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Answers to Review Exercises, Chapter 2, Cell and Tissue Characteristics

Please note: The exercises are meant to expand your thinking and approach to the information covered in the textbook; therefore, not all the answers to the exercises will be found simply by reading the textbook. You may need to use your research skills and consult other resources to fully answer the questions. Use these answers as guidance to your own explorations.

Exercise 1, Question A

Your answer should include the fact that pigments may accumulate in the cytoplasm and then give color to the skin. Tattoo pigment is one of the examples of this accumulation. Insoluble pigments are introduced into the skin in the tattooing process. The pigment itself is then engulfed by lysosomes and macrophages. The pigment contained within the lysosomes and macrophages may persist in the cytoplasm as residual bodies for decades.

Exercise 2, Question A

Your answer should include the following information:

- Materials that can dissolve in fat are lipid-soluble, such as alcohol, and can pass through the lipid bilayer of the cellular membrane with ease.
- As alcohol moves through the cellular membrane, it exerts effects at the cellular levels of motor function and behavioral changes.
- As alcohol moves through the cells and is metabolized, the smell of alcohol is evident on the breath of those who have consumed it.

Exercise 3, Question A

Your answer should include the following information:

- The relationship of sodium and glucose as a cotransport system is extremely important in developing an oral rehydration solution.
- Adding glucose to a sodium solution will take advantage of the cotransport benefit of the absorption of glucose coupled with sodium transport.
- The sodium transport across the intestinal wall will pull water after it because of the change in concentration gradient, and thereby increase hydration during the period of diarrhea.

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Suggested Answers to Assignments, Chapter 2, Cell and Tissue Characteristics

Written Assignments	Learning Objective(s)
1. Students' answers should include the following: • Prophase—centrioles replicate; pair moves to each side of the cell; the nucleolus disappears • Metaphase—chromosomes pair in cell midline and mitotic spindle is composed • Anaphase—chromosome pairs separate • Telophase—mitotic spindle disappears, new nuclear membrane develops and encloses each set of chromosomes	5
2. Students' answers should include the following: • The function of APT is to produce high-energy sugars. The function of ATP is to store energy within a cell. This way, energy within the body is not wasted and can be stored for later use. • Diffusion refers to the process by which molecules and other particles in a solution become widely dispersed and reach a uniform concentration because of energy created by their spontaneous kinetic movements. • Most cell membranes are semipermeable in that they are permeable to water but not to all solute particles. Water moves through water channels (aquaporins) in a semipermeable membrane along a concentration gradient, moving from an area of higher to one of lower concentration. This process is called *osmosis*, and the pressure that water generates as it moves through the membrane is called *osmotic pressure*. • When cells use energy to move ions against an electrical or chemical gradient, the process is called *active transport*. • *Endocytosis* is the process by which cells engulf materials from their surroundings. It includes pinocytosis and phagocytosis. *Pinocytosis* involves the ingestion of small solid or fluid particles. The particles are engulfed into small, membrane-surrounded vesicles for movement into the cytoplasm. The process of pinocytosis is important in the transport of proteins and strong solutions of electrolytes. • *Exocytosis* is the mechanism for the secretion of intracellular substances into the extracellular spaces. It is the reverse of endocytosis in that a secretory granule fuses to the inner side of the cell membrane, and an opening is created in the cell membrane. This opening allows the contents of the granule to be	6, 7

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Written Assignments	Learning Objective(s)
released into the extracellular fluid. Exocytosis is important in removing cellular debris and releasing substances, such as hormones, synthesized in the cell.	
3. Students' answers should include the following: • Cell diversification initiates disposition of cells into tissue types and continues for development of different organ systems. • Although most cells differentiate into specialized cell types, many tissues contain a few *stem cells* that apparently are only partially differentiated. These stem cells are still capable of cell division and serve as a reserve source for specialized cells throughout the life of the organism. They are the major source of cells that make regeneration possible in some tissues. Stem cells have varying abilities to differentiate. Some tissues, such as skeletal muscle tissue, lack sufficient numbers of undifferentiated cells and have limited regenerative capacity. Stem cells of the hematopoietic (blood) system have the greatest potential for differentiation. These cells can potentially reconstitute the entire blood-producing and immune systems. They are the major ingredient in bone marrow transplants. Other stem cells, such as those that replenish the mucosal surface of the gastrointestinal tract, are less general but can still differentiate.	9
4. Students' answers should include the following: • Electrical potentials exist across the membranes of most cells in the body. Because these potentials occur at the level of the cell membrane, they are called *membrane potentials*. In excitable tissues, such as nerve or muscle cells, changes in the membrane potential are necessary for generation and conduction of nerve impulses and muscle contraction. In other types of cells, such as glandular cells, changes in the membrane potential contribute to hormone secretion and other functions.	8

Group Assignments	Learning Objective(s)

