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Chapter 01: Cellular Biology
Huether: Understanding Pathophysiology, First Canadian Edition

MULTIPLE CHOICE

1. A student is observing a cell under the microscope. The student notices it to have supercoiled DNA with histones. What else would the student be expected to observe?
   a. A single circular chromosome
   b. A nucleus
   c. Free-floating nuclear material
   d. No organelles

   ANS: B
   The cell described is a eukaryotic cell, so it has histones and a supercoiled DNA within its nucleus; thus, the nucleus should be observed. A prokaryotic cell contains a single circular chromosome and lacks organelles.

   REF: p. 1

2. A nurse is instructing the staff about cellular functions. Which cellular function is the nurse describing when an isolated cell absorbs oxygen and uses it to transform nutrients to energy?
   a. Metabolic absorption
   b. Communication
   c. Secretion
   d. Respiration

   ANS: D
   The cell's ability to produce energy is respiration. Communication involves maintenance of a steady dynamic state, while metabolic absorption provides cellular nutrition, and secretion allows for the delivery or release of new substances.

   REF: p. 2

3. A eukaryotic cell is undergoing DNA replication. In which region of the cell would most of the genetic information be contained?
   a. Peroxisomes
   b. Ribosomes
   c. The nucleolus
   d. Suspended in nucleoplasm

   ANS: D
   The region of the cell that contains genetic material is the nucleoplasm contained within the nucleus. The nucleolus, contained within the nucleus, is largely composed of ribosomes. Peroxisomes contain digestive enzymes.

   REF: p. 2

4. Which of the following can remove proteins attached to the cell's bilayer by dissolving the layer itself?
   a. Peripheral membrane proteins

b. Integral membrane proteins
c. Glycoproteins
d. Cell adhesion molecules

ANS: B
Proteins directly attached to the membrane bilayer can be removed by the action of integral membrane proteins that dissolve the bilayer. Peripheral membrane proteins reside at the surface while cell adhesion molecules are on the outside of the membrane. Glycoproteins act as cell identifiers.

REF: p. 7

5. Which of the following can bind to plasma membrane receptors?
a. Oxygen
b. Ribosomes
c. Amphipathic lipids
d. Ligands

ANS: D
Ligands are the only specific molecules that can bind with receptors on the cell membrane.

REF: p. 9

6. A nurse is reviewing a report from a patient with metastatic cancer. What alternation in the extracellular matrix would support the diagnosis of metastatic cancer?
a. Decreased fibronectin
b. Increased collagen
c. Decreased elastin
d. Increased glycoproteins

ANS: A
Only a reduced amount of fibronectin is found in some types of cancerous cells, allowing them to travel or metastasize.

REF: pp. 10-11

7. What type of connection allows for cellular communication?
a. Belt desmosome
b. Gap junction
c. Spot desmosome
d. Tight junction

ANS: B
Gap junctions allow for cellular communication between cells. Neither desmosomes nor tight junctions are associated with cellular communication.

REF: p. 12

8. Pancreatic beta cells secrete insulin, which inhibits secretion of glucagon from neighbouring alpha cells. This action is an example of which of the following signalling types?
a. Paracrine
b. Autocrine

c. Neurohormonal
d. Hormonal

ANS: A
Paracrine signalling involves the release of local chemical mediators that are quickly taken up, destroyed, or immobilized, as in the case of insulin and the inhibition of the secretion of glucagon. None of the other options involve signalling that is associated with a local chemical mediator like insulin.

REF: p. 12

9. In cellular metabolism, each enzyme has a high affinity for a:
a. solute.
b. substrate.
c. receptor.
d. ribosome.

ANS: B
Each enzyme has a high affinity for a substrate, a specific substance converted to a product of the reaction. Cellular metabolism is not dependent on an attraction between an enzyme and any of the remaining options.

REF: p. 16

10. An athlete runs a marathon, after which his muscles feel fatigued and unable to contract. The athlete asks the nurse why this happened. The nurse's response is based on the knowledge that the problem is result of a deficiency of:
a. GTP
b. AMP
c. ATP
d. GMP

ANS: C
When ATP is deficient, impaired muscle contraction results. None of the other options are involved in muscle contraction.

REF: p. 17

11. Which phase of catabolism produces the most ATP?
a. Digestion
b. Glycolysis
c. Oxidation
d. Citric acid cycle

ANS: D
While some ATP is produced during the oxidation and glycolysis phases, most of the ATP is generated during the citric acid cycle. Digestion does not produce any ATP.

REF: p. 16

12. A nurse is teaching the staff about the phases of cellular catabolism. Which phases should the nurse include?

a. Digestion, glycolysis, oxidation, and the citric acid cycle
b. Diffusion, osmosis, and mediated transport
c. S phase, G phase, and M phase
d. Metabolic absorption, respiration, and excretion

ANS: A
Only digestion, glycolysis, oxidation, and the citric acid cycle are the phases of cellular catabolism.

