Chapter 2 The Levels of Organization of the Human Body

OVERVIEW

The purpose of this chapter is to introduce, all in one place, the essential information concerning the levels of organization of the human body up to an introduction to the systems. These levels of organization are necessary as a foundation from which to build to understand the body systems—the main focus of this text. The individual systems will comprise the 14 remaining chapters of this text.

The length of this chapter may at first seem daunting, but it can be easily split by outcomes—making it very easy to customize to your needs. For example, you may choose to divide the chapter in the following way: LO 2.1 as an introduction, LOs 2.2-2.10 chemistry, LOs 2.11-2.19 organelles and cells, LOs 2.20-2.23 histology, and LO 2.24 organs and an introduction to systems. The summary table below will show you all the relevant content, activities, and assessments for each outcome.

Chapter figures can be found in the Online Learning Center (OLC). Discussion points, group activities, and quizzes listed in the summary table below are explained under their individual outcomes following the table. Answer keys to the text chapter review questions, workbook concept maps, and workbook review questions are located at the end of this chapter.

A review guide is also available on the OLC. This guide lists all of the learning outcomes for the chapter and gives space for students to take notes and make sketches. This can be an important tool to encourage students to pay attention to what they are learning and to use to either take initial notes or to organize their existing notes before exams.

COMPETENCY CORRELATION GRID

Learning Outcome	CAAHEP Competencies	ABHES Competencies
2.1 List the levels of organization of the human body from simplest to most complex.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.2 Define the terms matter, element, atom, and isotope.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

2.3 Define molecule and describe two methods of bonding that may form molecules.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.4 Summarize the five functions of water in the human body and give an explanation or example of each.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.5 Compare solutions based on tonicity.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.6 Determine whether a substance is an acid or a base and its relative strength if given its pH.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.7 Describe the four types of organic molecules in the body by giving the elements present in each, their building blocks, an example of each, the location of each example in the body, and the function of each example.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.8 Explain three factors governing the speed of chemical reactions.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.9 Write the equation for cellular respiration using chemical symbols and describe it in words.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.10 Explain the importance of ATP in terms of energy use in the cell.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.11 Describe cell organelles and explain their functions.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.12 Compare four methods of passive transport and active transport across a cell membrane in terms of materials moved, direction of movement, and the amount of energy required.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.13 Describe bulk transport, including endocytosis and exocytosis.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their

		common diseases, symptoms and etiologies.
2.14 Describe the processes of transcription and translation in protein synthesis in terms of location and the relevant nucleic acids involved.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.15 Describe what happens to a protein after translation.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.16 Explain the possible consequences of mistakes in protein synthesis.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.17 Describe the process of mitosis, including a comparison of the chromosomes in a parent cell to the chromosomes in the daughter cells.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.18 Explain the possible consequences of mistakes in replication.	I.C.6. Identify common pathology related to each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.19 Describe the effects of aging on cell division.	I.C.10. Compare body structure and function of the human body across the life span	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.20 Describe the four classifications of tissues in the human body.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.21 Describe the modes of tissue growth, change, shrinkage, and death.	I.C.6. Identify common pathology related to each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
2.22 Identify the human body systems and their major organs.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

SUMMARY TABLE 2

LEARNING OUTCOME	LECTURE OUTLINE	ACTIVITIES – TALKING POINTS	ASSESSMENTS
2.1 List the levels of organization of the human body from simplest to most complex.	I. Overview II. Levels of organization **Chapter Figure:** 2.1 (Levels of organization in the human body)	**Talking Point:** Perhaps make a pyramid with chemicals at the base and then put the various levels above the base until you get to the point of the pyramid. At the point of the pyramid, place HUMANS. This would give students an idea of what it takes to maintain homeostasis in humans. If any of the lower levels malfunction, the human would malfunction (topple off the top of the pyramid).	***WkBk Review Questions:*** • MS: 10
2.2 Define the terms *matter*, *element*, *atom*, and *isotope*.	A. Chemical level 1. Atoms and isotopes **Chapter Figures:** 2.2 (Periodic Table of the Elements) 2.3 (Carbon atom diagram) **Table:** 2.1 (Major elements of the human body)	**Discussion point: 1** (see below) **Talking point:** Draw an example of an atom on the board. Explain to students that a limited number of electrons can be in each orbit around the nucleus of an atom. That limit for the first 20 elements of the periodic table is 2 in the first shell, 8 in the second shell, 8 in the third shell, and 8 in the fourth shell. This leads into Group Activity 1.	***Spot Check:*** *1*
2.3 Define *molecule* and describe two methods of bonding that may form molecules.	2. Bonding to form molecules **Chapter Figure:** 2.4 (Bonding)	**Group Activity: 1** (see below)	***WkBk Review Questions:*** • MS: 3 • Completion: 4

			Case Study: 1
2.4 Summarize the five functions of water in the human body and give an explanation or example of each.	3. Water		***WkBk Review Questions:*** • MS: 2
2.5 Compare solutions based on tonicity.	4. Solutions **Chapter Figure:** 2.5 (Tonicity)		***WkBk Review Questions:*** • Completion: 3 • Critical thinking: 1
2.6 Determine whether a substance is an acid or a base and its relative strength if given its pH.	5. Acids, bases, and pH **Chapter Figures:** 2.6 (pH scale) 2.7 (pH comparison)	***WkBk Laboratory exercises and activities:*** • pH • **WkBk Figures**: 2.32 (pH scale) 2.33 (pH paper) 2.34 (Eight mystery fluids) 2.35 (Completed pH tests) **Talking Point:** Be sure to stress and give several examples showing that each number on the pH scale is a multiplicative factor of 10. In other words; how many times more acidic is pH 6 compared to pH 8? How many times more acidic is pH 3 compared to pH 6, etc.	***Spot Check:*** *2* ***WkBk Review Questions:*** • MS: 4
2.7 Describe the four types of organic molecules in the body by giving the elements present in each, their building blocks, an	6. Organic molecules a. Carbohydrates b. Lipids	***WkBk Concept maps:*** • Chemical level Figure 2.38 (Chemical level concept map)	***Spot Check:*** *3* ***WkBk Review Questions:*** • MS: 7

example of each, the location of each example in the body, and the function of each example.	c. Proteins d. Nucleic acids **Chapter Figures:** 2.8 (Carbohydrates) 2.9 (Triglyceride (fat) synthesis) 2.10 (Protein structure) 2.11 (DNA structure) **Table:** 2.2 (Organic molecules)		• Matching: 1-5
2.8 Explain three factors governing the speed of chemical reactions.	7. Chemical reactions a. Speed of reactions		***Spot Check:*** *4* ***WkBk Review Questions:*** • MS: 1
2.9 Write the equation for cellular respiration using chemical symbols and describe it in words.	b. Cellular respiration	**Talking Point:** Balancing chemical equations is not a necessary skill for an A&P student. However, understanding equations is important. The balancing of the equation for cellular respiration is simply meant to help students (who have little chemistry background) understand what all the numbers and their locations mean.	***WkBk Review Questions:*** • Completion 1, 2
2.10 Explain the importance of ATP in terms of energy use in the cell.	c. ATP **Chapter Figure:** 2.12 (Formation of ATP)		***Spot Check:*** *7* **Quiz:** 1 Chemistry (Covers LOs 2.2-2.10 see below)

2.11 Describe cell organelles and explain their functions.	B. Organelle level 1. Cell membrane **Chapter Figures:** 2.13 (Generic cell) 2.14 (Cell membrane – plasma membrane) **Table:** 2.3 (Organelles)	***WkBk Coloring book:*** • The cell Figure 2.1 (Generic cell) ***WkBk Concept map:*** • Organelle level Figure 2.39 (Organelle level concept map)	***Spot Check:*** *5* **Quiz:** 2 Organelles (Covers LO 2.11 see below) ***WkBk Review Questions:*** • Matching: 6-10 • Critical thinking: 2
2.12 Compare four methods of passive transport and active transport across a cell membrane in terms of materials moved, direction of movement, and the amount of energy required.	C. Cellular level 1. Membrane transport a. Passive transport b. Active transport **Chapter Figures:** 2.15 (Simple diffusion) 2.16 (Examples of membrane proteins during transport) 2.17 (Osmosis) 2.18 (Red blood cells in three solutions)	***WkBk Laboratory exercises and activities:*** • Osmosis Figure 2.36 (Graph of an egg) Table 2.1 (Weights of the egg) **Talking Point:** If you have access to HCl, the osmosis workbook activity (above) makes a great demo. Mix equal parts water and HCl. Wear a vinyl glove and roll a raw egg in the acid/water solution until the shell is dissolved, leaving only the membrane surrounding the raw egg. The membrane should be translucent. If it is opaque, it has been burned by the acid. You can point out this is the same acid as in the stomach, and that the egg shell is not unlike a Tums/Rolaids. You can ask the student what they would expect to	***Spot Check****: 6, 7* ***WkBk Review Questions:*** • MS: 5, 6 • Critical thinking: 1

		happen to the pH of the solution as the shell is removed. This activity can be a great review of pH and solutions while teaching membrane transport. ***WkBk Concept maps:*** • Cellular level Figure 2.40 (Cellular level concept map)	
2.13 Describe bulk transport, including endocytosis and exocytosis.	c. Bulk transport **Chapter Figure:** 2.19 (Endocytosis and exocytosis)	***WkBk Concept maps:*** • Cellular level Figure 2.40 (Cellular level concept map)	
2.14 Describe the processes of transcription and translation in protein synthesis in terms of location and the relevant nucleic acids involved.	2. Protein synthesis a. Transcription b. Translation **Chapter Figures:** 2.20 (Protein synthesis) 2.21 (Close up look at translation at a ribosome)	***WkBk Laboratory exercises and activities:*** • Protein synthesis Figure 2.37 (tRNA and amino acids)	***Spot Check:*** *8* ***WkBk Review Questions:*** • MS: 8
2.15 Describe what happens to a protein after translation.	**Chapter Figure:** 2.22 (What happens after translation)	***WkBk Laboratory exercises and activities:*** • Protein synthesis Figure 2.37 (tRNA and amino acids)	
2.16 Explain the possible consequences of mistakes in protein synthesis.	c. Mistakes in protein synthesis	**Discussion Point 2:** (see below)	

