of ____ around a layer of ____.

a. xylem cells; mesophyll cells
b. mesophyll cells; bundle-sheath cells
c. mesophyll cells; phloem cells
d. bundle-sheath cells; phloem cells
e. bundle-sheath cells; mesophyll cells

40. The Carbon-Fixation Reactions; p. 143; moderate; ans: c
*Suaeda aralocaspica* is different from many other C₄ plants because it:

a. has only one type of chloroplast.
b. has Kranz anatomy.
c. lacks Kranz anatomy.
d. has bundle-sheath cells.
e. lacks bundle-sheath cells.

41. The Carbon-Fixation Reactions; p. 143; difficult; ans: e
Compared with a C₃ plant, a C₄ plant:

a. carries out more photorespiration.
b. has a lower photosynthetic efficiency.
c. has more Rubisco.
d. has a higher leaf nitrogen content.
e. needs more ATP to fix CO₂.

42. The Carbon-Fixation Reactions; p. 144; easy; ans: d
Which of the following is a C₄ plant?
a. rice
b. oats
c. Kentucky bluegrass
d. crabgrass
e. wheat

43. **The Carbon-Fixation Reactions; p. 144; moderate; ans: d**
Compared with C\textsubscript{3} plants, C\textsubscript{4} plants:

a. are well adapted to low light intensities.
b. are well adapted to low temperatures.
c. are well adapted to moist areas.
d. use nitrogen more efficiently.
e. fix CO\textsubscript{2} less efficiently.

44. **The Carbon-Fixation Reactions; p. 145; easy; ans: a**
In CAM plants, malate formed as the end product of CO\textsubscript{2} fixation in the dark is stored as malic acid in the:

a. vacuole.
b. chloroplast stroma.
c. thylakoid lumen.
d. cytosol.
e. nucleus.

45. **The Carbon-Fixation Reactions; p. 145; moderate; ans: c**
Which of the following is most likely to occur in a leaf cell of a CAM plant during the day?

a. entry of CO\textsubscript{2} through stomata
b. exit of water through stomata
c. decarboxylation of malic acid
d. fixation of CO\textsubscript{2} by PEP carboxylase
e. conversion of oxaloacetate to malate

46. **The Carbon-Fixation Reactions; p. 145; easy; ans: e**
Which of the following is *not* considered a CAM plant?

a. cactus
b. pineapple
c. Spanish “moss”
d. *Welwitschia*
e. wheat

47. **The Carbon-Fixation Reactions; p. 146; difficult; ans: b**
Which of the following statements about CAM plants is FALSE?

a. Not all CAM plants are succulent.
b. All CAM plants are flowering plants.
c. They use both C\textsubscript{3} and C\textsubscript{4} pathways.
d. They are dependent on nighttime accumulation of CO\textsubscript{2} for photosynthesis.
e. Their water-use efficiency is higher than that of C$_3$ and C$_4$ plants.

**Chapter 12: Systematics: The Science of Biological Diversity**

**Multiple-Choice Questions**

1. **Taxonomy: Nomenclature and Classification; p. 234; easy; ans: d**
   Modern biological classification began with:
   
   a. Charles Darwin.
   b. Gregor Mendel.
   c. Jean Baptiste de Lamarck.
   d. Carl Linnaeus.
   e. Caspar Bauhin.

2. **Taxonomy: Nomenclature and Classification; pp. 234-235; moderate; ans: e**
   Which of the following statements about Linnaeus is FALSE?
   
   a. He published the book *Species Plantarum*.
   b. He described each species using a sentence of no more than 12 words.
   c. He made permanent the binomial system of nomenclature.
   d. He devised a polynomial as a proper name for each species.
   e. He developed a “shorthand” designation for each species consisting of a single word.

3. **Taxonomy: Nomenclature and Classification; p. 235; moderate; ans: a**
   The binomial for poison ivy is *Toxicodendron radicans*. To what genus does this plant belong?
   
   a. *Toxicodendron*
   b. *Radicans*
   c. *Toxicodendron radicans*
   d. Poison ivy
   e. *Toxicodendron radicans* poison ivy

4. **Taxonomy: Nomenclature and Classification; p. 235; moderate; ans: c**
   The binomial for the coast redwood is *Sequoia sempervirens*. What is the species name of this plant?
   
   a. *Sequoia*
   b. *Sempervirens*
   c. *Sequoia sempervirens*
   d. Coast redwood
   e. *Sequoia sempervirens* coast redwood

5. **Taxonomy: Nomenclature and Classification; p. 235; difficult; ans: d**
   Which of the following statements about the naming of species and varieties is FALSE?
   
   a. Type specimens serve as a basis for designating the species of other specimens.
   b. Certain species consist of two or more varieties.
   c. The varieties of a species that includes the type specimen is named by repeating the specific
epithet.
d. When used alone, the specific epithet provides valuable taxonomic information.
e. Names of genera and species are printed in italic.