1. Students' answers should include the following:
• Nucleus
  ○ Control center of the cell, which is vital for protein synthesis
• Cytoplasm
  ○ Cell work occurs here
• Cellular organelles
  ○ Ribosomes—site of protein synthesis
  ○ Endoplasmic reticulum—system of paired membranes
  ○ Golgi complex—modifies and packages substances from ER
  ○ Mitochondria—power houses of the cell
	1, 2, 3

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Group Assignments	Learning Objective(s)
○ Lysosomes—metabolism • Cell membrane ○ Separates intracellular and extracellular environments ○ Provides receptors for hormones and other substances ○ Electrical activity between nerve and muscle cells ○ Aids in cell growth/proliferation They may compare the cell membrane to an eggshell. Encourage the students to be creative and think of as many examples as possible. Have them supply rationale for each example.	
2. Posters should include the different types of signaling and show communication from the initial receptors to the cellular response: • G-protein–linked cell surface receptors ○ Conversion of external signals to internal signals • Ion-channel–linked cell surface receptors ○ Open and close ion channels • Enzyme-linked cell surface receptors ○ Interact with peptide hormones and initiate activity of intracellular protein tyrosine kinase enzyme	4

Clinical Assignment	Learning Objective
1. Students' answers should include the following: • Epithelial—avascular, cell-to-cell adhesion, adhering junctions • Connective—soft, pliable, network of fibers • Muscle—myosin and actin • Nerve—cell body, dendrites, axon	10

Web Assignment	Learning Objective
1. Students' answers should include the following: • Diffusion—movement of particles from an area of higher concentration to an area of lower concentration • Osmosis—movement of water across a semipermeable membrane from an area of lower particle concentration to an area of higher particle concentration • Endocytosis—movement of a membrane-coated vesicle into a cell • Exocytosis—movement of a membrane-coated vesicle out of a cell • Active transport—requires energy to move ions	7

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Suggested Answers to Case Study, Chapter 2, Cell and Tissue Characteristics

1. Genes are "the individual units of inheritance that transmit information from one generation to another." They are contained in DNA, which are in turn coupled with DNA-associated proteins to form chromatin. When chromatin condenses, chromosomes are formed, and it is on the seventh chromosome that the defective gene rests.
2. Chloride channels are integral, or transmembrane, ion channels. Ion channels function to:
    - Move ions that would otherwise be unable to cross the lipid bilayer
    - Create an electrical gradient for the function of excitable cells (i.e., nerve cells and muscle fibers) and for the function of secretory cells
    - Assist in the regulation of cellular osmotic pressure
    - Provide electrical gradients to speed the movement of ions across the membrane
3. The retention of ions increases intracellular osmotic pressure as there are more ions in the cell in relation to the extracellular environment. As a result, water moves into the cell, leaving mucous secretions thick and viscous.

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Suggested Answers to Discussion Topics, Chapter 2, Cell and Tissue Characteristics

Suggested Answers to Discussion Topics	Learning Objective(s)
1a. Students' answers should include the following: • Signaling systems consist of receptors that reside either in the cell membrane (surface receptors) or within the cells (intracellular receptors). • Receptors are activated by a variety of extracellular signals or first messengers (including neurotransmitters, protein hormones and growth factors, steroids, and other chemical messengers). Signaling systems also include transducers and effectors that are involved in conversion of the signal into a physiologic response. • The pathway may include additional intracellular mechanisms called second messengers. Many molecules involved in signal transduction are proteins. • Three known classes of cell surface receptor proteins exist: G-protein linked, ion channel linked, and enzyme linked. • G-protein receptors rely on the intermediary activity of a separate class of membrane-bound regulatory proteins to convert external signals (first messengers) into internal signals (second messengers). • Enzyme-linked receptors' cytosolic domain either has intrinsic enzyme activity or associates directly with an enzyme. • Ion channel–linked signaling is mediated by neurotransmitters that transiently open or close ion channels formed by integral proteins in the cell membrane. 1b. Students' answers should include the following: • The patient is more likely to take their medication if they understand how it works to help them. • They have a patient's right and a medical obligation to be given this information. • This knowledge may ease the patient's anxiety about needing to take the medication.	4, 5
2a. Students' answers should include the following: • Facilitated diffusion occurs through a transport protein that is not linked to metabolic energy. Glucose molecules cannot pass unassisted through the cell membrane because they are not lipid soluble or are too large to pass through the membrane's pores.	7, 8, 9

Suggested Answers to Discussion Topics	Learning Objective(s)
2b. Students' answers should include the following: • *Glycolysis* is the process by which energy is liberated from glucose, and fatigue in type 2 diabetes mellitus is the inability to utilize this within the cell. • *Catabolism* consists of breaking down stored nutrients and body tissues to produce energy. • *Anabolism* is a constructive process in which more complex molecules are formed from simpler ones. • The special carrier for cellular energy is ATP.	

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