		WkBk Laboratory exercises and activities: • Protein synthesis Figure 2.37 (tRNA and amino acids)	
2.17 Describe the process of mitosis, including a comparison of the chromosomes in a parent cell to the chromosomes in the daughter cells.	3. Cell division **Chapter Figures:** 2.23 (Mitosis) 2.24 (Mitosis simplified)	***WkBk Concept maps:*** • Cell division Figure 2.41 (Cell division concept map) **Talking Point:** There are several You-tube videos of mitotic events (time-lapsed photography). These videos will give students a better appreciation for cell reproduction events since they will actually be able to see the chromatids move.	***Spot Check:*** *9* ***WkBk Review Questions:*** • Completion: 5
2.18 Explain the possible consequences of mistakes in replication.		**Discussion Point:** 3 (see below) ***WkBk Concept maps:*** • Cell division Figure 2.41 (Cell division concept map)	
2.19 Describe the effects of aging on cell division.	4. Effects of aging on cells **Chapter Figure:** 2.25 (Telomeres)		
2.20 Describe the four classifications of tissues in the human body.	D. Tissue level 1. Epithelial tissues 2. Connective tissues 3. Muscle tissues 4. Nervous tissue	**Talking Point:** The emphasis here is to introduce the four classes of tissues and help the student identify the tissues from one another. The specific structures of each tissue will be covered as the tissue becomes relevant in the	

	Chapter Figures: 2.26 (Epithelial cell shapes and layering) 2.27 (Simple squamous epithelial tissue) 2.28 (Simple cuboidal epithelial tissue) 2.29 (Stratified squamous epithelial tissue) 2.30 (Simple columnar epithelial tissue) 2.31 (Pseudostratified ciliated columnar epithelial tissue) 2.32 (Transitional epithelial tissue) 2.33 (Loose/areolar connective tissue) 2.34 (Dense regular connective tissue) 2.35 (Adipose connective tissue) 2.36 (Blood connective tissue) 2.37 (Hyaline cartilage connective tissue) 2.38 (Elastic cartilage connective tissue) 2.39 (Fibrocartilage connective tissue)	system chapters. At that time, specific microscopic anatomy of tissues is used to explain the physiology of the system. This is not the last time a student will see or learn about these tissues—it is simply an introduction. **Talking Point:** Have students make 5 columns on a piece of paper. Label the columns in this manner: Tissue type / Kind of cell / visible characteristic of the cell / Function of the cell / Location of the cell in the body. This will make a quick study guide for the students to use. **Discussion Point:** 4 (see below) **Group Activity:** 2 (see below) ***WkBk Coloring book:*** • Tissues Figures: 2.2 (Cell shapes and layering) 2.3 (Simple squamous epithelial tissue) 2.4 (Simple columnar epithelial tissue) 2.5 (Ciliate pseudostratified columnar epithelial tissue) 2.6 (Stratified cuboidal epithelial tissue) 2.7 (Transitional epithelial tissue)	

	2.40 (Bone connective tissue) 2.41 (Skeletal muscle tissue) 2.42 (Smooth muscle tissue) 2.43 (Cardiac muscle tissue) 2.44 (A neuron and surrounding neuroglial cells of nervous tissue)	2.8 (Loose/areolar connective tissue) 2.9 (Dense regular connective tissue) 2.10 (Adipose connective tissue) 2.11 (Blood connective tissue) 2.12 (Bone connective tissue) 2.13 (Hyaline cartilage connective tissue) 2.14 (Elastic cartilage connective tissue) 2.15 (Fibrocartilage connective tissue) 2.16 (Skeletal muscle tissue) 2.17 (Cardiac muscle tissue) 2.18 (Smooth muscle tissue) 2.19 (Nervous tissue) ***WkBk Concept maps:*** • Tissue level Figure 2.42 (Tissue level concept map)	
2.21 Describe the modes of tissue growth, change, shrinkage, and death.	5. Tissue growth 6. Tissue change 7. Tissue shrinkage and death	**Group Activity:** 3 (see below) ***WkBk Concept maps:*** • Tissue level Figure 2.42 (Tissue level concept map)	***WkBk Review Questions:*** • MS: 9
2.22 Identify the human body systems and their major organs.	E. Organ level F. System level **Chapter Figures:** 2.45 (Heart)	***WkBk Coloring book:*** • Systems Figures: 2.20 (Integumentary system) 2.21 (Skeletal system)	**Quiz:** 3 Systems (Covers LO 2.24 see below) Figures: IMQ2.1-2.10

	2.46 (Human body systems) **Table:** 2.4 (Human body systems)	2.22 (Muscular system) 2.23 (Nervous system) 2.24Endocrine system) 2.25 (Cardiovascular system) 2.26 (Lymphatic system) 2.27 (Respiratory system) 2.28 (Digestive system) 2.29 (Excretory/Urinary system) 2.30 (Male reproductive system) 2.31 (Female reproductive system) ***WkBk Concept maps:*** • Organ and system levels Figure 2.43 (Organ and system levels concept map)	

INDIVIDUAL OUTCOMES

OUTCOME 2.2

Discussion Point 1:

Does the air we breathe fit the definition of matter? How can you tell?

First establish that air is a gas. Students can understand that a gas takes up space if you blow up a balloon. They can understand that a gas has mass/weight if you have them compare a full propane tank for a grill with an empty tank. The propane in the tank is a liquid that converts to a gas when pressure is released when the grill is turned on. The tank gets lighter as more and more gas escapes. If students have not had experience with a gas grill, you can direct them to any store that exchanges tanks to experience the difference in weight for a full and empty tank.

Spot Check 1: How many protons, electrons, and neutrons are in a typical potassium (K) atom? Use the Periodic Table in Figure 2.2 to derive your answer**.**

Answer: Protons: 19, Electrons: 19, Neutrons: 20.

OUTCOME 2.3

Group Activity: 1

Explain to students that a limited number of electrons can be in each orbit around the nucleus of an atom. That limit for the first 20 atoms on the periodic table is 2, 8, 8, and 8. Have the students work in groups to draw an atom for each of the first 20 elements. Use the Periodic Table in Figure 2.2 of the text. Then ask the questions: Based on your drawings, what type of bond is calcium likely to make with chlorine? What would happen to the molecule when placed in water? *Answer: Ionic. Calcium would bind with 2 chlorine atoms to fill the outer shells for all three atoms, resulting in* $CaCl_2$*. If placed in water the resulting ions would be:* Ca^{++} *and 2* Cl^- .

Case Study 1: Paramedics arrive on the scene of a car accident. They assess the scene and call the emergency room with the victim's condition. The ER doctor recommends starting an IV, not to treat the patient at this time, but to establish an intravenous line should drugs need to be quickly administered later on the way to the hospital. Should the IV fluids be hypotonic, isotonic, or hypertonic to blood plasma? Explain.

Answer: The IV solution will be isotonic to blood plasma. The solution needs to isotonic to blood plasma in order to maintain homeostasis. If the patient is dehydrated, the isotonic solution will enter into the blood plasma since the patient would be hypotonic at that point in time. If the patient is isotonic, then there would not be any net exchange of fluid and homeostasis will be maintained. But if the patient is dehydrated a bit due to trauma, they would become hypotonic and therefore the isotonic solution (isotonic to what blood plasma normally should be) would be used to regain homeostasis.

OUTCOME 2.6

Spot Check 2: Liquid X has a pH of 8. Liquid Y has a pH of 11. Are these liquids acids or bases? Which ion will they release (H^+ or OH^-) when placed in water? Which liquid is stronger? How many times more ions will be released in the stronger liquid than the other liquid?

Answer: Both liquids are bases. They both release OH^-. Liquid Y is stronger. Liquid Y releases 1000 times more ions than Liquid X.

OUTCOME 2.7

Spot Check 3: What type of organic molecule is $C_6H_{12}O_6$? Use Table 2.2 to derive your answer.

Answer: Carbohydrate, the ratio of C:H:O is 1:2:1.

OUTCOME 2.8

Spot Check 4.: How does putting leftovers in the refrigerator relate to bacteria metabolism?

Answer: Removing heat slows down the chemical reactions of bacteria.

OUTCOME 2.10

Spot Check 7: What high-energy molecule will the sodium/potassium pump need?

Answer: ATP.

Quiz: 1 Chemistry

Answer the following short answer questions.

1. Carbon 14 has an atomic weight of 14, while typical atoms of carbon have an atomic weight of 12. What atomic particles account for this weight difference? What is the term for an atomic that has an unusual weight? *Neutrons, isotope*

2. What are two methods of bonding to form molecules? *Ionic bonding, covalent bonding*

3. Give two functions of water in the body. *Any two of the following: lubrication, allows for ions in solution, aids in chemical reactions, used for transportation, used for temperature regulation.*

4. If you jump in a bathtub to take a bath, is the bathwater hypertonic, isotonic, or hypotonic compared to the cytoplasm in your body's cells? *Hypotonic*

5. If liquid A has a pH of 9 and liquid B has a pH of 11, are A and B acids or bases? Which one is stronger? *Bases, Liquid B is stronger*

6. What are the building blocks of proteins? *Amino acids*

7. What is the point of cellular respiration? *Produce usable energy for the cell*

8. Write the equation for cellular respiration using chemical symbols. $C_6H_{12}O_6 + 6O_2 \text{---> } 6CO_2 + 6H_2O + \text{energy}$

9. Why is ATP important? *It contains the usable energy for the cell.*

10. Give one factor that governs the speed of a chemical reaction. *Any one of the following: Concentration of the reactants, speed of the reactants, or catalysts.*

OUTCOME 2.11

Spot Check 5: Predict the relative amounts of organelles needed for a cell in a testicle that produces the steroid hormone testosterone. Use Table 2.3 to derive your answer.

Answer: A cell in a testicle that produces testosterone would need large amounts of smooth ER and Golgi complexes.

Quiz: 2

Who am I? Answer the following description with a cell organelle.

1. I am the site for making lipids. *Smooth ER*

2. I use glucose all day long to do my job. *Mitochondria*

3. My job is quality control of manufactured products. *Golgi complex*

4. I make use of amino acids to manufacture my products. *Ribosome*

5. I house all the information on how the cell operates. *Nucleus*

6. I'm the gate keeper for the cell as to who can enter or leave. *Cell membrane*

7. I contain all the raw materials the cell needs and all the waste the cell produces. *Cytoplasm*

8. I contain materials to destroy things. *Lysosome*

9. I get things moving outside the cell. *Cilia*

10. I can be rough or smooth. *Endoplasmic reticulum*

OUTCOME 2.12

Spot Check 6: It is possible to chemically remove just the shell from a raw egg. You are then left with a membrane enclosing a highly-concentrated solution; the egg white. The egg's membrane is selectively permeable and will not let the solutes inside the egg cross this membrane. Predict what would happen to the egg's weight if the egg is placed in a beaker of water. What membrane transport process would be responsible for the change, if any?

Answer: The water in the beaker is a hypotonic solution compared to the egg white. The weight of the egg would increase as water is transported across the membrane through osmosis to the inside of the egg.

Spot Check 7: What high-energy molecule will the sodium/potassium pump need?

Answer: ATP.

Case Study 1: Paramedics arrive on the scene of a car accident. They assess the scene and call the emergency room with the victim's condition. The ER doctor recommends starting an IV, not to treat the patient at this time, but to establish an intravenous line should drugs need to be quickly administered later on the way to the hospital. Should the IV fluids be hypotonic, isotonic, or hypertonic to blood plasma? Explain.