6. **Taxonomy: Nomenclature and Classification; p. 236; moderate; ans: c**
Which of the following lists the taxonomic categories in the correct hierarchy, from most to least inclusive, under kingdom?

a. Class, phylum, order, family, genus, species
b. Order, class, phylum, family, genus, species
c. Phylum, class, order, family, genus, species
d. Phylum, order, class, family, genus, species
e. Order, phylum, family, class, genus, species

7. **Taxonomy: Nomenclature and Classification; p. 236; moderate; ans: e**
*Cattleya* is one genus in the *Orchidaceae*, the orchid family. In this example:

a. *Cattleya* is a category.
b. *Orchidaceae* is a category.
c. *Cattleya* is a taxon but *Orchidaceae* is not.
d. *Orchidaceae* is a taxon but *Cattleya* is not.
e. *Cattleya* and *Orchidaceae* are taxa.

8. **Taxonomy: Nomenclature and Classification; p. 236; easy; ans: b**
The term “phylum” is nomenclaturally equivalent to:

a. class.
b. division.
c. order.
d. kingdom.
e. family.

9. **Taxonomy: Nomenclature and Classification; p. 237; moderate; ans: e**
The names of almost all plant families end in:

a. -*ium*.
b. -*ica*.
c. -*om*.
d. -*ales*.
e. -*aceae*.

10. **Taxonomy: Nomenclature and Classification; p. 238; easy; ans: d**
Phylogeny refers to the:

a. naming of organisms.
b. placing of organisms into phyla.
c. nomenclature of species.
d. evolutionary history of an organism.
e. grouping of classes of organisms.
11. **Taxonomy: Nomenclature and Classification; p. 238; moderate; ans: a**
   A natural classification system differs from an artificial classification system in that a natural classification system:
   
   a. reflects the evolutionary relationships among organisms.
   b. is based on plant form: trees, shrubs, undershrubs, and herbs.
   c. is based on the number and arrangement of stamens in the flower.
   d. classifies organisms by means of one or a few characters.
   e. classifies organisms primarily as an aid to identification.

12. **Taxonomy: Nomenclature and Classification; p. 238; easy; ans: c**
   When the members of a taxon are all descendents of a common single ancestral species, the taxon is said to be:
   
   a. phylogenetic.
   b. paraphyletic.
   c. monophyletic.
   d. polyphyletic.
   e. amphiphyletic.

13. **Taxonomy: Nomenclature and Classification; p. 238; easy; ans: d**
   When the members of a group have two or more ancestors, that group is said to be:
   
   a. phylogenetic.
   b. paraphyletic.
   c. monophyletic.
   d. polyphyletic.
   e. amphiphyletic.

14. **Taxonomy: Nomenclature and Classification; p. 239; easy; ans: d**
   Biological features that have a common origin, even if they have a different function, are said to be:
   
   a. artificial.
   b. natural.
   c. paraphyletic.
   d. homologous.
   e. analogous.

15. **Taxonomy: Nomenclature and Classification; p. 239; moderate; ans: e**
   The wing of a bird and the wing of an insect are:
   
   a. homologous but not artificial.
   b. polyphyletic but not paraphyletic.
   c. paraphyletic but not polyphyletic.
   d. homologous but not analogous.
   e. analogous but not homologous.

16. **Cladistics; p. 239; easy; ans: a**
   Synapomorphies are:
   
   a. shared derived characters.
b. outgroups used to root a tree.
c. ingroups used to root a tree.
d. types of sister groups.
e. branches on a cladogram.

17. Cladistics; p. 240; moderate; ans: d
In a cladogram, groups that terminate in adjacent branches are called:

a. nodes.
b. derived groups.
c. synapomorphies.
d. sister groups.
e. outgroups.