REF: p. 16

13. A runner has depleted all the oxygen available for muscle energy. Which of the following will facilitate his continued muscle performance?
a. Electron-transport chain
b. Aerobic glycolysis
c. Anaerobic glycolysis
d. Oxidative phosphorylation

ANS: C
When no oxygen is available, anaerobic glycolysis occurs. The electron-transport chain is part of the citric acid cycle. Aerobic glycolysis involves the presence of oxygen. Oxidative phosphorylation is the mechanism by which the energy produced from carbohydrates, fats, and proteins is transferred to ATP. It is not part of muscle performance.

REF: p. 17

14. A faculty member asks a student to identify the appropriate term for the movement of a solute from an area of greater to lesser concentration. Which answer indicates the nursing student understood the teaching?
a. Osmosis
b. Diffusion
c. Hydrostatic pressure
d. Active transport

ANS: B
Diffusion is the movement of a solute molecule from an area of greater solute concentration to an area of lesser solute concentration through a permeable membrane. Osmosis is the movement of water across a semipermeable membrane from a region of higher water concentration to one of lower concentration. Hydrostatic pressure is the force of fluid against a cell membrane. In active transport, molecules move up a concentration gradient.

REF: p. 19

15. Which description accurately describes electrolytes?
a. Small lipid-soluble molecules
b. Large protein molecules
c. Micronutrients used to produce ATP
d. Electrically charged molecules

ANS: D
Electrolytes are electrically charged molecules. They are not lipid soluble, they are not made up of protein, and they do not play a role in ATP production.

REF: pp. 18-19

16. A nurse is reading a chart and sees the term oncotic pressure. The nurse recalls that oncotic pressure (colloid osmotic pressure) is determined by:
    a. diffusion rate.
    b. plasma proteins.
    c. hydrostatic pressure.
    d. the availability of membrane transporter proteins.

    ANS: B
    Oncotic pressure is determined by the effect of colloids or plasma proteins. Diffusion involves the movement of solute molecules. Hydrostatic pressure is the force within a vessel moving in opposition to oncotic pressure. Membrane transporter proteins are involved in active transport within a concentration gradient.

    REF: p. 20

17. A patient has a body fluid of 300 mOsm/kg. This laboratory result is measuring:
    a. osmolality.
    b. osmolarity.
    c. osmotic pressure.
    d. oncotic pressure.

    ANS: A
    Osmolality measures the number of milliosmoles per kilogram of water, or the concentration of molecules per *weight* of water, while osmolarity measures the number of milliosmoles per litre of solution, or the concentration of molecules per *volume* of solution. Osmotic pressure is the amount of hydrostatic pressure required to oppose the osmotic movement of water. Oncotic pressure is from plasma proteins, not body fluids.

    REF: p. 20

18. A nurse is discussing the movement of fluid across the arterial end of capillary membranes into the interstitial fluid surrounding the capillary. What mechanical force is involved with this movement?
    a. Hydrostatic pressure
    b. Osmosis
    c. Diffusion
    d. Active transport

    ANS: A
    Blood reaching the capillary bed has a hydrostatic pressure of 25 to 30 mm Hg, which is sufficient force to push water across the thin capillary membranes into the interstitial space. Osmosis involves the movement of fluid from an area of higher concentration to an area of lower concentration. It does not involve pressure or force. Diffusion is the passive movement of a solute from an area of higher solute concentration to an area of lower solute concentration. Active transport involves movement up a concentration gradient.

    REF: p. 20

19. How are potassium and sodium transported across plasma membranes?

a. By passive electrolyte channels
b. By coupled channels
c. By adenosine triphosphate enzyme (ATPase)
d. By diffusion

ANS: C
The transporter protein ATPase is directly related to sodium and potassium transport via active transport. Electrolyte movements require energy and do not move passively, nor are they transported by diffusion. Enzymes, not electrolytes, are passed via coupled channels.

REF: p. 21

20. The ion transporter that moves Na^+ and Ca^{2+} simultaneously in the same direction is an example of which of the following types of transport?
a. Biport
b. Uniport
c. Antiport
d. Symport

ANS: D
When ions are transported in one direction, it is termed symport. There is no such term as biport. Uniport refers to the movement of a single molecule. Antiport refers to the movement of molecules in the opposite direction.

REF: p. 18

21. During which process are bacteria engulfed for ingestion?
a. Endocytosis
b. Pinocytosis
c. Phagocytosis
d. Exocytosis

ANS: C
Phagocytosis (cell eating) involves the ingestion of large particles, such as bacteria, through the formation of large vesicles. Endocytosis involves the formation of vesicles to facilitate movement into the cell. Pinocytosis is a type of endocytosis in which fluids and solute molecules are ingested through the formation of small vesicles. Exocytosis occurs when coated pits invaginate and internalize ligand-receptor complexes in coated vesicles.

REF: p. 21

22. Some cancer drugs work during the cell cycle phase where nuclear and cytoplasmic divisions occur. What is this cell cycle phase called?
a. G_1
b. S
c. M
d. G_2

ANS: C
The M phase includes both nuclear and cytoplasmic divisions. The G_1 phase includes the period between the M phase and the start of DNA synthesis. The S phase includes synthesis of DNA in the cell nucleus. The G_2 phase includes RNA and protein synthesis.