Answer: The IV solution will be isotonic to blood plasma. The solution needs to isotonic to blood plasma in order to maintain homeostasis. If the patient is dehydrated, the isotonic solution will enter into the blood plasma since the patient would be hypotonic at that point in time. If the patient is isotonic, then there would not be any net exchange of fluid and homeostasis will be maintained. But if the patient is dehydrated a bit due to trauma, they would become hypotonic and therefore the isotonic solution (isotonic to what blood plasma normally should be) would be used to regain homeostasis

OUTCOME 2.14

Spot Check 8: If the third triplet on the DNA strand in the nucleus coding for a particular protein was GCC, what corresponding codon would be formed for the mRNA during transcription? What would have to be the anticodon of the tRNA used to match this mRNA codon during translation?

Answer: Codon: CGG, Anticodon: GCC.

OUTCOME 2.16

Discussion Point 2:

What are the possible effects on protein synthesis of: 1. mistakes in transcription, and 2. mistakes in translation.

First establish that there are twenty amino acids, but many more possible anticodon combinations. Ask the students: What is an anticodon? What is meant by anticodon combinations? What is the use of an anticodon? Why is it significant that there are more anticodon combinations than there are amino acids? Once the class has reviewed the role of tRNA and its anticodons, discuss the effects on protein synthesis of: 1. mistakes in transcription, and 2. mistakes in translation.

OUTCOME 2.17

Spot Check 9: How does the DNA of a brain cell compare to the DNA of a bone cell? How does the DNA of a brain cell differ from the DNA of a sperm cell?

Answer: The DNA of a brain cell is identical to the DNA of a bone cell. There is only half of the amount of DNA in the sperm cell as there is in a brain cell.

OUTCOME 2.18

Discussion Point: 3

Replication errors

Replication is the copying of the complete DNA done by cells as they are about to divide. In that way the resulting cells each receive an exact copy of the DNA in the original (parent) cell. Tell the students: you started as a single cell with 46 chromosomes. All of your cells have the exact DNA as that original cell. Imagine a skin cell that needs to make keratin, a waterproofing protein. If the DNA is damaged by ultraviolet light, replication may not be perfect. Does it depend what part of the DNA is damaged? What are the possible consequences? Are all of your cells affected equally?

OUTCOME 2.20:

Group activity: 2

Identifying tissues

Divide the students into groups of 3-4. Have the students look at histology pictures from the text or from histology websites. Ask each group to develop a description in their own words to describe the different classes of tissues. Have groups share their combined responses with the class.

This activity may help other students recognize the differences between tissues by hearing alternative explanations.

Discussion Point: 4

Tile floor as epithelial tissue analogy

Have the students imagine a tile floor. The tiles can be ceramic, vinyl, or carpet. In any case, the tiles are attached to a subfloor with some kind of adhesive. Does this example of a tile floor work as an analogy for epithelial tissue? Is there a basement membrane in this analogy? What shape of cell would a single tile represent? How would you know if the floor/tissue is stratified? Would the view change the appearance of the floor/tissue?

This analogy is meant to help students understand that view makes a difference. Most slides show an epithelial tissue on edge to show layering. But in this case, if the tile floor was viewed from above, multiple layers (stratification) and the basement membrane (adhesive) would not be seen.

OUTCOME 2.21:

Group Activity: 3

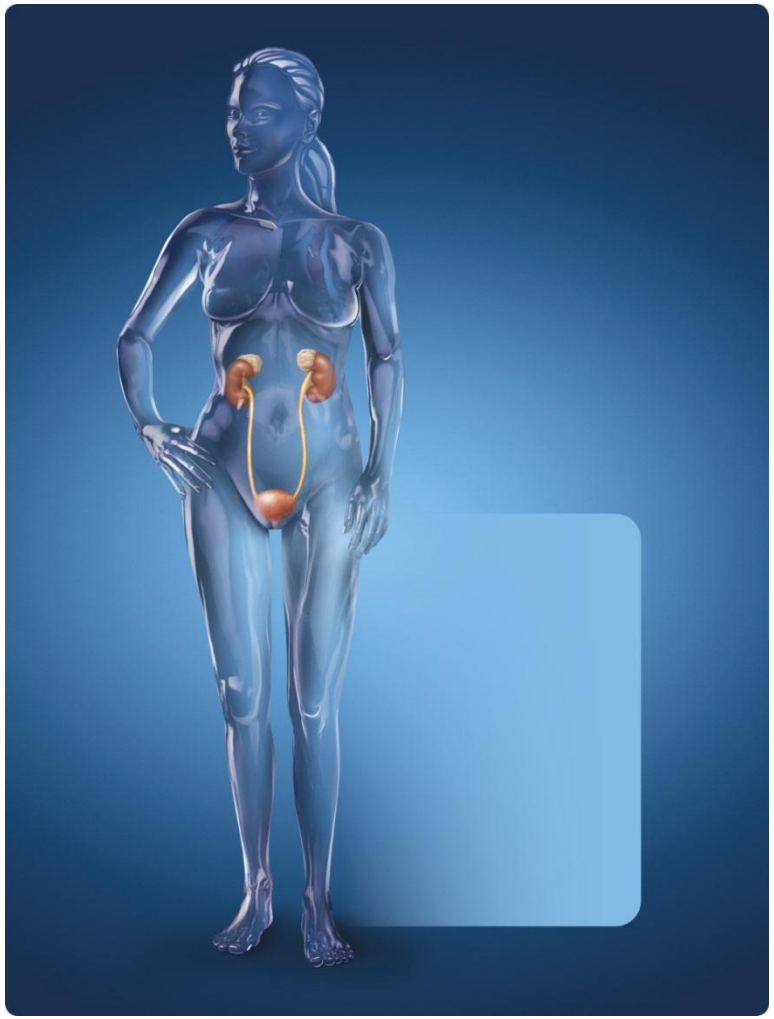
Tissue growth, change, and death

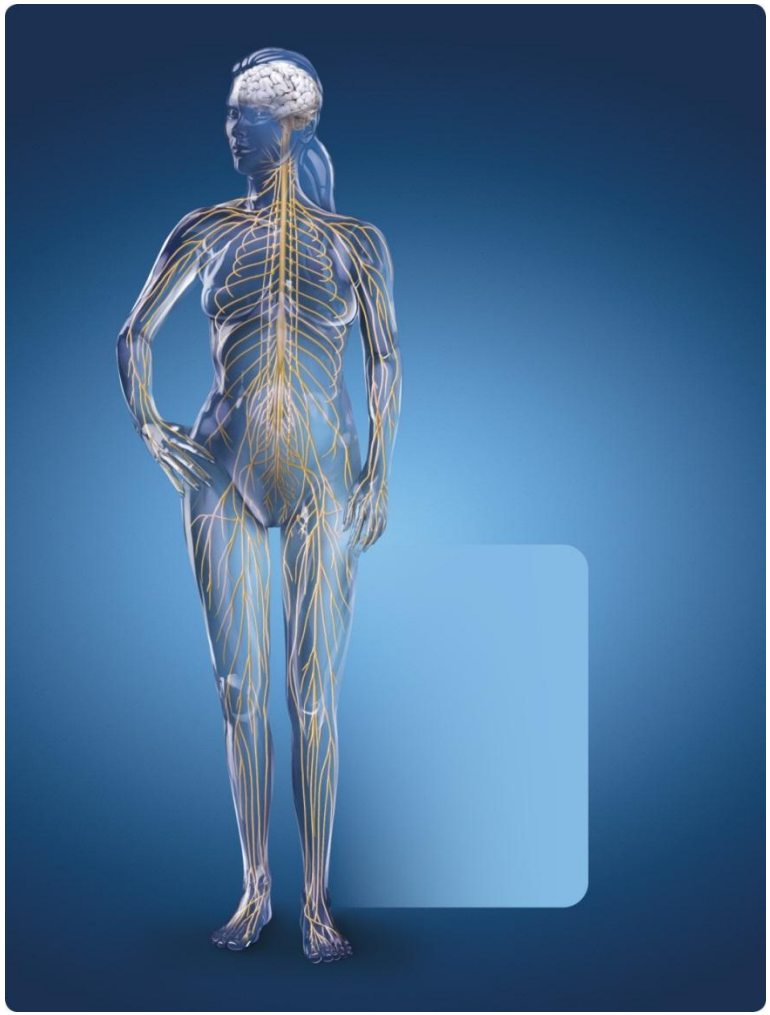
Divide students in groups of 2-3. Have each group complete the following table.

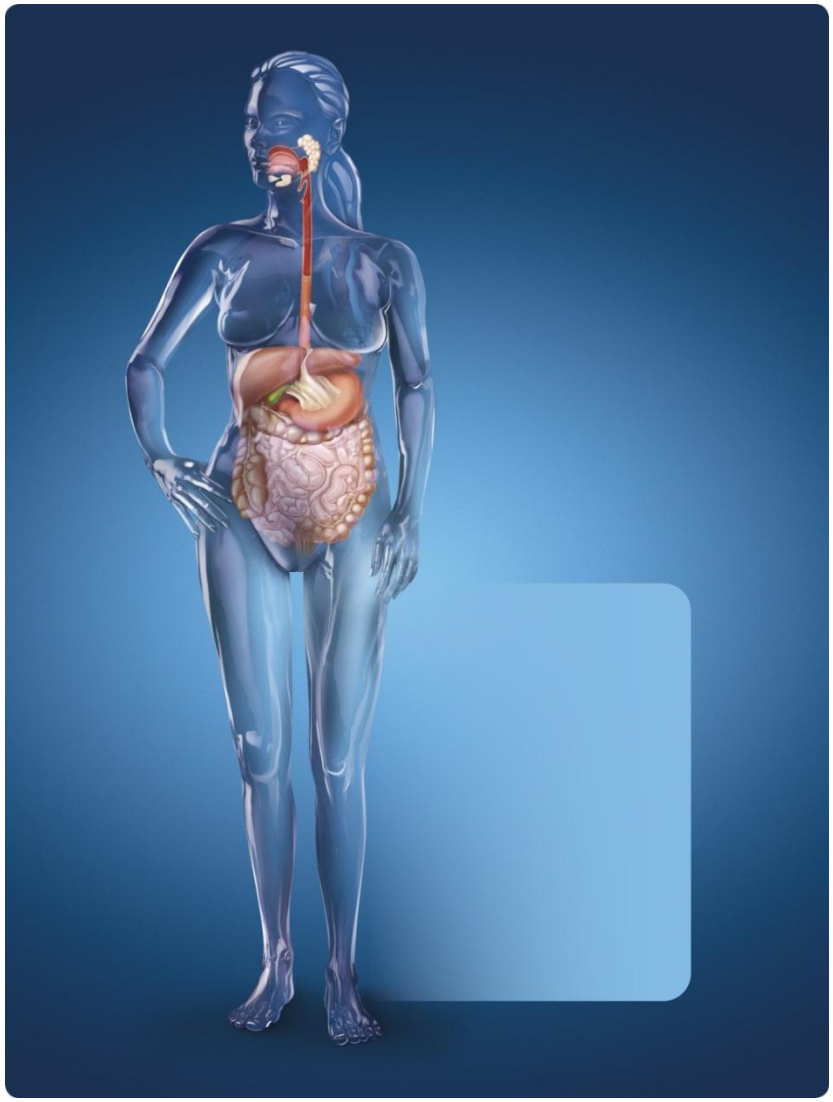
	Types	**Definitions**	**Examples**
Tissue growth	Hyperplasia Hypertrophy Neoplasia		
Tissue change	Metaplasia		
Tissue shrinkage and death	Atrophy Necrosis Gangrene Infarction Apoptosis		