18. Cladistics; p. 240; easy; ans: b
The rule of parsimony states that:

a. analogous features should be given more importance than homologous features.
b. cladograms should be constructed in the least complicated way.
c. character states are distinguished from one another by comparison with outgroups.
d. adjacent branches should terminate in a node.
e. phylogenetic relationships should be based on ancestral character states.

19. Molecular Systematics; p. 240; easy; ans: e
Which of the following statements concerning the use of molecular data in systematics is FALSE?

a. Molecular data are easier to quantify than traditional data.
b. Molecular data provide more characters for analysis than traditional data.
c. Molecular data allow comparisons of morphologically different organisms.
d. Molecular data permit comparisons of organisms at the level of the gene.
e. Molecular data concerning the amino acid sequences of proteins are the most widely used.

20. Molecular Systematics; p. 240; moderate; ans: b
Neutral mutations:

a. are not helpful in systematics.
b. can be used to determine changes occurring in homologous genes since lineages diverged.
c. have accumulated over time as the result of natural selection.
d. have accumulated at a highly changeable rate over evolutionary time.
e. account for a very small percentage of the variation in homologous genes in different groups of organisms.

21. Molecular Systematics; p. 240; moderate; ans: c
If you analyze the neutral mutations from two groups and find there are few differences in their nucleotide sequences, you would logically conclude that the two groups:

a. belong to the same species.
b. belong to different species.
c. diverged relatively recently from a common ancestor.
d. diverged relatively long ago from a common ancestor.
e. belong to a monophyletic taxon.
22. **Molecular Systematics; p. 243; easy; ans: b**
Which of the following statements concerning chloroplast DNA is FALSE?

a. It is a circular molecule.
b. It contains more nucleotides than the mitochondria.
c. It contains inverted repeats.
d. It contains genes that encode the large Rubisco subunit.
e. It contains two regions that encode the same genes.

23. **Molecular Systematics; p. 243; moderate; ans: c**
Which of the following statements concerning the *rcbL* gene is FALSE?

a. It is useful for resolving relationships between closely related genera.
b. It is present in all photosynthetic eukaryotes and cyanobacteria.
c. It is a rapidly evolving gene.
d. It is a single-copy gene.
e. It encodes the large subunit of the Rubisco enzyme.

24. **Molecular Systematics; p. 243; moderate; ans: e**
The DNA barcode used for animals is _____, and for plants the DNA barcode is ______.

a. *CO1* or *matK*; *CO1*
b. *CO1* or *rbcL*; *CO1*.
c. *rbcL* or *matK*; *CO1*
d. *CO1*; *CO1*
e. *CO1*; *rbcL* or *matK*

25. **The Major Groups of Organisms: Bacteria, Archaea, and Eukarya; p. 244; easy; ans: d**
The three domains of organisms are the:

a. Archaea, Bacteria, and Protista
b. Bacteria, Eukarya, and Protista
c. Bacteria, Eukarya, and Fungi
d. Archaea, Bacteria, and Eukarya
e. Archaea, Eukarya, and Fungi

26. **The Major Groups of Organisms: Bacteria, Archaea, and Eukarya; p. 244; easy; ans: e**
The eukaryotes are divided into _____ supergroups.

a. 2
b. 3
c. 4
d. 6
e. 7

27. **Origin of the Eukaryotes; p. 247; easy; ans: a**
According to the serial endosymbiotic theory, chloroplasts evolved from:

a. bacteria.
b. protists.
c. fungi.
d. plasmids.
e. portions of the plasma membrane.

28. **Origin of Eukaryotes; p. 247; easy; ans: c**

By definition, an endosymbiont is an organism that:

a. is a parasite.
b. is a phagocyte.
c. lives within another, dissimilar organism.
d. lives within a nonliving substance.
e. forms an organelle within the cells of another organism.

29. **Origin of the Eukaryotes; p. 247; difficult; ans: b**

Which of the following best indicates the correct sequence in which the evolution of these organelles occurred?

a. mitochondrion, lysosome, chloroplast
b. lysosome, mitochondrion, chloroplast
c. lysosome, chloroplast, mitochondrion
d. chloroplast, mitochondrion, lysosome
e. chloroplast, lysosome, mitochondrion

30. **Origin of the Eukaryotes; p. 247; easy; ans: d**

The endomembrane system of plant cells most likely evolved from:

a. a chloroplast.
b. a mitochondrion.
c. a lysosome.
d. portions of the plasma membrane.
e. portions of the vacuole.