REF: p. 25

23. Which causes the rapid change in the resting membrane potential that initiates an action potential?
    a. Potassium gates open, and potassium rushes into the cell, changing the membrane potential from negative to positive.
    b. Sodium gates open, and sodium rushes into the cell, changing the membrane potential from negative to positive.
    c. Sodium gates close, allowing potassium into the cell to change the membrane potential from positive to negative.
    d. Potassium gates close, allowing sodium into the cell to change the membrane potential from positive to negative.

    ANS: B
    When the threshold is reached, the cell will continue to depolarize with no further stimulation. The sodium gates open, and sodium rushes into the cell, causing the membrane potential to reduce to zero and then become positive (depolarization). Sodium is involved in creating the action potential, not potassium. The sodium gate and channel must be open, not closed. The action potential is not affected by a change in the potassium gate.

    REF: p. 24

24. What event occurs to return a cell to its resting potential?
    a. K^+ rushes into the cell.
    b. Na^+ rushes into the cell.
    c. Na+-K+ pumps move Na+ and K+ out of the cell.
    d. Na+-K+ pumps move Na+ out of the cell and K+ into the cell.

    ANS: D
    In repolarization, K+ moves to the extracellular space. For a resting potential to return, Na+ is pumped to the extracellular space and K+ is pumped back to the intracellular space.

    REF: p. 24

25. A nurse teaching the staff about platelet-derived growth factor includes information that platelet-derived growth factor (PDGF) stimulates the production of:
    a. platelets.
    b. epidermal cells.
    c. connective tissue cells.
    d. nerve cells.

    ANS: C
    Different types of cells require different growth factors; for example, PDGF stimulates the production of connective tissue cells, but not platelets, epidermal cells, or nerve cells.

    REF: p. 26

26. The phase of the cell cycle during which the centromeres split and the sister chromatids are pulled apart is referred to as:
    a. anaphase.
    b. telophase.

c. prophase.
d. metaphase.

ANS: A
Anaphase begins when the centromeres split and the sister chromatids are pulled apart. During telophase, a new nuclear membrane is formed around each group of 46 chromosomes, the spindle fibres disappear, and the chromosomes begin to uncoil. During prophase, the first appearance of chromosomes occurs. Metaphase occurs when two centrioles located at opposite poles of the cell pull the chromosomes to opposite sides of the cell.

REF: p. 25

27. What is the role of cytokines in cell reproduction?
a. Provide growth factor for tissue growth and development
b. Block progress of cell reproduction through the cell cycle
c. Restrain cell growth and development
d. Provide nutrients for cell growth and development

ANS: A
Cytokines play a major role in the regulation of tissue growth and development but do not restrain it. Cytokines help overcome intracellular braking mechanisms that restrain cell growth and promote cell growth, but they do not provide nutrients.

REF: p. 26

28. A biopsy of the lung bronchi revealed ciliated epithelial cells that are capable of secretion and absorption. These cells are called _____ columnar epithelium.
a. simple
b. ciliated simple
c. stratified
d. pseudostratified ciliated

ANS: B
Ciliated simple columnar epithelium is found in the bronchi of the lungs. Simple columnar epithelium is found from the stomach to the anus. Stratified columnar epithelium is found in the lining of the epiglottis, part of the pharynx, the anus, and the male urethra. Pseudostratified ciliate columnar epithelium is found in the lining of the large ducts of some glands (parotid, salivary), male urethra, respiratory passages, and Eustachian tubes of the ears.

REF: p. 30; Table 1-6

29. A student is reviewing functions of the cell. The student would be correct in identifying a chief function of the nerve cell as:
a. sensory interpretation.
b. conductivity.
c. maintenance of homeostasis.
d. communication.

ANS: B
Conductivity, not sensory interpretation, homeostasis, or communication, is one of the eight chief functions of nerve cells.

REF: p. 2

MULTIPLE RESPONSE

1. A nurse recalls that which of the following are the basic types of tissues? *(Select all that apply.)*
   a. Nerve
   b. Epithelial
   c. Mucosal
   d. Connective
   e. Skeletal
   f. Muscle

   ANS: A, B, D, F
   The basic tissue types include nerve, epithelial, connective, and muscle. Mucosal is a type of epithelial cell, while skeletal is a type of connective tissue.

   REF: p. 27

2. Characteristics of prokaryotes include which of the following? *(Select all that apply.)*
   a. They contain no organelles.
   b. Their nuclear material is not encased by a nuclear membrane.
   c. They contain a distinct nucleus.
   d. They contain histones.
   e. They contain a cellular membrane.

   ANS: A, B, C
   The prokaryotes have a cellular membrane, but lack a nuclear membrane that encases nuclear material; thus, they have no distinct nucleus; organelles and histones are also missing.

   REF: p. 1