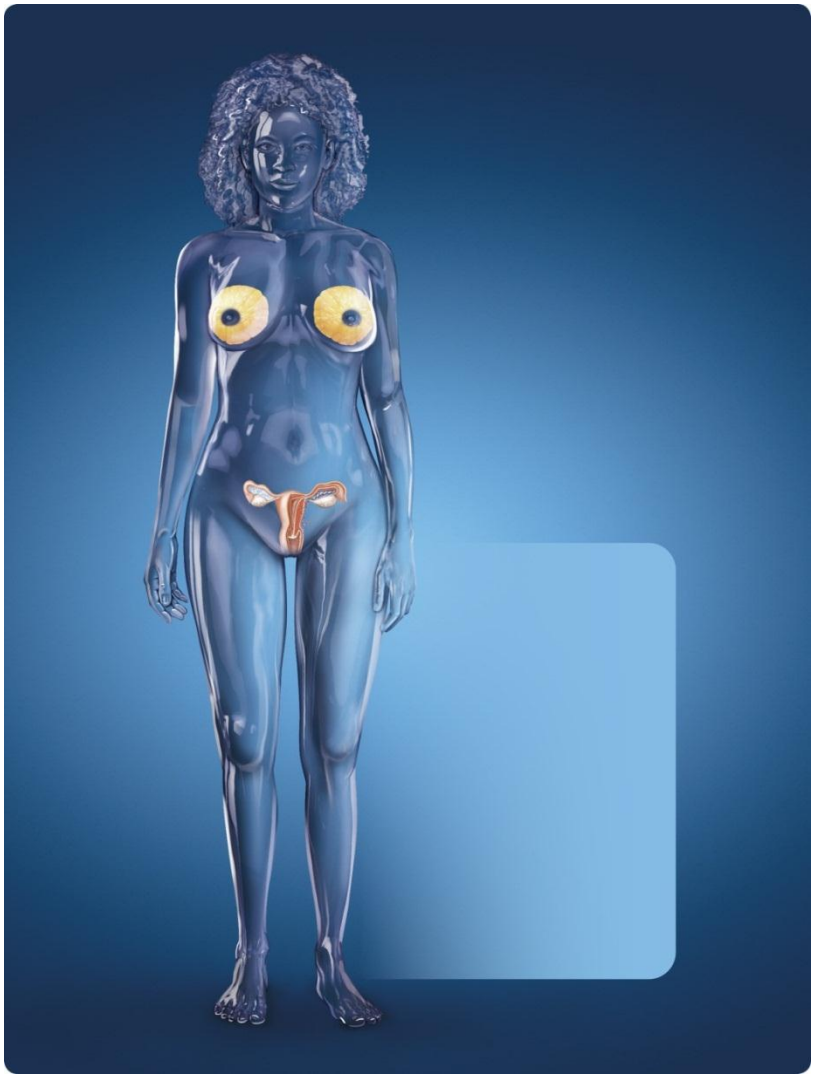
OUTCOME 2.22

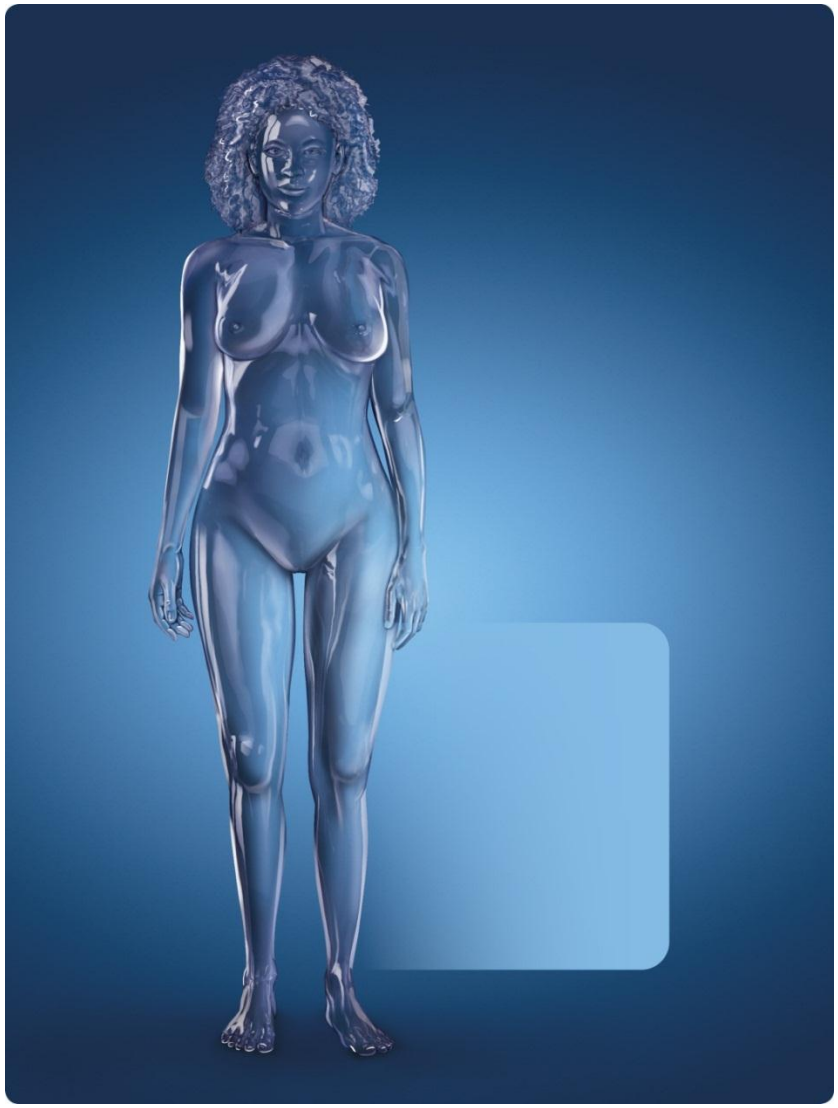
Systems

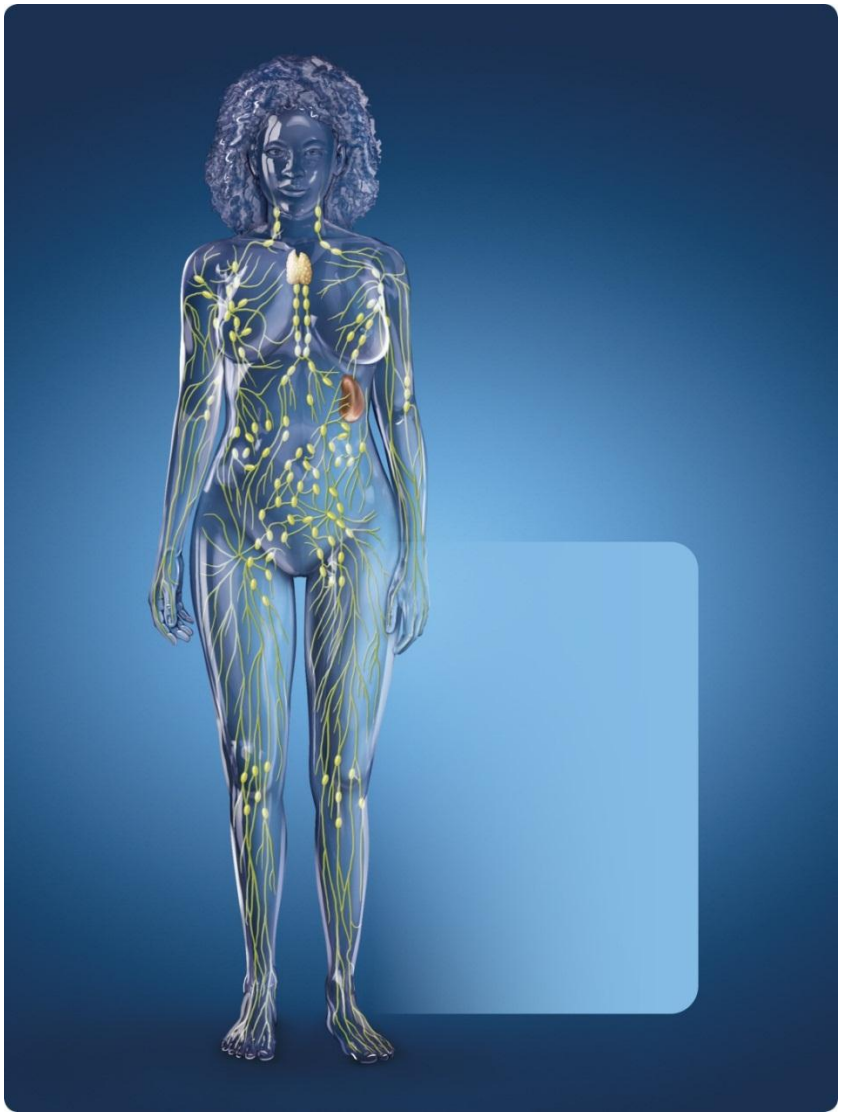
1. 