31. **Origin of the Eukaryotes; p. 247; easy; ans: d**

The nucleus of plant cells most likely evolved from:

a. a chloroplast.
b. a mitochondrion.
c. a lysosome.
d. portions of the plasma membrane.
e. portions of the vacuole.

32. **Origin of the Eukaryotes; p. 247; easy; ans: e**

In the *Vorticella/Chlorella* endosymbiosis:

a. *Vorticella* functions as the endomembrane system for *Chlorella*.
b. *Chlorella* provides minerals for *Vorticella*.
c. *Chlorella* functions as a chloroplast in *Vorticella*.
d. *Vorticella* functions as a mitochondrion in *Chlorella*.
e. *Chlorella* provides photosynthetic products for *Vorticella*.

33. **Origin of the Eukaryotes; p. 248; easy; ans: c**

In the course of evolution of eukaryotic cells, some mitochondrial DNA was transferred to:
a. the host cell’s chloroplast.
b. a bacterial cell.
c. the host cell’s nucleus.
d. the host cell’s plasma membrane.
e. a plasmid.

34. **Origin of the Eukaryotes; p. 248; moderate; ans: c**
In secondary endosymbiosis, a ______ is engulfed by a eukaryotic host.

a. cyanobacterial cell
b. mitochondrion
c. cell containing a primary plastid
d. cell containing a secondary plastid
e. cell containing a tertiary plastid

35. **The Protists and Eukaryotic Kingdoms; p. 248; easy; ans: b**
A eukaryotic, multicellular organism that absorbs its food belongs to the kingdom:

a. Protista.
b. Fungi.
c. Animalia.
d. Plantae.
e. Eukarya.

36. **The Protists and Eukaryotic Kingdoms; p. 249; easy; ans: c**
A multicellular organism that ingests its food belongs to the kingdom:

a. Protista.
b. Monera.
c. Animalia.
d. Plantae.
e. Eukarya.

37. **The Protists and Eukaryotic Kingdoms; p. 249; moderate; ans: b**
Water molds and slime molds are included in the _____ group.

a. fungus
b. protist
c. animal
d. archaean
e. plant

38. **The Protists and Eukaryotic Kingdoms; p. 249; easy; ans: b**
_____ are a paraphyletic group of eukaryotic organisms that are unicellular, colonial or multicellular.

a. Fungi
b. Protists
c. Animals
39. **The Protists and Eukaryotic Kingdoms; pp. 249-250; moderate; ans: e**

Multicellular eukaryotes that have an embryo during the sporophyte phase belong to the kingdom:

a. Fungi.
b. Protista.
c. Eukarya.
d. Archaea.
e. Plantae.

40. **Life Cycles and Diploidy; p. 250; moderate; ans: b**

Which of the following describes zygotic meiosis?

a. It occurs in most plants.
b. The zygote is the only diploid cell in the life cycle.
c. It results directly in gametes.
d. It is characteristic of organisms having an alternation of generations.
e. It is characteristic of organisms with isomorphic generations.

41. **Life Cycles and Diploidy; p. 251; moderate; ans: d**

Which of the following describes sporic meiosis?

a. It occurs in most animals.
b. The gametes are the only haploid cells in the life cycle.
c. It most likely evolved before zygotic meiosis.
d. It is characteristic of organisms having an alternation of generations.
e. The zygote is the only diploid cell in the life cycle.

42. **Life Cycles and Diploidy; p. 253; moderate; ans: d**

The gametophyte:

a. is the diploid generation.
b. is the spore-producing generation.
c. is the dominant generation in vascular plants.
d. occurs in organisms having sporic meiosis.
e. stores more genetic information than the sporophyte.

43. **Life Cycles and Diploidy; p. 253; easy; ans: e**

Life cycles in which the haploid and diploid forms are similar in external appearance are said to have _______ generations.

a. morphospecific
b. isospecific
c. isogamous
d. heteromorphic
e. isomorphic
44. **Life Cycles and Diploidy; p. 254; easy; ans: a**

One clear evolutionary trend in the vascular plants is the increasing dominance of:

a. the sporophyte.

b. the gametophyte.

c. zygotic meiosis.

d. gametic meiosis.

e. isomorphic life cycles.