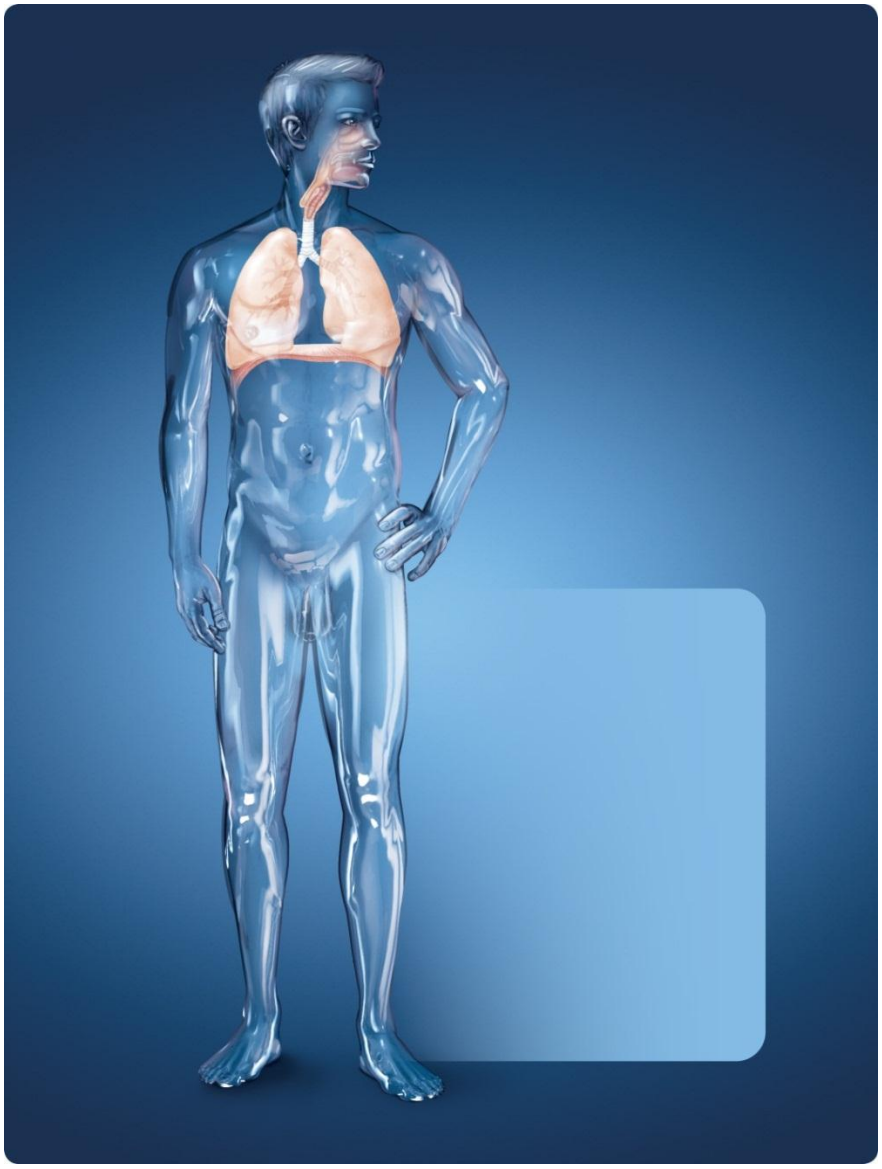
2. 

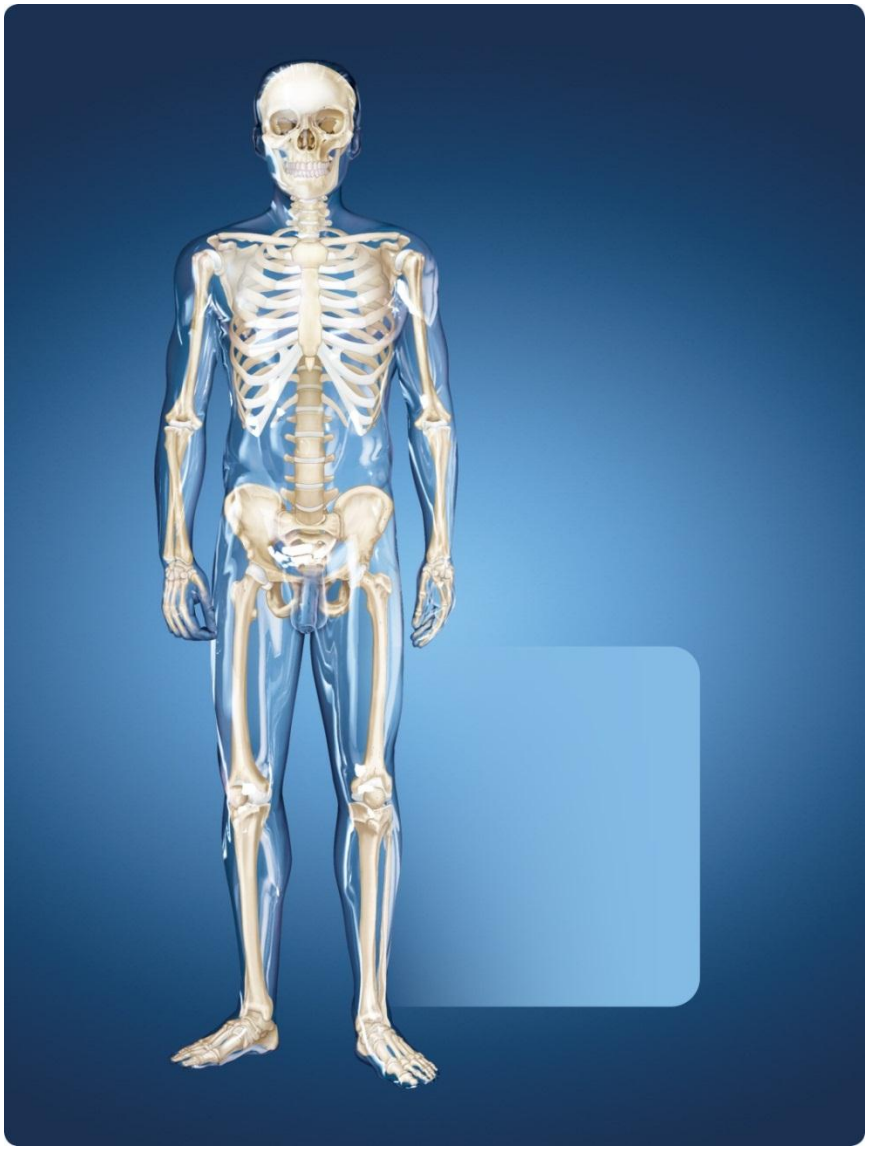
3. 

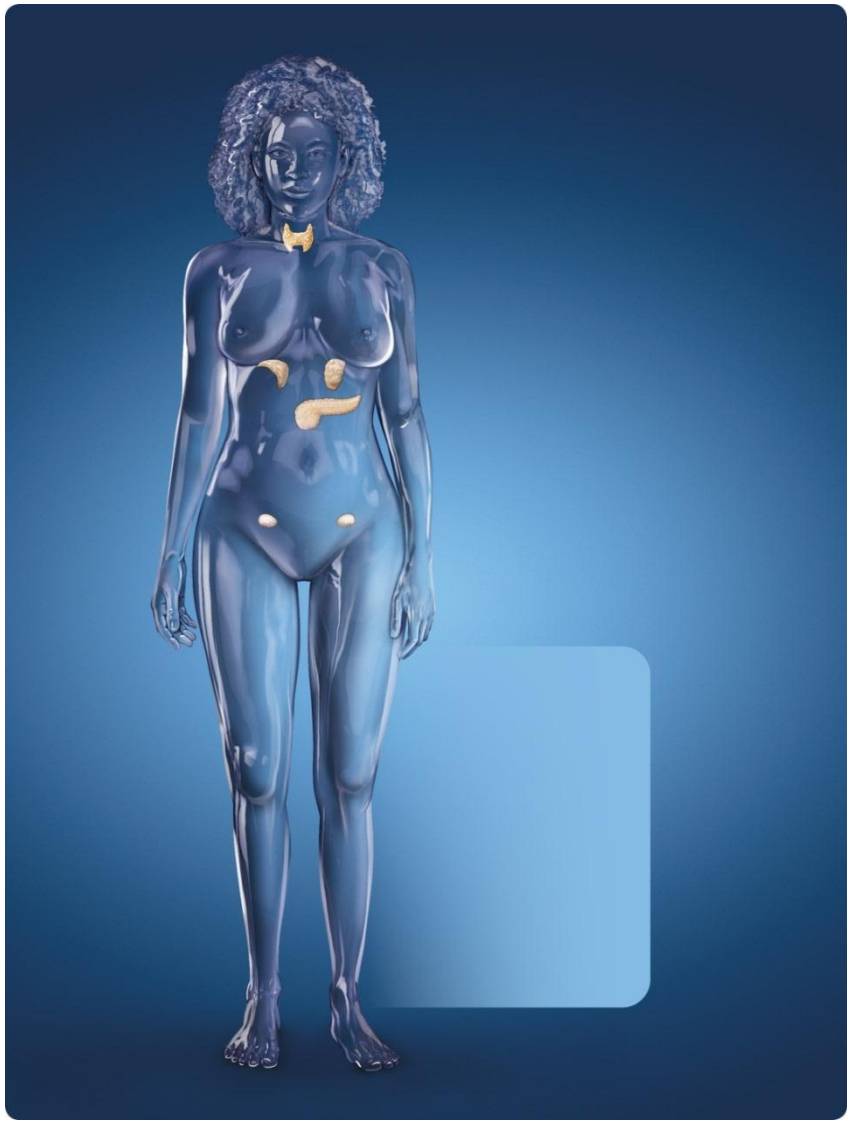
4. 

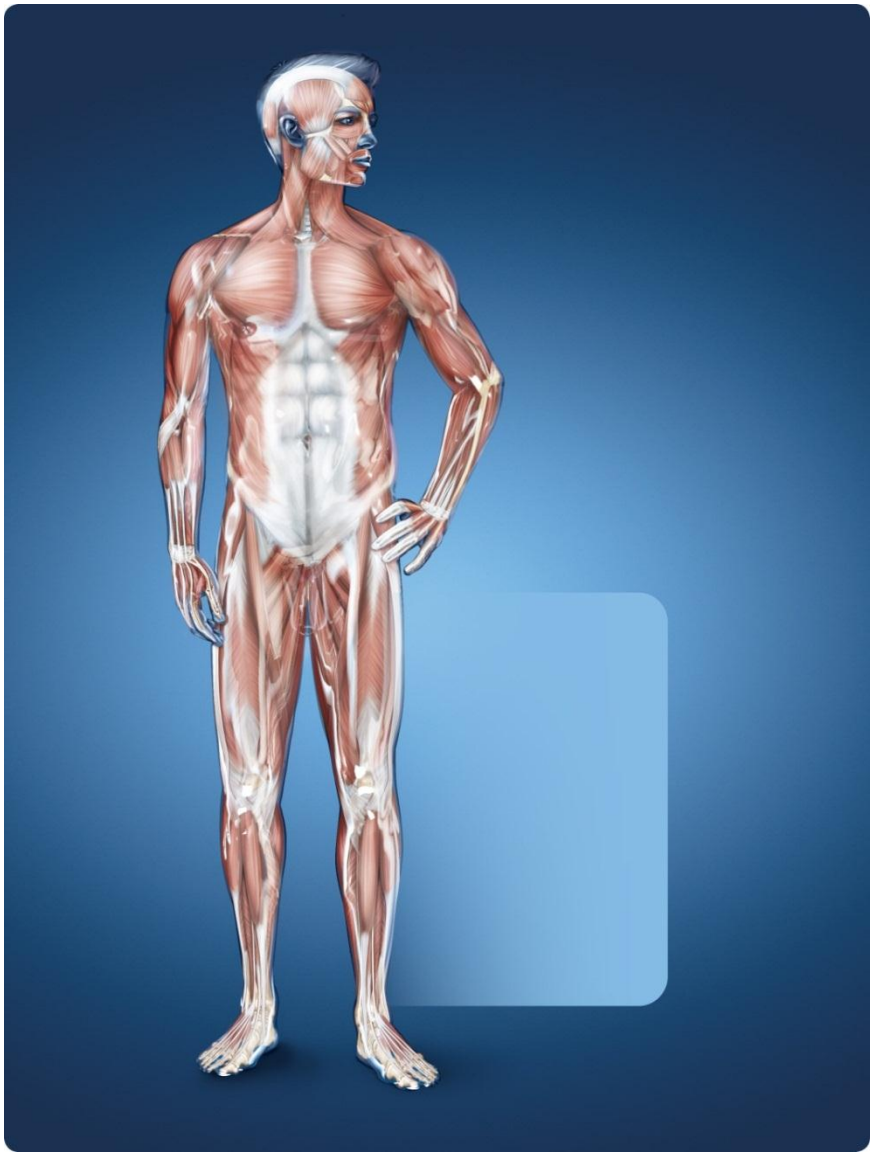
5. 

6. 

7. 

8. 

9. 

10. 

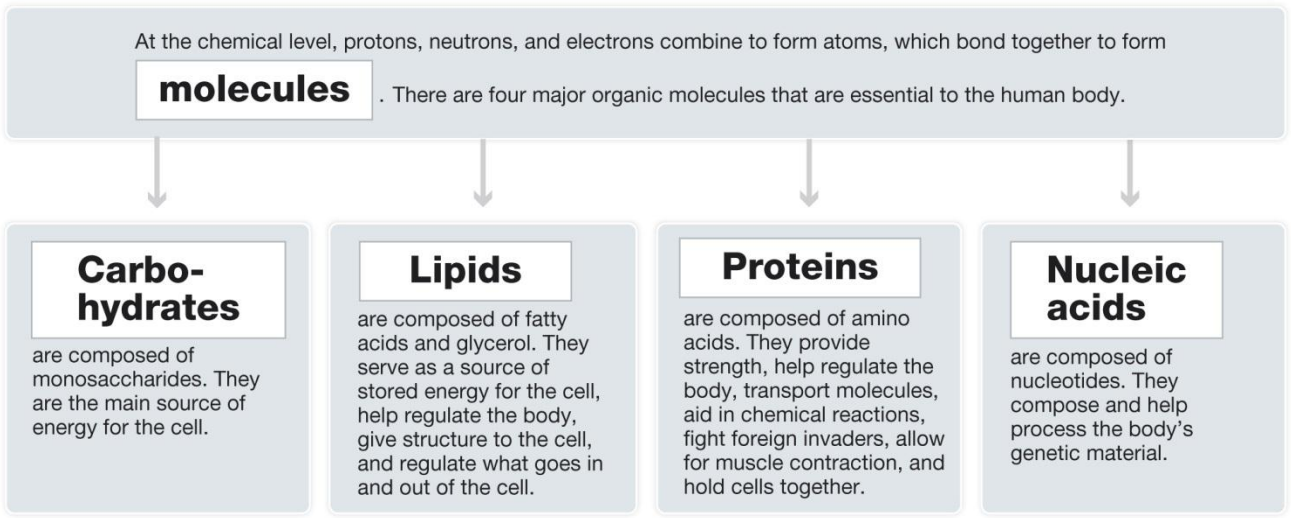
ANSWER KEYS

Chapter Review Questions

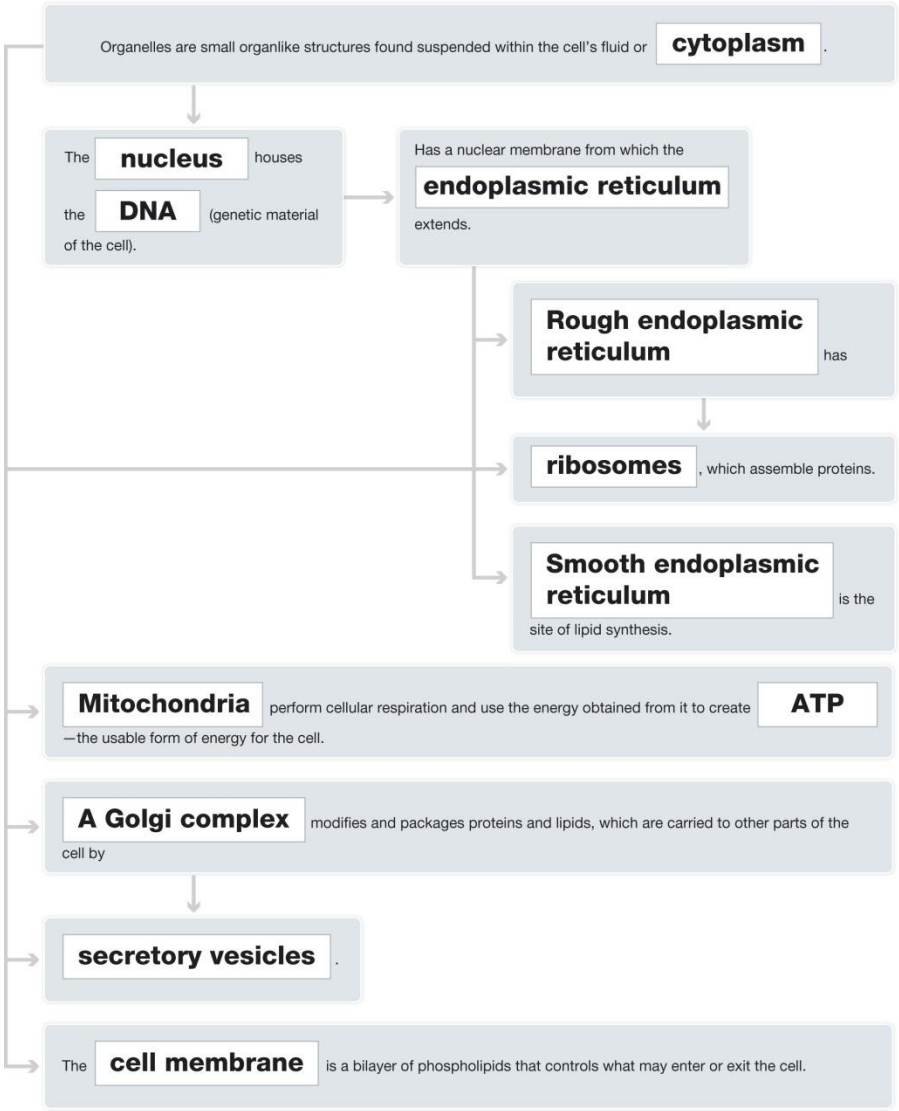
1. B
2. B
3. A
4. A
5. C
6. D
7. C
8. B
9. D
10. A
11. D
12. C
13. A
14. D
15. A
16. B
17. C
18. A
19. C
20. D
21. D
22. D

Workbook Concept Maps:

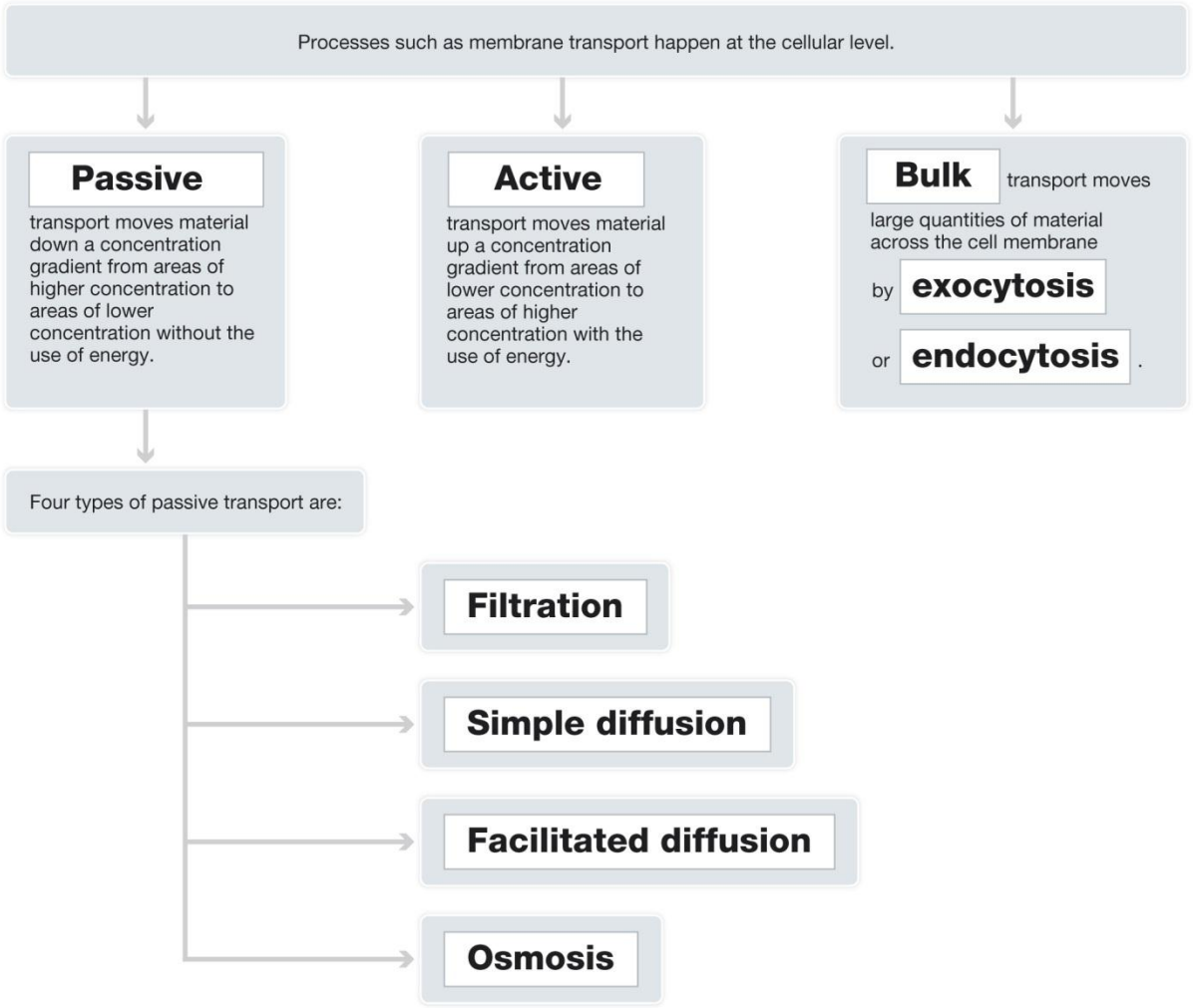
Chemical Level



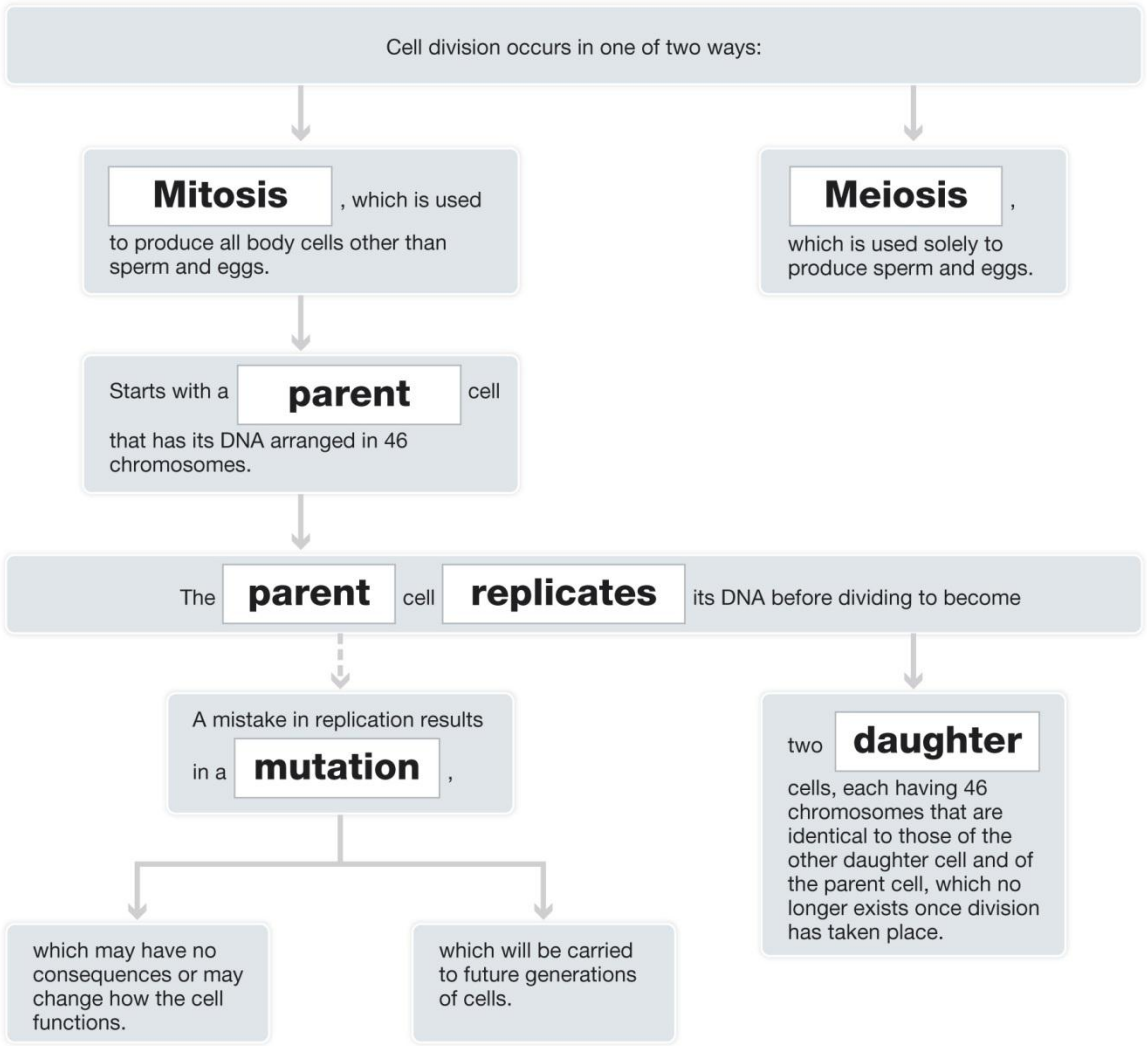
Organelle Level



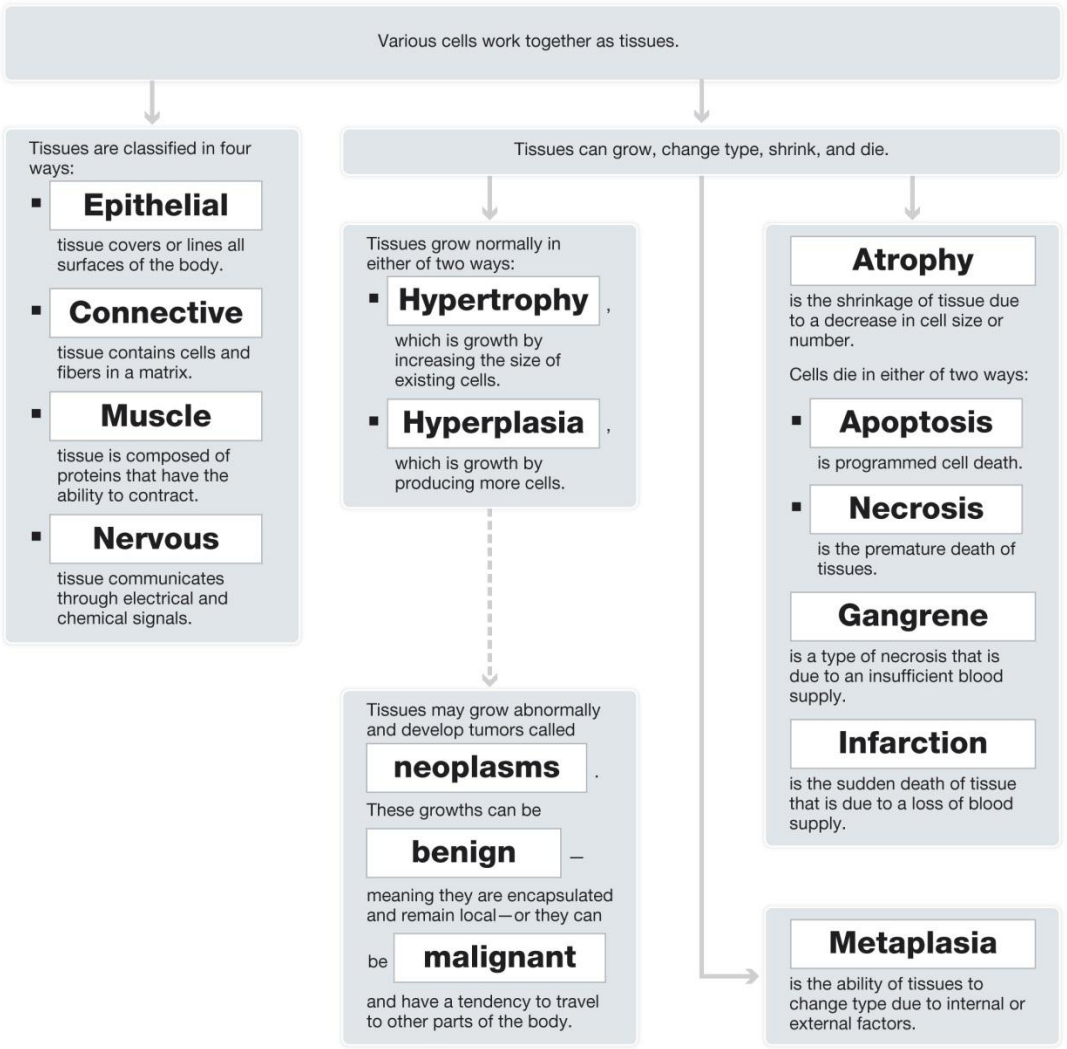
Cellular Level



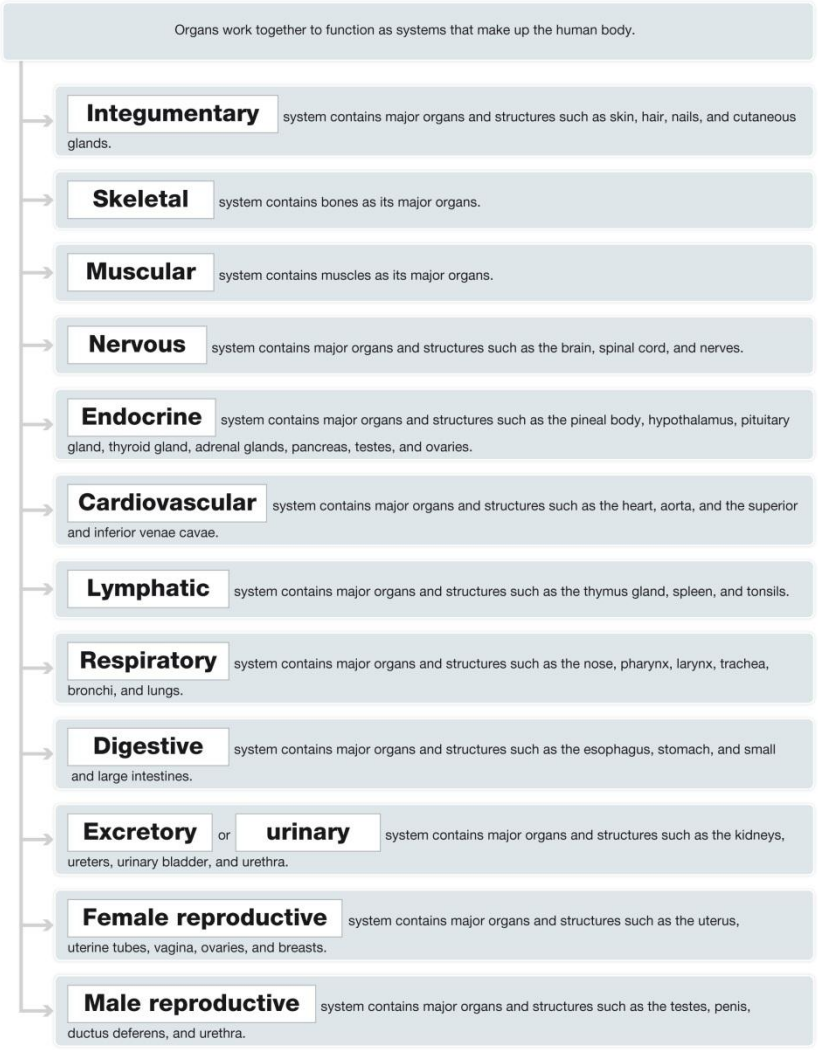
Cell Division



Tissue Level



Organ and System Levels



Workbook Chapter Review Questions

Multiple Select: Select the correct choices for each statement. The choices may be all correct, all incorrect, or any combination of correct and incorrect.