---

**Chapter 13: Prokaryotes and Viruses**

**Multiple-Choice Questions**

1. **Introduction; p. 256; easy; ans: d**

The oldest known fossils of prokaryotes are found in rocks dated at about ______ years old.

a. 3.5 million

b. 35 million

c. 350 million

d. 3.5 billion

e. 35 billion

2. **Characteristics of the Prokaryotic Cell; p. 258; moderate; ans: b**

Which of the following statements does NOT describe the plasma membrane of prokaryotes?

a. Like eukaryotic plasma membranes, it is a lipid bilayer.

b. Like eukaryotic plasma membranes, it contains proteins and sterols.

b. In aerobic species, it is the site of the electron transport chain.

d. In some photosynthetic species it is the site of photosynthesis.

ej. It has attachment sites for daughter chromosomes during cell division.

3. **Characteristics of the Prokaryotic Cell; p. 239; easy; ans: e**

In the photosynthetic purple bacteria, photosynthesis occurs in the:

a. pili.

b. glycocalyx.

c. cell wall.

d. nucleoid.

e. plasma membrane.

4. **Characteristics of the Prokaryotic Cell; p. 258; moderate; ans: c**

The cell walls of Bacteria differ from those of Archaea and eukaryotes in that the cell walls of Bacteria contain:

a. cellulose.

b. sterols.

c. peptidoglycans.

d. phospholipids.
e. poly-β-hydroxybutyric acid.

5. Characteristics of the Prokaryotic Cell; p. 258; difficult; ans: b
The cell walls of gram-positive and gram-negative Bacteria differ in that gram-positive species have cell walls:

a. with less peptidoglycan.
b. of greater thickness.
c. consisting of two layers.
d. with a layer of lipopolysaccharides.
e. with a structure similar to that of the plasma membrane.

6. Characteristics of the Prokaryotic Cell; p. 258; moderate; ans: e
The glycocalyx is a:

a. type of bacterial plasmid.
b. convoluted infolding of the prokaryotic plasma membrane.
c. type of inclusion body in prokaryotic cells.
d. constituent of the cell wall of gram-positive Bacteria.
e. slimy or gummy substance coating the outer surface of the prokaryotic cell wall.

7. Characteristics of the Prokaryotic Cell; p. 258; easy; ans: d
In prokaryotes, poly-β-hydroxybutyric acid is a storage compound occurring:

a. in the nucleoid.
b. in the plasma membrane.
c. in the cell wall.
d. as inclusion bodies.
e. as fimbriae.

8. Characteristics of the Prokaryotic Cell; p. 258; moderate; ans: c
Prokaryotic flagella differ from eukaryotic flagella in that prokaryotic flagella:

a. are surrounded by a plasma membrane.
b. consist of microtubules.
c. consist of subunits of flagellin.
d. are long, slender appendages.
e. are involved in motility.

9. Characteristics of the Prokaryotic Cell; p. 259; moderate; ans: a
Structures called _______ connect two cells and draw them together for DNA transfer.

a. pili
b. flagellin
c. flagella
d. fimbriae
e. nanotubes

10. Characteristics of the Prokaryotic Cell; p. 259; moderate; ans: e
Which of the following statements concerning nanotubes is FALSE?

a. They have a plasma membrane.
b. They are composed of cell wall material.
c. They contain cytoplasm.
d. They provide a network for the exchange of molecules.
e. They are indistinguishable from pili.

11. **Diversity of Form; p. 259; moderate; ans: a**
A coccus has a ______ shape.

   a. spherical  
   b. spiral  
   c. cylindrical  
   d. curved  
   e. triangular

12. **Diversity of Form; p. 259; moderate; ans: b**
Which of the following statements concerning biofilms is FALSE?

   a. They consist of assemblages of cells enclosed in a matrix of molecules.  
   b. They are composed of bacteria but not archaea.  
   c. They require communication and signaling among cells.  
   d. An example is the film that develops on unbrushed teeth.  
   e. They increase the chances for survival of cells in the biofilm.

Which of the following processes is NOT a type of lateral gene transfer in prokaryotes?

   a. binary fission  
   b. transduction  
   c. transformation  
   d. conjugation  
   e. horizontal gene transfer

Which of the following is the uptake of DNA by a prokaryotic cell from its environment?

   a. binary fission  
   b. transduction  
   c. transformation  
   d. conjugation  
   e. budding

15. **Endospores; p. 261; moderate; ans: d**
Which of the following statements about prokaryotic endospores is FALSE?

   a. They are dormant, resting cells.  
   b. They form when a population of cells begins to exhaust its food supply.  
   c. They greatly increase the survival capacity of the cell.  
   d. They are resistant to heat but not to desiccation.  
   e. They can remain viable for long periods.