1. What may increase the speed of chemical reactions?

A. Enzymes that act as catalysts.

B. Decreasing the amount of the reactants.

C. Decreasing the temperature of the reactants.

D. Increasing the amount of the reactants.

E. Increasing the temperature of the reactants.

2. What is (are) the function(s) of water in the human body?

A. Water acts as a lubricant.

B. Water aids in chemical reactions.

C. Water is used for transportation of wastes.

D. Water separates ionically bonded molecules.

E. Water is used for temperature regulation.

3. Which of the following statements is (are) true about molecules?

A. Molecules are composed of two or more elements bonded together.

B. In the molecule CO_2, there are two atoms of oxygen and one atom of carbon.

C. Atoms bind together to form molecules to fill their outer shells with electrons.

D. Water and carbon dioxide are organic molecules.

E. Atoms share electrons in a covalent bond.

4. A urine pH test came back as normal with a pH of 6. What is true about this urine?

A. It is a strong acid.

B. It is a weak acid.

C. It is a weak base.

D. It is a strong base.

E. It has more H^+ ions than pure water.

5. What is true about osmosis?

A. It requires ATP to move materials up a concentration gradient.

B. It is a passive process.

C. It is used for solutes that can cross the cell membrane.

D. It will occur across a selectively permeable membrane if there is a concentration gradient.

E. It speeds up as time goes by and concentrations become equal.

6. What is true about active transport?

A. Active transport moves materials from low to high concentration across a membrane.

B. Active transport moves materials from high to low concentration across a membrane.

C. Active transport requires ATP.

D. Active transport is a passive process.

E. Active transport continues until the concentrations are equal.

7. What is true about the comparison of DNA and RNA?

A. DNA is double-stranded, RNA is single-stranded.

B. DNA is the genetic material of the cell, RNA processes it.

C. DNA and RNA contain guanine (G), cytosine (C), and adenine (A).

D. DNA and RNA can be found in the nucleus.

E. DNA and RNA molecules are composed of the elements C, H, O, N, and P.

8. Which of the following statements is (are) true about protein synthesis?

A. Anticodons match to identical codons in translation.

B. Anticodons are present in mRNA.

C. Mistakes in protein synthesis result in mutations.

D. Transfer RNA carries the message from the DNA in the nucleus to the ribosome.

E. All mistakes in translation results in proteins that do not function properly.

9. What may happen to tissues?

A. They may grow by increasing the number of cells called hyperplasia.

B. They may die a programmed death, a process called necrosis.

C. They may die a sudden death called an infarct.

D. They may change from one type to another, a process called metaplasia.

E. They may shrink through disuse, a process called apoptosis.

10. What is true about the levels of organization in the human body?

A. The organism level is the most complex.

B. The chemical level is the simplest level.

C. Organelles work together to form systems.

D. There are four classifications of tissues in the human body.

E. Tissues work together to function as organs.

Matching: Match the type of organic molecule to the example. Choices may be used more than once.

__*D*__ 1. Phospholipid	A. Protein
__*C*__ 2. Glycogen	B. Nucleic acid
__*D*__ 3. Steroid	C. Carbohydrate
__*D*__ 4. Fats	D. Lipids
__*B*__ 5. RNA	

Matching: Match the organelle to its function. Choices may be used more than once.

__*D*__ 6. Inspects and modifies proteins	A. Secretory vesicles
__*E*__ 7. Site of lipid synthesis	B. Mitochondria
__*B*__ 8. Produces ATP	C. Rough endoplasmic reticulum
__*C*__ 9. Site of protein synthesis	D. Golgi complex
__*A*__ 10. Packages of materials for transport	E. Smooth endoplasmic reticulum

Completion: Fill in the blanks in the following statements.

1. Cellular respiration can be written as:

Glucose + ___***Oxygen***_____ yields Carbon dioxide + Water + _***Energy***_____.

2. The chemical formula for cellular respiration is:

_____***$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6\ H_2O + Energy$***_____

3. In a sugar solution, water is the _____***solvent***_____ and sugar is the __***solute***_____.

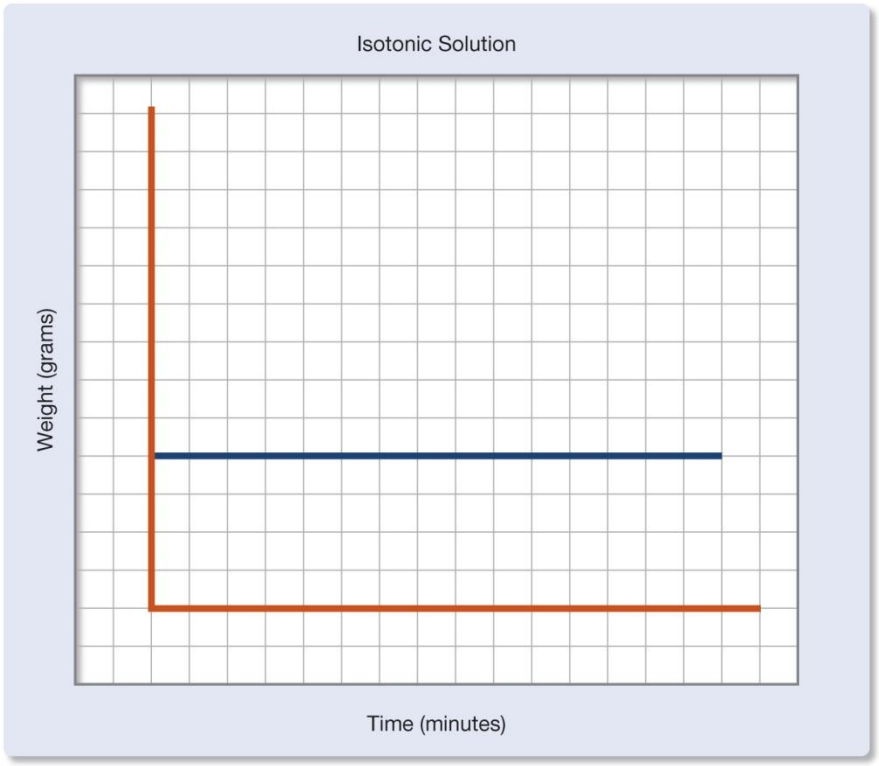
4. When placed in water, ionically bonded molecules become ions in solution called

_____***electrolytes***_____.

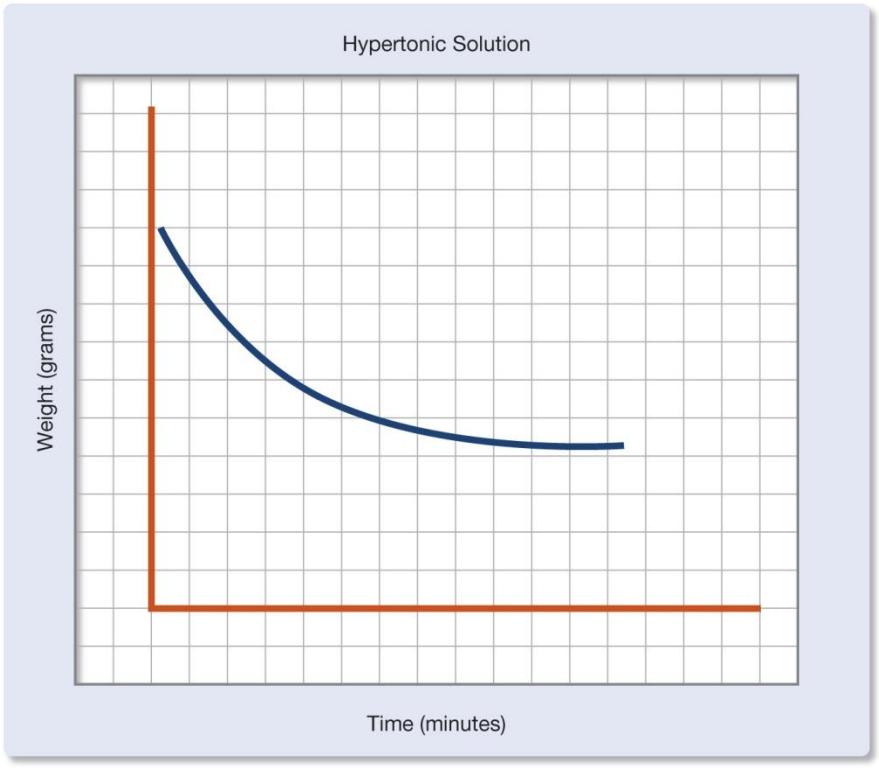
5. DNA is arranged as 46 _____***chromosomes***_____ when it is about to divide, but is arranged as __***chromatin***_____ through most of its life cycle so that it can be used.

Critical Thinking:

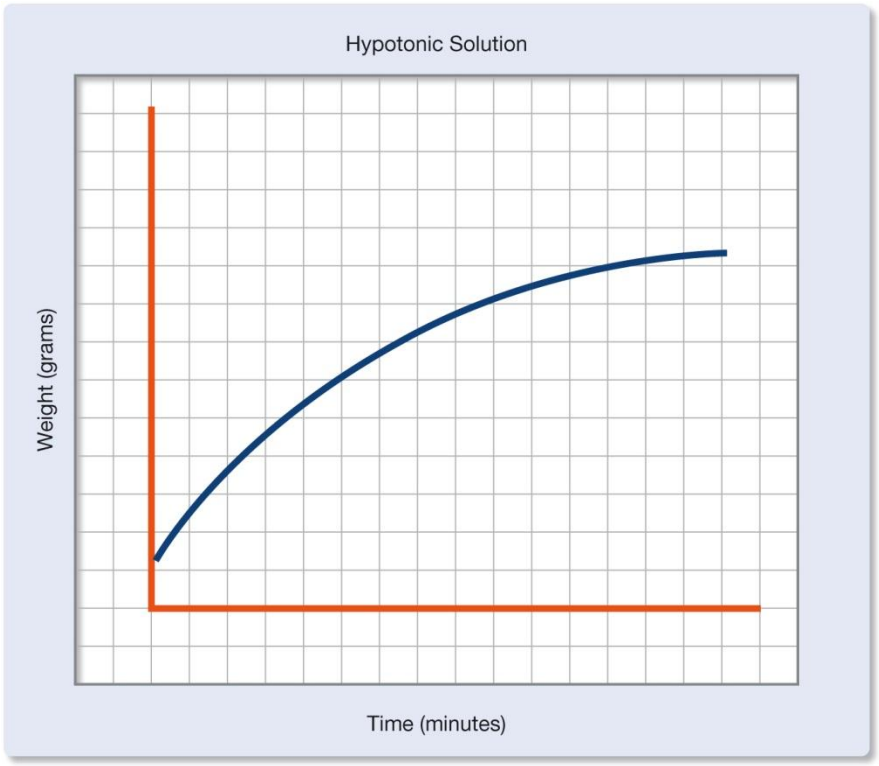
1. Draw a general graph of what you would expect to happen to the weight of an egg placed in each of the following solutions. See Figures 2.44, 2.45, and 2.46.



Isotonic solution answer



Hypertonic solution answer



Hypotonic solution answer

2. Cells in the ovary produce the hormone estrogen. Estrogen is a steroid. What would be the relative amount of organelles in these cells in order to carry out this function?

A cell in the ovary would need well developed smooth endoplasmic reticulum and Golgi complexes.

Case Study

IV fluid should be isotonic so as to not affect the blood cells through osmosis.