16. **Metabolic Diversity; pp. 261-262; difficult; ans: c**
By definition, autotrophs differ from heterotrophs in that autotrophs:

a. use inorganic compounds as an energy source.
b. use light as an energy source.
c. use carbon dioxide as their sole source of carbon.
d. obtain their carbon from dead organic matter.
e. obtain their energy from dead organic matter.

17. Metabolic Diversity; p. 262; moderate; ans: b
Prokaryotes that use inorganic compounds rather than light as an energy source are called:

a. heterotrophs.
b. chemosynthetic autotrophs.
c. photosynthetic autotrophs.
d. psychrophiles.
e. saprotrophs.

18. Metabolic Diversity; p. 262; moderate; ans: a
Prokaryotes that can grow in the presence of oxygen, even though they cannot use oxygen, are called:

a. facultative anaerobes.
b. facultative aerobes.
c. photosynthetic autotrophs.
d. psychrophiles.
e. thermophiles

19. Metabolic Diversity; p. 262; difficult; ans: e
Which of the following statements about the ecological role of prokaryotes is FALSE?

a. Autotrophic species make major contributions to the global carbon balance.
b. Certain species fix atmospheric nitrogen.
c. Decomposers recycle materials from the bodies of dead organisms.
d. Certain bacteria degrade pesticides and other synthetic substances.
e. Certain prokaryotes are currently the most widely used method for cleaning up toxic dumps.

20. Metabolic Diversity; p. 263; moderate; ans: c
Bacterial fermentation of lactose is associated with the production of:

a. streptomycin.
b. tetracycline.
c. cheese.
d. vinegar.
e. amino acids.

21. Bacteria; p. 263; easy; ans: d
Phylogenetic analysis indicates that there are at least ______ major lineages of Bacteria.

a. 4
b. 5
c. 8
22. **Bacteria; p. 264; moderate; ans: d**
Which of the following statements about the environmental ranges of cyanobacteria is FALSE?

a. Most species are symbiotic.
b. Some species grow in hot springs.
c. Some species grow in Antarctic lakes.
d. Some species grow in acidic waters.
e. Some species grow in the fur of polar bears.

23. **Bacteria; p. 264; easy; ans: a**
Stromatolites are produced when cyanobacteria:

a. bind calcium-rich sediments.
b. produce sheaths covered with ice crystals.
c. react with the minerals in hot springs.
d. interact with fur.
e. interact with the roots of higher plants.

24. **Bacteria; p. 265; difficult; ans: e**
In the process of nitrogen fixation:

a. Photosystem II occurs but not Photosystem I.
b. cyclic photophosphorylation does not occur.
c. oxygen is produced as a waste product.
d. nitrogen gas is converted to amino acids.
e. nitrogen gas is converted to ammonium.

25. **Bacteria; p. 265; moderate; ans: b**
The heterocysts of cyanobacteria are most closely associated with:

a. sporulation.
b. nitrogen fixation.
c. photosynthesis.
d. gliding movements.
e. buoyancy.

26. **Bacteria; p. 266; easy; ans: d**
An akinete is a ______ of cyanobacteria.

a. photosynthetic pigment
b. filamentous fragment
c. storage compound
d. resistant spore

e. pigment

27. **Bacteria; p. 266; difficult; ans: e**
________ are photosynthetic prokaryotes that contain chlorophylls a and b and carotenoids but lack
phycobilins (藻紅素藻藍素？).

a. Mycoplasmas
b. Purple and green bacteria
c. Mycoplasma-like organisms
d. Cyanobacteria
e. Prochlorophytes → 原光合菌？XD

28. **Bacteria; p. 266; moderate; ans: b**
Which group of photosynthetic prokaryotes has bacteriochlorophyll and only one photosystem?

a. mycoplasmas
b. purple and green bacteria → 紫細菌、綠細菌，他們有細菌葉綠素
c. spiroplasmas
d. cyanobacteria
e. prochlorophytes

29. **Bacteria; p. 267; easy; ans: a**
______ are probably the smallest organisms capable of independent growth.

a. Mycoplasmas → 黴漿菌是最小的細菌
b. Purple bacteria
c. Green sulfur bacteria
d. Cyanobacteria
e. Prochlorophytes

30. **Bacteria; p. 267; moderate; ans: c**
Citrus stubborn（柑橘硬化症） disease is caused by a:

a. green bacterium.
b. purple nonsulfur bacterium.
c. spiroplasma. → 螺原體，硬背吧...
d. cyanobacteium.
e. prochlorophyte.

31. **Bacteria; p. 267; moderate; ans: e**
What prokaryotes lack a cell wall and cause highly destructive diseases such as X-disease of peach?

a. prochlorophytes
b. cyanobacteria
c. purple nonsulfur bacteria
d. green nonsulfur bacteria
e. phytoplasmas → 沒細胞壁，第一個想到子囊菌

32. **Bacteria; p. 268; easy; ans: c**
A disease in which bacteria invade the vessels of the xylem and interfere with the movement of water and minerals is a:

a. blight.
b. soft rot.
33. **Archaea; p. 269; easy; ans: c**
Which of the following statements concerning archaeans is FALSE?

a. Some inhabit hostile environments.
b. Some inhabit soils.
c. Some are pathogenic.
d. They are a major component of the oceanic picoplankton.
e. They can be divided into four groups.

34. **Archaea; p. 269; easy; ans: d**

_____ are archaeans living in regions of very high salt concentration.

a. Mycoplasmas
b. Extreme thermophiles
c. Members of the genus *Thermoplasma*
d. Extreme halophiles
e. Methanogens

35. **Archaea; p. 270; easy; ans: e**
The strict anaerobes residing in the digestive tracts of cattle are:

a. mycoplasmas.
b. extreme thermophiles.
c. members of the genus *Thermoplasma*.
d. extreme halophiles.
e. methanogens.

36. **Archaea; p. 270; moderate; ans: c**
Which group of archaeans lacks a cell wall?

a. mycoplasmas
b. extreme thermophiles
c. members of the genus *Thermoplasma*
d. extreme halophiles
e. methanogens

37. **Viruses; pp. 271-273; moderate; ans: d**
Which of the following statements about viruses is FALSE?

a. Practically every kind of organism can be infected by a virus.
b. The simplest viruses consist of a nucleic acid surrounded by a capsid.
c. Some viruses have an RNA genome.
d. Outside its host cell, a virion has a slow metabolism. → 寄主細胞外無代謝
e. Some viruses contain double-stranded DNA.

38. **Viruses; p. 272; moderate; ans: e**
A viral disease of plants in which the symptoms are small, light-colored flecks intermingled with the
normal green of leaves and fruit is called:

a. ring spot.
b. yellows.
c. canker.
d. leaf roll.
e. mosaic. → 菸草「鑲嵌」病

39. **Viruses; p. 272; easy; ans: a**
The great majority of viruses have a genome composed of:

a. single-stranded RNA. → 單鍊RNA的病毒最多
b. single-stranded DNA.
c. double-stranded RNA.
d. double-stranded DNA.
e. RNA and DNA.

40. **Viruses; p. 272; moderate; ans: a**
Which of the following statements concerning plant viral infections is FALSE?

a. The viruses penetrate the cell wall. → 病毒不可能戳破細胞壁
b. Once inside the cell, the virion sheds its capsid.
c. The viral nucleic acid takes over the genetic machinery of the host cell.
d. Additional nucleic acids are produced.
e. Viral nucleic acids and proteins are assembled into additional virus particles.

41. **Viruses; p. 273; easy; ans: a**
A viral capsid is a:

a. protein coat.
b. strand of DNA.
c. strand of RNA.
d. plasma membrane.
e. type of organelle.

42. **Viruses; p. 274; moderate; ans: a**
Movement proteins facilitate the movement of viruses:

a. through plasmodesmata.
b. through vessels.
c. through sieve tubes.
d. across the plasma membrane.
e. across the nuclear envelope.

43. **Viruses; p. 274; moderate; ans: b**
Which of the following statements concerning the hypersensitive response is FALSE?

a. It is a response to infection by different types of pathogens.
b. It is usually mediated by recessive genes. → 優勢基因（dominant gene）才對
c. It includes host cell death at the infection site.
d. It includes the accumulation of antimicrobial molecules.
e. It inhibits pathogen movement at the edge of the lesion.

44. **Viroids: Other Infectious Particles; p. 275; moderate; ans: e**

Viroids consist only of a:

a. protein capsid.
b. linear DNA molecule.
c. circular DNA molecule.
d. linear RNA molecule.
e. circular RNA molecule.